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ARTICLE

Navigating the Competitive Landscape: A Comprehensive Model to Evaluate Competitiveness for Enterprises in Electromechanical Systems Engineerings

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ABSTRACT

The competitiveness of enterprises in the electromechanical systems engineering sector plays a crucial role in driving economic growth and innovation. This study aims to design a comprehensive index for evaluating enterprise competitiveness, focusing on operational efficiency, strategic positioning, and the international environment. Employing an exploratory factor analysis, data was collected through a questionnaire administered to 280 enterprises in Moscow, Russia. The proposed index allows for a dynamic assessment of competitiveness, enabling the analysis of key indicators over time and predicting changes in competitiveness. The findings reveal critical factors contributing to competitiveness in the sector, enabling decision-makers to formulate strategies for improving their competitive position. This research provides valuable insights for policymakers, industry practitioners, and academic researchers in enhancing the competitiveness of electromechanical systems engineering enterprises and fostering sustainable economic development. The study's contributions to the literature and its practical relevance make it a valuable resource for academic and industry audiences alike.

KEYWORDS

competitiveness, electromechanical systems engineerings, comprehensive index, operational efficiency, international environment, strategic positioning

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RESUMO

A competitividade das empresas do setor de sistemas eletromecânicos de engenharia desempenha um papel fundamental na promoção do crescimento econômico e da inovação. O objetivo deste estudo é desenvolver um índice abrangente para avaliar a competitividade das empresas, com foco na eficiência operacional, posicionamento estratégico e o ambiente internacional. Empregando uma análise fatorial exploratória, os dados foram coletados por meio de um questionário aplicado a 280 empresas em Moscou, Rússia. O índice proposto permite uma avaliação dinâmica da competitividade, permitindo a análise de indicadores-chave ao longo do tempo e prevendo mudanças na competitividade. As conclusões revelam fatores críticos que contribuem para a competitividade no sector, permitindo aos decisores formular estratégias para melhorar a sua posição competitiva. Esta pesquisa fornece informações valiosas para formuladores de políticas, profissionais da indústria e pesquisadores acadêmicos no aumento da competitividade das empresas de sistemas eletromecânicos de engenharia e na promoção do desenvolvimento econômico sustentável. As contribuições do estudo para a literatura e sua relevância prática o tornam um recurso valioso para o público acadêmico e do setor.

PALAVRAS-CHAVES

competitividade, sistemas eletromecânicos de engenharia, índice abrangente, eficiência operacional, ambiente internacional, posicionamento estratégico

1. INTRODUCTION

In the fast-paced and competitive landscape of electromechanical systems engineering, enterprises face numerous challenges to maintain their competitive edge and sustain long-term success. The field of electromechanical systems engineering encompasses a diverse range of industries, including industrial automation, renewable energy, robotics, and telecommunications, each vying for market share and growth opportunities. To thrive in this dynamic environment, enterprises must continuously assess and enhance their competitiveness. Competitiveness plays a pivotal role in determining an enterprise's ability to achieve its strategic goals, expand its market presence, and withstand market fluctuations and technological advancements.

Prior research on organizational competitiveness has examined various factors that can impact a firm's competitive position and performance in the marketplace. Porter's seminal work identified operational effectiveness, strategic positioning, and industry structure as key determinants of competitiveness (Porter, 1985). Other scholars have looked at the role of innovation (Farida & Setiawan, 2022; Cho & Pucik, 2005), market orientation (Fatonah & Haryanto, 2022; Kumar et al., 2011), human capital (Guo & Chen, 2022), and technology adoption (Hooks et al., 2022).

Lara-Prieto et al. (2023), Aithal (2023), and Wang et al. (2023) discuss the lack of research on technology innovation capabilities of rapidly advancing electromechanical firms. Iranmanesh et al. (2023) echoed this gap regarding supply chain adaptability dynamics. Rastogi & Sharma (2023) also highlighted the shortage of targeted case studies on organizational resilience, skills, and competitive edge. Further 2023 research continues stressing the need for more nuanced electromechanical industry competitiveness frameworks than current literature provides (Fen, 2023; Muerza et al., 2023). Despite repeated recent appeals for greater research here, few studies have developed or validated tailored competitiveness models for the distinct product development, production, and distribution landscape.

While seminal works have identified key determinants of competitiveness, such as operational effectiveness, strategic positioning, and innovation (Porter, 1985; Farida & Setiawan, 2022; Cho & Pucik, 2005), these models are too broad and do not address the unique challenges facing electromechanical systems firms. These include rapid technological change, fragmented markets, globalized supply chains, and blurred industry boundaries (Rudyk et al., 2022; Wei et al., 2022). Prior studies examining competitiveness have focused on various industries in general (Kumar et al., 2011), with limited empirical research tailored to the specific context of enterprises in the electromechanical systems engineering sector in Moscow, Russia. This highlights a significant gap in knowledge regarding the industry-specific factors influencing competitiveness for these firms. To address this gap, this study aims to develop a comprehensive framework identifying the main drivers of competitiveness and integrating them into a specialized index for enterprises in the Moscow-based electromechanical systems engineering industry. The findings can provide actionable insights for enhancing the competitiveness of enterprises in this vital industry. Therefore, the main objective of this study is to design an index that enables a holistic and dynamic evaluation of enterprise competitiveness in the field of electromechanical systems engineering. The study focuses on enterprises operating in Moscow, Russia, one of the prominent hubs for electromechanical systems' industries. By undertaking this research, we aim to provide valuable insights into the factors that contribute to enterprise competitiveness, helping enterprises enhance their performance, identify strategic opportunities, and adapt to the evolving market conditions. To achieve our research objectives, this study addresses the following key questions:

1. What are the main factors that significantly contribute to enterprise competitiveness in the field of electromechanical systems engineering?
2. How can these identified factors be effectively measured and integrated into a comprehensive evaluation index?

This study holds significant contributions to both academia and industry. By delving into the unique aspects of competitiveness within the electromechanical systems engineering sector, it enhances an understanding of the factors influencing success in this domain. For enterprises, the findings and recommendations arising from this study will offer actionable strategies to optimize their operational efficiency, strengthen their strategic positioning, and effectively navigate the international environment to gain a competitive edge. Additionally, this work provides a stepping stone for future research on enterprise competitiveness and its implications for economic development and innovation.

2. THEORETICAL FRAMEWORK

2.1. Operational Efficiency

Operational efficiency can be defined as the ability of an organization to maximize output while minimizing input resources (Aroul et al., 2022; Slack & Brandon-Jones, 2018). An operationally efficient firm uses lean processes to produce its products or deliver services by reducing waste, variances, and maximizing resource utilization (Mugoni et al., 2023; Fu & Jacobs, 2022; Peng & Lai, 2012). As Porter (1985) notes, operational effectiveness means performing activities better than rivals through improvements in operations.

There are strong linkages between operational efficiency and organizational competitiveness documented in the literature. Investments in operational improvements and technologies that enhance efficiency allow firms to lower costs and improve quality (Zhang & Fu, 2022; Semin et al., 2020; Shafer & Byrd, 2000). This gives them a competitive advantage over rivals with less efficient operations. Hendricks and Singhal (2001) provide empirical evidence that effective total quality management programs, aimed at boosting operational performance, result in better long-term stock market results. Efficient operations directly impact competitiveness by enabling firms to maximize output while controlling costs (Slack & Brandon-Jones, 2018). Peng and Lai (2012) summarize numerous studies showing operational efficiency measures relate positively to competitiveness. In summary, by optimizing the conversion of inputs to outputs, operationally excellent firms can achieve a lower cost structure, higher quality, and superior competitiveness.

Hypothesis 1 (H1): Operational efficiency is a factor of competitiveness.

The literature supports defining operational efficiency in terms of lean processes that minimize waste and maximize productivity. Empirical studies and theoretical models demonstrate that operational efficiency directly impacts organizational competitiveness across various industries and contexts. The hypothesis reflects the expected positive relationship between operational efficiency and competitiveness based on academic research.

2.2. Strategic Positioning

Strategic positioning can be defined as the deliberate choice of a distinctive mix of activities and attributes to gain competitive advantage in an industry or market segment (Ghemawat, 1986; Porter, 1985). It involves differentiating a firm's offerings, capabilities, and market scope from rivals to establish a unique and valued position in the competitive landscape. Strategic positioning is the result of business and corporate strategy decisions on how to competitively position the firm.

The literature provides extensive evidence that strategic positioning is a key determinant of organizational competitiveness and performance. Porter (1985) argues competitive advantage stems from strategic positioning based on lower cost or differentiation from competitors. Kim and Mauborgne (2005) show how innovative strategic positioning creates new market spaces driving growth and profitability. Empirically, Akan et al. (2006) discuss how effective application of generic strategies relies on astute strategic positioning. Coccia (2022) assesses countries' preparedness for the COVID-19 pandemic, revealing that strategic positioning is crucial for effectively addressing such crises. While no country was highly prepared, those with better governance and healthcare investments are more competitive in handling pandemic threats. Majzoubi and Zhao (2022) highlight how firms can enhance their competitiveness by strategically positioning themselves to gain favorable audience evaluations. By targeting audiences with positive predispositions and engaging with moderately diverse evaluative schemas, firms can achieve an audience composition premium, ultimately improving their evaluations. Gu et al. (2023) demonstrates that corporate strategic positioning affects environmental information disclosure (EID), showcasing how a prospector strategy enhances competitiveness. Firms adopting this approach engage in higher-quality EID and display a more active stance in addressing environmental concerns, contributing to their competitive advantage. Zheng et al. (2022) explores the strategic positioning of projects on crowdfunding platforms, emphasizing that well-articulated project pitches which reference advanced technologies lead to crowdfunding success, highlighting the competitiveness gained through effective positioning. In summary, by delineating a distinct strategic position, firms can target specific segments, create differentiated value propositions, and establish a competitive advantage that drives performance.

Hypothesis 2 (H2): Strategic positioning is a factor of competitiveness.

The literature indicates that strategic positioning provides the foundation for competitive advantage and performance. The hypothesis reflects the expected positive relationship between greater strategic positioning differentiation and competitiveness based on the literature.

2.3. International environment

The international environment can be defined as the external conditions, institutions, policies, regulations, and factors originating outside of the focal firm that impact its strategy and competitiveness in global markets (Cantwell, 2015; Rugman & Verbeke, 1993). It encompasses factors from both home and host countries for multinational enterprises as well as broader regional and global conditions.

The literature provides extensive evidence that the international environment shapes organizational competitiveness. Porter (1990) argues home country factors like culture and demand conditions contribute to competitive advantage. Pereira et al. (2021) examine how home country institutional factors like state ownership and prior acquisition experience affect the performance of emerging market multinational enterprises making cross-border acquisitions. Their findings suggest these home country specific conditions moderate the relationship between acquisition diversification and performance in international markets. By showing how home and host country factors influence multinational competitiveness, they show how international environment shapes firm competitiveness. Yang et al. (2020), also, examine how China's Belt and Road Initiative affects the corporate social responsibility practices of enterprises in emerging markets, especially for state-owned firms. They find this home country policy positively influences CSR, with stronger effects when host countries have high CSR institutional pressures. The authors show home and host country factors interact to shape multinational strategy and performance. Rugman and Verbeke (1993) show how incorporating home and host country factors expands understanding of multinational firm strategy. Empirically, Lu and Beamish (2006) find host country developmental factors impact foreign subsidiary performance. Julian and Ofori-Dankwa (2013) show home country financial and cultural institutions affect corporate social responsibility investments. In summary, the international context in which firms are embedded creates variations in access to resources, institutions, and demand conditions that directly influence competitiveness.

Hypothesis 3 (H3): International environment is a factor of competitiveness.

The academic research indicates the international environment a firm operates within has a significant impact on its competitiveness and performance. The hypothesis reflects the expected positive relationship between beneficial international factors and competitiveness.

This study, according to the literature, hypothesizes that operational efficiency, strategic positioning, and the international environment are considered the building blocks of enterprise competitiveness. Accordingly, the proposed theoretical framework of the study is designed and presented in Figure 1.

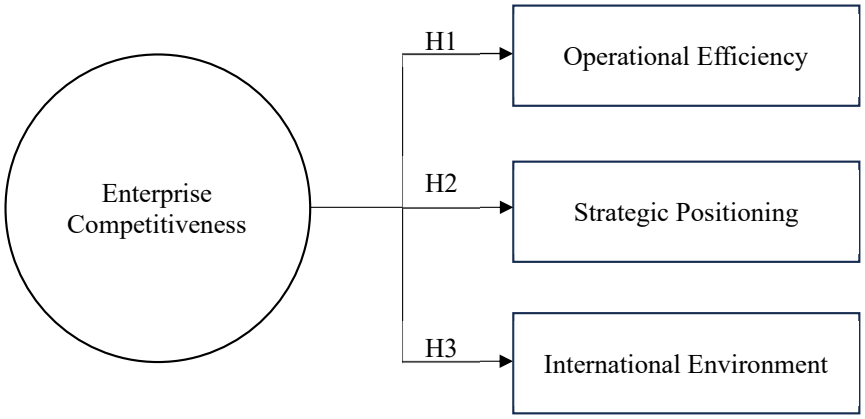

Figure 1. The proposed theoretical framework of the study.
Source: Authors' own construction

3. METHODOLOGY

The methodology section of this study outlines the research design and data collection approach used to evaluate the competitiveness of enterprises working in the field of electromechanical systems engineering. The main goal of this study is to design an index that can effectively assess enterprise competitiveness. To achieve this, three main factors – Operational Efficiency, Strategic Positioning, and the International Environment – have been identified as the key components of enterprise competitiveness. The methodology employed involves the use of an exploratory factor analysis to verify whether these three variables can collectively explain the concept of enterprise competitiveness.

3.1. Research Design

An exploratory factor analysis was chosen as the research approach to identify the underlying structure of the three main factors – Operational Efficiency, Strategic Positioning, and the International Environment – and to understand how they relate to the concept of enterprise competitiveness. This analysis allows us to determine if the chosen variables can form a unified construct that represents the competitiveness of enterprises in the field of electromechanical systems engineering.

3.2. Participants and Data Collection

The sample for the study on evaluating competitiveness of enterprises in the electromechanical systems engineering sector consisted of 20 companies based in Moscow. These companies were selected based on their relevance to the study's focus and their representation across ten sectors, including Industrial Automation Companies, Electrical Machinery Manufacturers, Renewable Energy Equipment Manufacturers, Robotics and Mechatronics Companies, Electrical Vehicle (EV) Manufacturers, Aerospace and Defense Contractors, Consumer Electronics Companies, Medical Device Manufacturers, HVAC (Heating, Ventilation, and Air Conditioning) Systems Providers, and Telecommunication Infrastructure Companies. As summarized in Table 1, these enterprises reflected diversity in terms of size, age, ownership structure, offerings, manufacturing capabilities, end-user industries served, and strategic priorities. In terms of size, the participating enterprises ranged from small companies with 50 employees to medium-sized firms with up to 500 employees. The average age of the companies since establishment was 5 to 15 years, representing both younger and more established players in the industry. The ownership structure included private companies as well as joint ventures between domestic and international partners.

Table 1
Descriptive Features of Participating Enterprises

Feature	Description
Size	50 – 500 employees
Age	5 – 15 years since establishment
Ownership Structure	Private companies and joint ventures
Annual Revenue	$10 million – $100 million
Offerings	Manufacturing of electromechanical components and systems, engineering services
Manufacturing Technology	Advanced automation and lean practices
End-user Industries	Automotive, aerospace, energy, infrastructure, healthcare, etc.
Geographic Presence	Based in Moscow, sales, and distribution across Russia
Exports	20% – 40% of production
R&D Focus	Product innovation and new product development
Strategic Priorities	Operational efficiency, product quality, market reach

Source: Authors' own construction

Table 2 reports descriptive statistics of critical numerical features for the sample of enterprises analyzed. As shown, there is variation across the firms regarding age, size factors like number of employees and revenue, market share, R&D spending, and number of patents held. The minimum and maximum values demonstrate the range present for metrics like workforce numbers (12 to 502 employees) and patents (3 to 283) among the group of companies examined, while large standard deviations confirm heterogeneity in the sample.

Table 2
Descriptive statistics of sample enterprises

Feature	Mean	Standard Deviation	Minimum	Maximum
Age (years)	15.2	5.3	5	25
Number of employees	235	125	12	502
Revenue (million USD)	48	19.2	12	92
Market share (%)	7.3	3.1	1.2	12
R&D spending (million USD)	1.8	1.2	0.1	5.2
Patents held	73	46	3	283

Source: Authors' own construction

With regard to offerings, the enterprises were engaged in manufacturing specialized electromechanical components, systems, and subsystems. Some also provided related engineering design services. Their manufacturing facilities employed advanced automation technologies and lean practices. The products and services catered to end-user industries such as automotive, aerospace, energy, infrastructure, healthcare, among others. While based out of Moscow, the enterprises had established sales and distribution networks across Russia. Many companies exported 20% to 40% of their production to neighboring regions and countries. Investments in R&D and a focus on new product development represented key strategic priorities for competitiveness. The sample mix reflected a balanced representation of enterprises across different maturity stages, size categories, ownership structures, and focus industries within the electromechanical engineering domain. This enhanced the generalizability of findings for the competitiveness assessment study.

A questionnaire based on the 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), was designed for the data collection. Participants were asked to indicate their level of agreement with each statement, reflecting their perceptions of the company's performance or the impact of external factors. The responses were later scored, with higher values indicating higher agreement or more positive evaluations. 400 questionnaires were administered among the participants out of which 280 responses were deemed usable and included in the analysis. The response rate of 70% reflects a satisfactory level of participation and provides a significant sample size for conducting the factor analysis.

The questionnaire items were developed to measure the three main factors of enterprise competitiveness: Operational Efficiency, Strategic Positioning, and International Environment. The Operational Efficiency factor was evaluated through five items assessing the company's management activities, marketing activities, service activities, innovative activities, and financial activities. Strategic Positioning was assessed using three items related to market share, revenue growth, and supplier performance. The International Environment factor was measured using 12 items that considered political, economic, social, and technological factors affecting the company.

Communication with the participating enterprises was established through email. An introductory email was sent explaining the purpose and nature of the study and inviting the individual to participate in the study. The data collection process was conducted online using a secure survey platform. Each participating enterprise received a unique link to access the questionnaire and submit their responses. This online approach ensured data privacy and ease of participation for respondents. The data collection phase took place from January 2023 to May 2023, allowing sufficient time for enterprises to respond and ensure a representative sample. Informed consent was obtained from all participants before they began the survey. They were informed that their participation was voluntary, and their anonymity and confidentiality would be strictly maintained throughout the research.

4. RESULTS

Table 3 presents the demographic characteristics of the participants who responded to the questionnaire in the study. A total of 280 (out of 400) usable questionnaires were received and analyzed. The table provides insights into the distribution of participants based on their gender, age range, educational level, years of experience, and job position. Regarding gender distribution, approximately 66% of the respondents identified as male, while 44% identified as female. In terms of age range, the majority of participants fell into the 30-40 age group, representing 37% of the total respondents. The second-largest age group was 20-30, constituting 22% of the participants. Participants over the age of 50 accounted for 19% of the sample, and the age group 40-50 comprised 22%. Regarding educational qualifications, the majority of respondents held a master's degree, accounting for 67% of the participants. A substantial portion of the sample (21%) possessed a bachelor's degree, and 12% had attained a PhD. With respect to years of experience, the distribution was as follows: 14% of participants had 0-5 years of experience, 25% had 5-10 years, 34% had 10-15 years, and 27% had over 15 years of experience in the field. Regarding job positions, the largest group among the participants were managers, constituting 37% of the respondents. Engineers accounted for 26% of the sample, while technicians represented 22%. Interns comprised 15% of the participants.

Table 3
Demographic Characteristics of the Participants

	Features	Number	Percentage
Gender	Male	184.8	66%
	Female	123.2	44%
Age Range	20-30	61.6	22%
	30-40	103.6	37%
	40-50	61.6	22%
	over 50	53.2	19%
Educational Level	Bachelor	58.8	21%
	Master	187.6	67%
	PhD	33.6	12%
Years of Experience	0-5	39.2	14%
	5-10	70	25%
	10-15	95.2	34%
	Over 15	75.6	27%
Job Position	Manager	103.6	37%
	Engineer	72.8	26%
	Technician	61.6	22%
	Intern	42	15%

Source: Authors' own construction

4.1. Factor Analysis Results

Table 4 presents the results of a factor analysis conducted to assess the relationship between the questionnaire items and their corresponding latent constructs (variables) of operational efficiency, strategic positioning, and international environment. The loading factors represent the strength of the relationship between each questionnaire item and its corresponding latent construct. The loading factors are considered significant when they are above a certain threshold, typically 0.7 or higher. In this case, all the loading factors for the operational efficiency and strategic positioning variables meet the criteria of being significant (above 0.7). However, for the international environment variable, two question items (Q10, Q16, and Q19) have loading factors lower than 0.7. As a result, those three question items, Q10, Q16 and Q19, which did not show strong associations with the international environment, were eliminated from the questionnaire for further analysis. This decision was made to ensure the questionnaire only includes items that contribute significantly to measuring the intended constructs accurately. By removing these three less significant items, the researchers aim to refine the questionnaire and ensure that the remaining items effectively capture the underlying factors of operational efficiency, strategic positioning, and the international environment for a more reliable and accurate assessment of the enterprise's competitiveness.

Table 4
Loading Factors Analysis Results

Variables	Question Items	Loading Factors	Mean	SD	P-Value
Operational Efficiency	Q1	0.727	3.660	1.560	0.032
	Q2	0.831	3.040	1.720	0.022
	Q3	0.795	4.800	1.780	0.030
	Q4	0.877	3.680	1.260	0.029
	Q5	0.873	4.250	1.440	0.033
Strategic Positioning	Q6	0.812	2.480	0.830	0.023
	Q7	0.782	4.490	1.210	0.007
	Q8	0.859	2.520	1.070	0.008
	Q9	0.870	3.230	0.940	0.008
	Q10	0.584	2.910	1.410	0.029
International Environment	Q11	0.851	3.810	1.300	0.017
	Q12	0.869	4.670	1.250	0.017
	Q13	0.764	2.330	0.960	0.040
	Q14	0.800	4.080	1.260	0.019
	Q15	0.882	4.070	1.270	0.023
	Q16	0.597	3.590	1.740	0.039
	Q17	0.887	2.440	0.860	0.025
	Q18	0.819	2.800	1.080	0.037
	Q19	0.669	4.110	1.210	0.041
	Q20	0.755	2.120	1.610	0.003

Source: Authors' own construction

Table 5 presents the results of reliability and validity assessments for the latent constructs of operational efficiency, strategic positioning, and international environment. Cronbach's Alpha measures internal consistency, indicating high values (Operational Efficiency: 0.886, Strategic Positioning: 0.742, International Environment: 0.870). Composite reliability also shows strong consistency (Operational Efficiency: 0.912, Strategic Positioning: 0.783, International Environment: 0.904). Average Variance Extracted (AVE) indicates satisfactory convergent validity for operational efficiency (0.715) and well above the acceptable threshold for international environment (0.844), while strategic positioning meets the minimum requirement (0.593). Overall, these measures validate the questionnaire items and ensure an accurate assessment of the intended constructs.

Table 5
Reliability and Validity Assessment Results

	Cronbach's Alpha	Composite Reliability	AVE
Operational Efficiency	0.886	0.912	0.715
Strategic Positioning	0.742	0.783	0.593
International Environment	0.870	0.904	0.844

Source: Authors' own construction

4.2. Exploratory Factor Analysis

The main objective of this study is to develop an index for evaluating enterprise competitiveness, with a focus on three key factors: Operational Efficiency, Strategic Positioning, and the International Environment. The researchers aimed to demonstrate that these three variables collectively explain the concept of enterprise competitiveness. To achieve this, an exploratory factor analysis was conducted. The analysis involved calculating the average value of the question items related to each variable and treating it as the representative value of that variable. We then tested the exploratory factor analysis to determine if the three variables indeed converge into a single concept of enterprise competitiveness. In the previous phase, three question items (Q10, Q16, and Q19) with loading factors below the threshold of 0.7 were removed from the analysis.

Table 6 presents the results of the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity. The KMO value of 0.763 indicates a good sampling adequacy, suggesting that the dataset is suitable for factor analysis. The Bartlett's Test of Sphericity has a significant p-value (0.000), indicating that the correlation matrix is not an identity matrix, further confirming the appropriateness of the data for factor analysis.

Table 6
KMO and Bartlett's test

Tests		Values
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.763
Bartlett's Test of Sphericity	Approx. Chi-Square	472.272
	df	6
	Sig.	.000

Source: Authors' own construction

Table 7 demonstrates the total variance explained by the principal component analysis. The analysis extracted one dominant component with an eigenvalue of 2.131, explaining 89.381% of the total variance. The remaining eigenvalues (0.289 and 0.580) are relatively small, contributing to 9.065% and 1.554% of the variance, respectively. The high percentage of variance explained by the first component suggests that Operational Efficiency, Strategic Positioning, and the International Environment converge into a single overarching concept of enterprise competitiveness.

Table 7
Total Variance Explained

Component*	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.131	89.381	89.381	2.131	89.381	89.381
2	0.289	9.065	98.446			
3	0.58	1.554	100.000			

*Extraction Method: Principal Component Analysis.
Source: Authors' own construction

Table 8 provides the component matrix resulting from the principal component analysis. The values in the matrix represent the loading factors of each variable on the extracted component. The loading factors for Operational Efficiency, Strategic Positioning, and the International Environment are 0.912, 0.815, and 0.906, respectively, all indicating strong associations with the extracted component. This confirms that these three variables collectively contribute to the concept of enterprise competitiveness. The "1 component extracted" note signifies that the exploratory factor analysis identified one dominant component, reinforcing the convergence of the three variables into the single concept of enterprise competitiveness.

Table 8
Component Matrix

Variables	Component*
	1[a]
Operational Efficiency	0.912
Strategic Positioning	0.815
International Environment	0.906

*Extraction Method: Principal Component Analysis.
[a] 1 component extracted.
Source: Authors' own construction

The factor analysis revealed that Operational Efficiency, Strategic Positioning, and the International Environment collectively converge into a single concept, namely enterprise competitiveness. Therefore, the findings strongly support the hypotheses.

- **H1:** Operational Efficiency is indeed a significant factor of competitiveness, as evidenced by its high loading factor (0.912) on the extracted component, which reflects its substantial contribution to the concept of enterprise competitiveness.
- **H2:** The factor analysis also confirms that Strategic Positioning is a significant factor of competitiveness, as indicated by its strong loading factor (0.815) on the extracted component, demonstrating its notable role in defining enterprise competitiveness.
- **H3:** The International Environment is likewise validated as a substantial factor of competitiveness, as supported by its high loading factor (0.906) on the extracted component, underscoring its significance in shaping enterprise competitiveness.

In summary, the factor analysis results provide robust empirical evidence supporting the hypotheses, thereby establishing the critical role of Operational Efficiency, Strategic Positioning, and the International Environment as fundamental factors contributing to the concept of enterprise competitiveness. These findings contribute to a deeper understanding of the multifaceted nature of enterprise competitiveness and emphasize the importance of considering these specific dimensions when evaluating and enhancing an organization's competitive standing in the market.

4.3. Enterprise Competitiveness Index

Calculating the aggregate indicator of the competitiveness of the organization, using the proposed coefficients, such as the coefficient of operational efficiency, the coefficient of strategic positioning and the coefficient of the international environment:

$$K = K_R * K_I * K_Z \quad (1)$$

Where:
K – the level of competitiveness of the enterprise;
K_R – indicator of operational efficiency;
K_I – indicator of strategic positioning;
K_z – indicator of the international environment.
The indicators of operational efficiency can be calculated as follow:

$$K_R = \frac{R_A}{R_S} \quad (2)$$

Where:
R_A – operating efficiency of the analyzed company for the reporting period;
R_S – operating efficiency of the sample company for the reporting period.
It is important to note that the sample includes competitors whose activities are considered together with the activities of the studied enterprise. The aggregate indicator for the sample is determined by the sum of the corresponding indicators of each enterprise in the sample.

$$R_A = \frac{K_p + K_M + K_S + K_T + K_L}{5} \quad (3)$$

Where:
K_p – management activities of the company during the reporting period;
K_M – marketing activities of the company during the reporting period;
K_S – service activity of the company during the reporting period;
K_T – the company's innovative activity in the reporting period;
K_L – financial activity of the company for the reporting period;

$$R_S = \frac{K_{pi} + K_{Mi} + K_{Si} + K_{Ti} + K_{Li}}{5} \quad (4)$$

Where:
K_{pi} – management activities of the sample for the reporting period;
K_{Mi} – marketing activity by sample for the reporting period;
K_{Si} – service activity by sample for the reporting period;
K_{Ti} – innovation activity in the sample for the reporting period;
K_{Li} – financial activity by sample for the reporting period;
Managerial activity of the enterprise, which is characterized by the coefficient of change in sales volume is as follows:

$$K_p = \frac{C_{KP}}{C_{NP}} \quad (5)$$

Where:

C_{NP} – the volume of sales at the beginning of the reporting period;

C_{KP} – the volume of sales at the end of the reporting period.

The following is the marketing activities of the enterprise, characterized by an indicator of advertising activities, comparable with the cost of promotional activities at the beginning and end of the reporting period:

$$K_M = \frac{K_p * E_{KP}}{E_{NP}} \quad (6)$$

Where:

E_{NP} – expenditures on advertising activities at the beginning of the reporting period;

E_{KP} – expenditures on advertising activities at the end of the reporting period.

Service activities of enterprises, characterized by the criterion of bringing the product to the consumer, are as follows:

$$K_S = \frac{K_p * W_{KP}}{W_{NP}} \quad (7)$$

Where:

W_{NP} – the amount of costs of selling the product at the beginning of the reporting period;

W_{KP} – the sum of the costs of selling the product at the end of the reporting period.

Innovative activity of the enterprise, which is characterized by the coefficient of digital technology, is as follows:

$$K_T = \frac{K_p * Q_{KP}}{Q_{NP}} \quad (8)$$

Where:

Q_{NP} – the amount of costs for information and communication technologies at the beginning of the reporting period;

Q_{KP} – the amount of costs for information and communication technologies at the end of the reporting period.

The financial performance of the company, characterized by the evaluation of the balance sheet structure using current liquidity ratios, is as follows:

$$K_L = \sqrt{\frac{G_{OA}}{G_{KO}}} \quad (9)$$

Where:
G_{OA} – the company's current assets at the end of the reporting period;
G_{KO} – current liabilities of the company at the end of the reporting period.
The indicator of strategic positioning can be calculated by the formula:

$$K_I = \frac{Y_A}{Y_S} \quad (10)$$

Where:
Y_A – strategic positioning of the company for the reporting period;
Y_S – strategic positioning on the sample for the reporting period.

$$Y_A = \frac{K_W + K_K + K_G}{3} \quad (11)$$

Where:
K_W – market share of the company for the reporting period;
K_K – changes in the company's revenues during the reporting period;
K_G – an indicator of the supplier's performance in the reporting period;

$$Y_S = \frac{K_{Wi} + K_{Ki} + K_{Gi}}{3} \quad (12)$$

Where:
K_{Wi} – market share in the sample for the reporting period;
K_{Ki} – changes in the sample revenue for the reporting period;
K_{Gi} – an indicator of the supplier's performance in the reporting period;
The market share coefficient, which reflects the market segments occupied by the enterprise, looks as follows:

$$K_W = \frac{C_p}{C_{ob}} \quad (13)$$

Where:
C_p – the total volume of sales of services by the company for the reporting period;
C_{ob} – total sales of services in the market during the reporting period.
The growth or decline in revenue in the reporting period can be denoted as the coefficient of change in revenue enterprise:

$$K_K = \frac{X}{Z} \quad (14)$$

Where:
X – the company's revenue for the reporting period;
Z – the costs of the enterprise for the reporting period.

Let's evaluate the performance of the supplier in accordance with the following criteria using the method of expert evaluations by criteria: 1) Price (with factor weight= 0.3), 2) Compliance of goods/products with procurement requirements (quality, quantity) (with factor weight= 0.25), 3) Timing of delivery (with factor weight= 0.1), 4) Delivery of goods/products (with factor weight= 0.5), 5) Payment (with factor weight= 0.15), 6) Interaction with the supplier (with factor weight= 0.15).

The final coefficient of supplier performance is determined by summing the products of the importance of the factor by its score.

$$K_G = \sum_{i=0}^{n} H_i * M_i \quad (15)$$

Where:

Hi – the specific weight of the factor in the reporting period;

M_i – evaluation of the factor for the reporting period.

To assess indicators of the international environment, such as political, economic, social, and technological factors affecting the competitiveness of the company, the method of expert assessments on the factors including political factors, economic factors, social factors, and technological factors.

After selecting all the factors that can affect competitiveness, it is necessary to assess the degree of influence of each of them. The strength of the influence of a factor will be evaluated on a scale of 1 to 3.

If the value of the factor equals 1, then the influence of the factor is insignificant; no changes in the factor almost do not affect the results of the enterprise. If the factor value is 2, then only significant changes in the factor affect the sales and profit of the company. If the factor value is equal to 3, then the impact of the factor is very large, any change will lead to significant changes in sales and profits of the enterprise.

After all grades are assigned in a separate column, the international environment indicator is calculated as an arithmetic mean according to the following formula:

$$K_z = \frac{1}{n} * \sum_{i=0}^{n} X_i * f_i \quad (16)$$

Where:

X_i – evaluation of the factor for the reporting period;

f_i – the specific weight of the factor in the reporting period.

To correctly assess the statistically significant coefficients of financial condition, which, therefore, have an excessive impact on the company's competitiveness indicators, let's derive the square root of the liquidity ratio.

In the end, given the formulas, we get:

$$K = \frac{R_A}{R_S} \times \frac{Y_A}{Y_S} \times \frac{L_A}{L_S} \quad (17)$$

Approximate dynamics of the level of competitiveness of enterprises depending on the coefficient of competitiveness of enterprises is presented in Table 9. Assuming that the enterprise in question has a *K*-value higher than 1, then the competitiveness of this enterprise is higher than that of its competitors. If the value of *K* is equal to 1, then it turns out that the competitiveness of the company under consideration is identical to the competitive evaluation. The competitiveness of the enterprise in question can also be lower (when the value of *K* is between 0 and 1) than the competitive indicators of the enterprise. Most often itis possible to find the coefficients of operational efficiency, strategic positioning and international environment in the range of values from 0.61 to 1.4. Thus, the final coefficient below 0.6 and above 1.4 is extremely rare. If we analyze the formula (17), the numerator and denominator indices separately can be considered as integral indices reflecting the efficiency of the use of the resources of the analyzed enterprise. Therefore, the overall competitiveness indicator can be presented as a comparison.

$$K = K_R * K_I * K_Z \tag{18}$$

Table 9
Gradation of the Levels of Competitiveness of the Enterprise

The level of competitiveness of the company in comparison with a sample of competitors	The significance of the level of competitiveness of an enterprise
Pretty high	If *K* is higher than 1.4
High	If *K* is in the range 1.16-1.4
Above average	If *K* is in the range 1.00-1.15
Meets the competition	If *K* is 1.00
Below average	If *K* is between 0.85 and 1.00
Low	If *K* is between 0.61 and 0.84
Pretty low	If *K* is below 0.6

Source: Authors' own construction

The competitiveness of an enterprise depends on many factors, including product quality, service level, innovation, price level, etc. The classical value chain created by M. Porter considers various factors influencing competitiveness, and they are presented at the levels of macroeconomic conditions, industry conditions and competitive environment (Porter, 1998).

Irrespective of the level of interaction of economic subjects, Porter's model offers an assessment of the competitiveness of the company on each factor separately. It means that calculations of competitiveness of the enterprise, based on Porter's model, are rather complicated and require an assessment for each of the factors (Xiang et al., 2023).

5. DISCUSSION

The initial aim was to create a competitiveness index for engineering electromechanical enterprises, identifying operational efficiency, strategic positioning, and the international environment as its core components. Research goals, objectives, and hypotheses were formulated accordingly. Through exploratory factor analysis, significant loading factors emerged for questionnaire items tied to operational efficiency, strategic positioning, and the international environment, indicating their strong influence on overall enterprise competitiveness. Particularly noteworthy were high

loading factors for management activities, marketing efforts, service quality, and financial activities, underscoring their significant impact on operational efficiency.

Our findings confirming Hypothesis 1 that operational efficiency is a significant factor influencing competitiveness are supported by recent literature. Wen et al. (2022) empirically demonstrates how investments in operational efficiency enhance manufacturing competitiveness, aligning with Slack and Brandon-Jones's (2018) model linking operational excellence to competitive advantage. Further studies by Aroul et al. (2022) and Mugoni et al. (2023) showcase how improvements in operational efficiency driven by technology adoption and process optimization lead to superior firm performance and competitiveness across sectors. The high loading factor observed for operational efficiency in our analysis reinforces its pivotal role in competitive positioning as recommended by Peng and Lai (2012).

In addition, the findings of this study validated Hypothesis 2 that implies strategic positioning contributes markedly to competitiveness are consistent with new empirical evidence. Bischoff (2023) examines strategic positioning among solar energy firms, revealing how product differentiation and focus on distinctive capabilities are linked to competitive advantage. Similarly, Zheng et al. (2022) work highlights how strategic branding enhances audience engagement and evaluations, improving competitiveness as proposed by Kim and Mauborgne (2005). The strong association between strategic positioning and competitiveness in our study confirms recommendations by Akan et al. (2006) on the effectiveness of positioning strategies. Our results emphasize strategic positioning's significance in establishing a competitive edge.

The findings also support Hypothesis 3 that the international environment shapes competitiveness align with recent international business scholarship. Zhou et al. (2023) analyzes how home country institutional factors like state ownership influence emerging market multinational competitiveness, extending Lu and Beamish's (2006) research. Additionally, Yang et al. (2020) showcase how China's Belt and Road initiative moderates state-owned multinationals' social performance, underscoring the international context's impact per Julian and Ofori-Dankwa (2013). The high loading of our international environment factor reinforces its relevance in determining competitiveness as posited by prominent models like Porter (1990). Our study contributes added empirical evidence on the international environment's multifaceted role.

The analysis identifies critical factors impacting enterprise competitiveness in the electromechanical systems engineering sector. These factors include efficient management, effective marketing, exceptional customer service, and financial stability for operational efficiency. Market share, revenue growth, and supplier performance are pivotal for strategic positioning. The international environment is shaped by political, economic, social, and technological elements, underscoring adaptability and strategic decision-making. Recommendations entail improving management, optimizing marketing, enhancing financial stability, streamlining processes, and investing in technology for operational efficiency. Market share expansion, positive revenue growth, and reliable supplier relations are crucial for strategic positioning. Vigilance towards international factors is vital. The proposed dynamic competitiveness index offers a holistic evaluation method, surpassing static approaches. This approach aids in anticipating challenges, fostering strategic decisions, and long-term planning, contributing to competitiveness evaluation advancement. The study underscores operational efficiency, strategic positioning, and the international environment's significance and provides actionable insights for enterprises' competitive enhancement through dynamic strategies.

The study makes four main contributions: advancing competitiveness evaluation methodologies by proposing a new dynamic index; validating key factors influencing competitiveness through empirical findings; providing a dynamic perspective emphasizing adaptability and strategic decision-making; and offering insights through application in the electromechanical systems engineering industry. First, the study makes a valuable contribution to the advancement of competitiveness evaluation methodologies by introducing a novel dynamic index incorporating operational efficiency, strategic positioning, and the international environment. This integrated approach enables a multifaceted assessment of competitiveness over time. Second, the empirical findings from the factor analysis validate the potency of specific factors like efficient operations, marketing effectiveness, financial stability, market share, revenue growth, and supplier relations in determining competitiveness. This empirical validation enhances theoretical understanding of the sources of competitive advantage. Third, the study's emphasis on adaptability and strategic decision-making contributes a dynamic perspective to competitiveness research, underscoring the importance of continually evolving to sustain competitive edge. Finally, the application of the competitiveness framework in the electromechanical systems engineering industry provides tailored insights for enterprises in this sector to optimize their strategies and performance.

6. IMPLICATIONS

6.1. Theoretical Implications

This study elucidates the multifaceted drivers of competitiveness in the electromechanical systems engineering sector, yielding pivotal theoretical implications for business and management research. The proposed dynamic index represents a methodological advancement, capturing the complex interplay of operational, strategic, and environmental factors shaping competitiveness over time. By revealing competitiveness as an evolving, adaptive process rather than a static attribute, the study provides a more holistic lens. The empirical findings validate specific performance dimensions like marketing effectiveness and revenue growth as integral to theoretical conceptions of competitive advantage. Accordingly, the research refines theoretical perspectives to mirror the nuances that manifest within particular organizational contexts. A key contribution lies in emphasizing the agility and foresight enterprises need to thrive amidst rapidly changing market landscapes and technologies. Rather than deterministic models, this study underlines how sustaining competitiveness requires strategic decision-making under uncertainty. For the electromechanical systems engineering sector specifically, these insights can orient future research and managerial practice. Overall, the study enriches theoretical understanding of competitiveness as a dynamic, multivariate, and context-dependent organizational phenomenon. The findings will aid scholars seeking to unravel the complexities of achieving competitive advantage across various industries and business environments. With its multifaceted contributions, this study represents a steppingstone toward more dynamic, tailored, and prescriptive conceptions of competitiveness.

6.2. Managerial Implications

This study offers several pivotal implications for management practice in the electromechanical systems engineering sector. Firstly, managers must continuously refine processes and allocate resources to optimize operational efficiency as markets rapidly evolve. Securing sales volume, sharpening marketing strategies, enhancing customer service and pursuing innovation can boost productivity, cut costs, and improve responsiveness to change. Additionally, establishing a differentiated market position is key through expanding market share in strategic segments,

sustaining revenue growth and forging reliable supplier relationships. This can solidify reputation, loyalty, and presence. Given intensifying globalization, vigilantly monitoring the international environment across political, economic, social, and technological dimensions is vital when shaping pricing, financial plans, and target markets. Lastly, managers must cultivate a culture of adaptability, innovation, and workforce development to execute strategies adeptly as competitiveness drivers fluctuate. Rather than static attributes, competitiveness emerges as a dynamic outcome of managerial acumen in marshaling resources, nurturing strategic positioning, and navigating uncertainty. This study equips managers to pursue operational excellence, distinctiveness, environmental awareness, and organizational agility in steering their enterprises to long-term success.

This study offers a strong foundation for evaluating enterprise competitiveness, but expanding the research across broader contexts, industries, and factors can enrich the insights. While the sample provides a useful baseline, including more geographic regions and engineering sub-sectors would reveal important contextual variations. The sector comprises diverse industries, necessitating tailored competitiveness strategies. Incorporating exogenous factors like economic conditions could also better capture the full competitive landscape organizations navigate. Essentially, testing the boundaries of the findings along various dimensions – contextual, sectoral, and exogenous – can uncover nuances required to master competitiveness in an intricate, fast-changing environment. By building upon this study's strengths through multi-pronged research, scholars can advance the precision and adaptability of competitiveness evaluation for organizational success. Though condensed, strategic expansion of the research agenda leveraging the current findings promises to yield sharper and more externally attuned insights.

6.3. Policy Recommendations

In this section, we present policy recommendations derived from our study's findings to policymakers, governmental authorities, and relevant stakeholders. These recommendations aim to foster a conducive environment for enterprises operating in the field of electromechanical systems engineering, promoting their competitiveness, growth, and contribution to the overall economy.

Fostering Innovation and Research & Development: Policymakers play a crucial role in enhancing innovation and R&D in the electromechanical systems engineering sector by offering financial incentives, tax benefits, and grants for technological investments. Encouraging collaboration between academia, research institutions, and industry can facilitate knowledge exchange and sector advancement. Policymakers' support for innovation can lead to cutting-edge product development, boosting global competitiveness in the sector.

Enhancing Access to Skilled Labor and Talent: A critical policy priority involves bridging the skills gap and advancing education and training, especially in engineering, robotics, and mechatronics. Policymakers should partner with educational institutions and industry to create curricula aligning with sector needs, ensuring students possess relevant job market skills. Attracting and retaining skilled individuals, both domestically and internationally, can strengthen the sector's human capital and competitive advantage.

Infrastructure Development and Support: Strategic investments in infrastructure, especially in transportation, logistics, and communication networks, hold substantial potential for boosting the competitiveness of engineering electromechanical enterprises. Policymakers should prioritize resource allocation to enhance transportation networks, port access, and technology infrastructure, thereby promoting efficient supply chain management and connectivity. Furthermore, offering incentives and support for advanced manufacturing facilities and research centers can attract investment and elevate the sector's capabilities.

Streamlining Regulatory Framework: Policymakers must enhance the regulatory framework for the electromechanical systems engineering sector, minimizing bureaucratic obstacles and cultivating a favorable business climate. Simplified licensing, transparent regulations, and decreased administrative burdens can incentivize investments and boost competitiveness. Additionally, continuous monitoring and updating of industry regulations, in line with market shifts and technological progress, will enable enterprises to operate effectively while staying compliant.

7. CONCLUSIONS AND FUTURE LINES OF RESEARCH

This study first aimed to address identifying the main factors that significantly contribute to enterprise competitiveness in the electromechanical systems engineering sector. The exploratory factor analysis results revealed that operational efficiency, strategic positioning, and the international environment are substantial factors influencing competitiveness. Key drivers of operational efficiency included management activities, marketing efforts, service quality, innovation, and financial stability. These findings directly address the first research question on determining the factors influencing enterprise competitiveness. Strategic positioning was shaped by market share, revenue growth, and supplier relations. The international environment consisted of political, economic, social, and technological dimensions. In addition, the study, to address the second research question on effectively measuring and integrating the identified factors into an index, put forth a dynamic index quantifying operational efficiency, strategic positioning, and the international environment using objective performance data and expert assessments. Mathematical formulas were proposed to calculate indices for each factor annually, enabling competitiveness analysis over time. The composite index combined the three indices into an overall competitiveness score. This dynamic approach enabled a multifaceted assessment, identifying strengths and weaknesses across the key factors and predicting future changes in competitiveness.

Further research can build upon the findings of this study to advance the understanding of competitiveness evaluation in the electromechanical systems engineering sector. Comparative assessments across different industries and regions would allow for benchmarking the proposed competitiveness index and identifying best practices that could enhance the framework's applicability across contexts. Investigating the impact of external factors like macroeconomic conditions could augment the index by incorporating exogenous variables that shape the strategic landscape yet remain beyond organizational control. Examining industry-specific competitive strategies may reveal nuances within sub-sectors that warrant tailored recommendations, lending greater precision to the evaluation. Additionally, validating the index against objective performance data would cement its accuracy and reliability as a measurement tool. Ultimately, a multi-pronged research agenda encompassing cross-industry comparisons, macroeconomic analysis, industry-specific inquiries and empirical validation would realize the index's full potential. It would transition an exploratory instrument into an established framework that enterprises in various engineering sectors could reliably apply to appraise their competitiveness. Partnerships between academia and industry can facilitate access to data and incubate new research directions. As the engineering environment grows in complexity, a rigorous yet adaptable index can serve as a compass guiding organizations to sustain competitive advantage. By pursuing knowledge-building along multiple avenues, scholars can unlock new possibilities for firms to understand, benchmark and enhance their competitiveness in a dynamic world.

REFERENCES

Aithal, P. S. (2023). Enhancing Industrial Automation through Efficient Technology Management in Society. *International Journal of Applied Engineering and Management Letters (IJAEML)*, *7*(4), 184–215. https://doi.org/10.47992/IJAEML.2581.7000.0199

Akan, O., Allen, R. S., Helms, M. M., & Spralls, S. A. (2006). Critical tactics for implementing Porter's generic strategies. *Journal of Business Strategy*, *27*(1), 43–53. https://doi.org/10.1108/02756660610640173

Aroul, R. R., Sabherwal, S., & Villupuram, S. V. (2022). ESG, operational efficiency and operational performance: Evidence from Real Estate Investment Trusts. *Managerial Finance*, *48*(8), 1206–1220. https://doi.org/10.1108/mf-12-2021-0593

Bischoff, M. (2023). *Sustainability as strategic advantage in the energy industry: The case of Enpal* [Doctoral dissertation, Universidade Católica Portuguesa, Lisboa].

Cantwell, J. (2015). An introduction to the eclectic paradigm as a meta-framework for the cross-disciplinary analysis of international business. In J. Cantwell (Ed.), *The Eclectic Paradigm.* (pp. 1–22). Palgrave Macmillan. https://doi.org/10.1007/978-1-137-54471-1_1

Cho, H. J., & Pucik, V. (2005). Relationship between innovativeness, quality, growth, profitability, and market value. *Strategic Management Journal*, *26*(6), 555–575. https://doi.org/10.1002/smj.461

Coccia, M. (2022). Preparedness of countries to face COVID-19 pandemic crisis: Strategic positioning and factors supporting effective strategies of prevention of pandemic threats. *Environmental Research*, *203*, 111678. https://doi.org/10.1016/j.envres.2021.111678

Farida, I., & Setiawan, D. (2022). Business strategies and competitive advantage: The role of performance and innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(3), 163. https://doi.org/10.3390/joitmc8030163

Fatonah, S., & Haryanto, A. T. (2022). Exploring market orientation, product innovation and competitive advantage to enhance the performance of SMEs under uncertain evens. *Uncertain Supply Chain Management*, *10*(1), 161–168. https://doi.org/10.5267/j.uscm.2021.9.011

Fen, T. A. N. (2023). A study on the trade complementarity and competitiveness of mechanical and electrical products between China and RCEP member countries. In *2023 International Conference on Management Innovation and Economy Development (MIED 2023)* (pp. 384–393). Atlantis Press.

Fu, W., & Jacobs, B. W. (2022). Does increased water efficiency improve financial performance? The important role of operational efficiency. *International Journal of Operations & Production Management*, *42*(3), 304–330. https://doi.org/10.1108/ijopm-10-2021-0628

Ghemawat, P. (1986). Sustainable Advantage. *Harvard Business Review*, *64*(5), 53–58.

Gu, Y., Wu, P., & Du, R. (2023). Corporate strategic positioning and environmental information disclosure under circular economy: Evidence from China. *Management Decision*. In Press. https://doi.org/10.1108/md-02-2023-0301

Guo, W., & Chen, M. (2022). Construction of structural dimensions of organizational human capital competitive advantage. *Journal of Intellectual Capital*, *23*(5), 1081–1106. https://doi.org/10.1108/jic-07-2020-0223

Hendricks, K. B., & Singhal, V. R. (2001). The long-run stock price performance of firms with effective TQM programs. *Management Science*, *47*(3), 359–368. https://doi.org/10.1287/mnsc.47.3.359.9773

Hooks, D., Davis, Z., Agrawal, V., & Li, Z. (2022). Exploring factors influencing technology adoption rate at the macro level: A predictive model. *Technology in Society*, *68*, 101826. https://doi.org/10.1016/j.techsoc.2021.101826

Iranmanesh, M., Maroufkhani, P., Asadi, S., Ghobakhloo, M., Dwivedi, Y. K., & Tseng, M. L. (2023). Effects of supply chain transparency, alignment, adaptability, and agility on blockchain adoption in supply chain among SMEs. *Computers & Industrial Engineering*, *176*, 108931. https://doi.org/10.1016/j.cie.2022.108931

Julian, S. D., & Ofori-Dankwa, J. C. (2013). Financial resource availability and corporate social responsibility expenditures in a sub-Saharan economy: The institutional difference hypothesis. *Strategic Management Journal*, *34*(11), 1314–1330. https://doi.org/10.1002/smj.2070

Kim, W. C., & Mauborgne, R. (2005). *How to Create Uncontested Market Space and Make the Competition Irrelevant*. Harvard Business School Publishing.

Kumar, V., Jones, E., Venkatesan, R., & Leone, R. P. (2011). Is market orientation a source of sustainable competitive advantage or simply the cost of competing? *Journal of Marketing*, *75*(1), 16–30. https://doi.org/10.1509/jmkg.75.1.16

Lara-Prieto, V., Ruiz-Cantisani, M. I., Arrambide-Leal, E. J., de la Cruz-Hinojosa, J., Mojica, M., Rivas-Pimentel, J. R., & Membrillo-Hernández, J. (2023). Challenge-Based Learning Strategies Using Technological Innovations in Industrial, Mechanical and Mechatronics Engineering Programs. *International Journal of Instruction*, *16*(1), 261–276. https://doi.org/10.29333/iji.2023.16115a

Lu, J. W., & Beamish, P. W. (2006). Partnering strategies and performance of SMEs' international joint ventures. *Journal of Business Venturing*, *21*(4), 461–486. https://doi.org/10.1016/j.jbusvent.2005.02.002

Majzoubi, M., & Zhao, E. Y. (2022). Going beyond optimal distinctiveness: Strategic positioning for gaining an audience composition premium. *Strategic Management Journal*, *44*(3), 737–777. https://doi.org/10.1002/smj.3460

Muerza, V., Larrodé, E., Moreno-Jiménez, J. M., & Royo, B. (2023). Multicriteria evaluation of technological competitiveness in diversification processes. An application to the automotive components industry. *International Transactions in Operational Research, 30*(6), 3863–3885. https://doi.org/10.1111/itor.13286

Mugoni, E., Nyagadza, B., & Hove, P. K. (2023). Green reverse logistics technology impact on agricultural entrepreneurial marketing firms' operational efficiency and sustainable competitive advantage. *Sustainable Technology and Entrepreneurship*, *2*(2), 100034. https://doi.org/10.1016/j.stae.2022.100034

Peng, D. X., & Lai, F. (2012). Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management*, *30*(6), 467–480. https://doi.org/10.1016/j.jom.2012.06.002

Pereira, V., Temouri, Y., Budhwar, P., & Tarba, S. (2021). Cross-border acquisition performance of emerging market multinational enterprises: The moderating role of state-ownership and acquisition experience. *Long Range Planning*, *54*(6), 102107. https://doi.org/10.1016/j.lrp.2021.102107

Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. Free Press.

Porter, M. E. (1990). *The Competitive Advantage of Nations*. Free Press.

Porter, M. E. (1998). *The Competitive Advantage: Creating and Sustaining Superior Performance.* Free Press.

Rastogi, P., & Sharma, S. (2023). Sustainable Marketing Strategies: Evaluating the Economic Benefits of Green Consumerism. (2023). *Boletin De Literatura Oral – The Literary Journal*, *10*(1), 997–1008.

Rudyk, N. V., Niyazbekova, S. U., Yessymkhanova, Z. K., & Toigambayev, S. K. (2022). Development and Regulation of the Digital Economy in the Context of Competitiveness. In A. V. Bogoviz, A. E. Suglobov, A. N. Maloletko & O. V. Kaurova (Eds.), *Cooperation and Sustainable Development* (pp. 167–174). Springer International Publishing.

Rugman, A. M., & Verbeke, A. (1993). Foreign subsidiaries and multinational strategic management: An extension and correction of Porter's single diamond framework. *Management International Review*, *33*(2), 71–84.

Semin, A., Vasiljeva, M., Sokolov, A., Kuznetsov, N., Maramygin, M., Volkova, M., Zekiy, A., Elyakova, I., & Nikitina, N. (2020). Improving early warning system indicators for crisis manifestations in the Russian economy. *Journal of Open Innovation: Technology, Market, and Complexity, 6*(4), 171. https://doi.org/10.3390/joitmc6040171

Shafer, S. M., & Byrd, T. A. (2000). A framework for measuring the efficiency of organizational investments in information technology using data envelopment analysis. *Omega*, *28*(2), 125–141. https://doi.org/10.1016/s0305-0483(99)00039-0

Slack, N., & Brandon-Jones, A. (2018). *Operations and process management: Principles and practice for strategic impact*. Pearson.

Wang, Q., Chen, S., & Wang, Y. (2023). An Empirical Study on the Impact of Digital Economy Innovation Development on the Export Quality of Chinese Electromechanical Products. *Sustainability*, *15*(24), 16908. https://doi.org/10.3390/su152416908

Wei, Y., Zhu, R., & Tan, L. (2022). Emission trading scheme, technological innovation, and competitiveness: evidence from China's thermal power enterprises. *Journal of Environmental Management*, *320*, 115874. https://doi.org/10.1016/j.jenvman.2022.115874

Wen, H., Zhong, Q., & Lee, C. C. (2022). Digitalization, competition strategy and corporate innovation: Evidence from Chinese manufacturing listed companies. *International Review of Financial Analysis*, *82*, 102166. https://doi.org/10.1016/j.irfa.2022.102166

Xiang, H., Lu, J., Kosov, M. E., Volkova, M. V., Ponkratov, V. V., Masterov, A. I., Elyakova, I. D., Popkov, S. Y., Taburov, D. Y., Lazareva, N. V., Muda, I., Vasiljeva, M. V., & Zekiy, A. O. (2023). Sustainable Development of Employee Lifecycle Management in the Age of Global Challenges: Evidence from China, Russia, and Indonesia. *Sustainability, 15*(6), 4987. https://doi.org/10.3390/su15064987

Yang, N., Wang, J., Liu, X., & Huang, L. (2020). Home-country institutions and corporate social responsibility of emerging economy multinational enterprises: The belt and road initiative as an example. *Asia Pacific Journal of Management*, *39*(3), 927–965. https://doi.org/10.1007/s10490-020-09740-y

Zhang, R., & Fu, Y. (2022). Technological progress effects on energy efficiency from the perspective of technological innovation and technology introduction: An empirical study of Guangdong, China. *Energy Reports*, *8*, 425–437. https://doi.org/10.1016/j.egyr.2021.11.282

Zheng, Y., Wang, Y., & Mian, S. A. (2022). Strategic positioning of projects in crowdfunding platforms: do advanced technology terms referencing, signaling and articulation matter? *International Journal of Entrepreneurial Behavior & Research*. https://doi.org/10.1108/ijebr-01-2022-0071

Zhou, C., Zhang, Y., & Bu, M. (2023). Home country adverse political shocks and cross-border mergers and acquisitions financial performance of politically connected emerging market firms. *International Business Review*, *33*(3), 102175. https://doi.org/10.1016/j.ibusrev.2023.102175

AUTHOR'S CONTRIBUTION

AA: conceptualization, data curation, funding acquisition, methodology, validation, reviewing and editing; **EK:** conceptualization, methodology, supervision, validation, reviewing and editing; **WS:** formal analysis, investigation, visualization, writing original draft; **HW:** formal analysis, investigation, resources, software, writing original draft.

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COMPLIANCE WITH ETHICAL STANDARDS

The study was conducted in accordance with the Declaration of Helsinki, national legislation and local requirements. Under these guidelines, human rights have been preserved and participants' safety was considered as a priority for sharing information. During the research, the study made sure to maintain the confidentiality of the respondents. The respondents were not forced to share any personal information. Informed consent was obtained from all subjects involved in the study.

CONFLICTS OF INTEREST

None.