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Modeling and Validating the Role of Artificial Intelligence in Enhancing the Export Capabilities of Electronics Industry Companies: A Mixed Approach

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Abstract

The aim of the present study is to model and validate the role of artificial intelligence in improving the export capabilities of electronics industry companies: a mixed approach. The research method is applicable in terms of its purpose, and mixed (qualitative-quantitative) in terms of its implementation method. The statistical population in the qualitative section included 16 experts in the field of electronics industry exports and artificial intelligence technology selected by snowball sampling method; and in the quantitative section, 306 experts in marketing and sales of electronic products. The tool for collecting findings in the qualitative section was a semi-structured interview, and a questionnaire in the quantitative section. Data analysis in the qualitative section was based on data-based theory (Strauss and Corbin model) including three stages of open, axial and selective coding and MAXQDA software was used, and in the quantitative section, structural equation modeling (PLS-SEM) was used. The results of the qualitative section showed that five main categories including causal conditions (ICT infrastructure, data quality, technical capacity), contextual conditions (supportive policies, international cooperation, innovative organizational culture), intervening conditions (sanctions, rapid technological changes, legal barriers and customs regulations), strategies (demand forecasting, price optimization, logistics intelligence, human resource empowerment) and consequences (competitive advantage, global market penetration, increased customer satisfaction, cost reduction) constitute the model structure. In the quantitative section, the composite reliability indices were all more than 0.7 and the convergent validity for most categories was more than 0.5. The results of the hypothesis test also indicated the complete confirmation of the relationships between the model categories with a significance level of $p<0.001$.

Keywords:
Artificial intelligence, electronics industry exports, human resource empowerment, strategic decision-making, demand forecasting

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Extended Abstract

Introduction

In the current competitive and globalized world, exports are known as the engine of economic growth and the main tool for enterprise development. Among the transformative technologies of the digital age, artificial intelligence is redefining international trade patterns as a strategic advantage and a tool for data-driven decision-making (Wang et al., 2023). By using machine learning algorithms and smart data analytics, export-oriented companies are able to predict the behavior of foreign customers and accelerate their market responses in volatile international markets (Jain & Aggarwal, 2020). Recent research also shows that artificial intelligence not only affects tactical decisions in export marketing, but also, at the strategic level, by developing innovative organizational capabilities, increases export performance and creates sustainable competitive advantage (Hasan & Ojala, 2024). In advanced industries, especially electronics industries, the wave of digitalization and integration of smart technologies has created a new form of export value chain. By optimizing supply chain management, product design, quality control, dynamic pricing, and international after-sales services, AI has made a significant contribution to improving productivity and sustainable entry of companies into global markets. On the other hand, recent studies in Asian countries show that the deployment of AI systems in electronics companies has reduced the rate of demand forecast errors by 40% and increased foreign customer satisfaction by 25% (Sugiharti et al., 2020). Despite the large volume of technical research, a native and integrated model that can explain the role of AI in developing the export performance of electronics industries in relation to Iran's economic, institutional, and technological conditions has not yet been presented. Therefore, there is a clear theoretical and practical gap between the potential capabilities of AI and its actual mechanism in promoting the exports of Iranian companies. This gap forms the main focus of the present study; this means that the present research attempts to develop a comprehensive model to explain and validate the role of artificial intelligence in improving export performance by empirically analyzing data from exporting companies active in the electronics industry. The results of this study can be a practical guide for industrial policymakers and company managers on the path to digitizing export processes and achieving a sustainable position in global markets. Accordingly, the present research seeks to answer this question: What does modeling and validating the role of artificial intelligence in improving the export capabilities of electronics companies: a mixed approach look like?

Theoretical Framework

Artificial Intelligence

Artificial intelligence enables the process of converting data into information, information into knowledge, and knowledge into intelligent action, and paves the way for the development of decision-making systems in conditions of uncertainty and intense competition. From a theoretical perspective, AI can be considered a strategic resource within the framework of resource-based theories and dynamic capabilities through which organizations increase their ability to analyze, innovate, and respond to environmental changes (Mahmood, 2023).

The Role of AI in Firms' Export Performance

In the electronics industry, where competitive advantage is based on innovation, speed of response, and supply chain optimization, AI acts as a strategic driver for improving export performance indicators. Companies that apply AI technologies in their marketing, demand planning, and export logistics processes have more sustainable growth and higher market share compared to competitors (Zhai, 2022).

Fekret et al. (2024) investigated the role of artificial intelligence marketing on increasing sales and exports of Iranian sports goods using a phenomenological approach. After coding the

interviews using the phenomenological method, 9 main themes and 53 sub-themes were identified. The 9 main themes included accurate identification of dimensions and indicators of smart marketing, SEO development, greater use of digital marketing and content marketing strategies, increasing the quality of Iranian sports goods, proper management of advertising and sales of Iranian sports goods, use of artificial intelligence tools, coverage of neuromarketing, employment of specialized human resources, exchange of information between the marketing and sales units. The findings of this study can serve as a basis for increasing sales and, as a result, developing exports and increasing profitability of organizations and companies in the field of Iranian sports goods. It is suggested that, due to the great importance of quality data in artificial intelligence marketing systems, the use of specialized human resources in marketing science should always be considered by managers of organizations and companies.

Haghighi (2024) examined the necessity of using artificial intelligence in the development and progress of the country's exports and imports and stated that artificial intelligence can play a key role in the development and progress of the country's exports and imports. By optimizing the supply chain, forecasting demand, identifying new opportunities, improving risk management, and facilitating customs processes, artificial intelligence can help promote international trade and economic growth. However, challenges such as the shortage of skilled labor, high implementation costs, and security and legal issues are obstacles to realizing this potential. To benefit from the advantages of artificial intelligence in international trade, it is essential that the government and the private sector work together to implement programs for the development and application of this technology. The focus of these programs should be on training a skilled workforce, creating appropriate infrastructure, and developing transparent laws and regulations. By adopting a comprehensive and planned approach, artificial intelligence can be used as a tool to promote international trade and the country's economic development. Also, ethical issues, privacy, and data security should be considered. In general, artificial intelligence can play a significant role as a powerful tool in accelerating the development of countries' exports and imports.

Research methodology

The research method is applicable in terms of its purpose, and mixed (qualitative-quantitative) in terms of implementation. The statistical population in the qualitative section included 16 experts in the field of electronics industry exports and artificial intelligence technology selected by snowball sampling method; and in the quantitative section included 306 experts in marketing and sales in the field of electronic product exports. The tool for collecting findings in the qualitative section was a semi-structured interview, and a questionnaire in the quantitative section.

Research findings

Data analysis in the qualitative section was based on data-based theory (Strauss and Corbin model) including three stages of open, axial and selective coding and MAXQDA software was used, and in the quantitative section, structural equation modeling (PLS-SEM) was used. The results of the qualitative section showed that five main categories including causal conditions (ICT infrastructure, data quality, technical capacity), contextual conditions (supportive policies, international cooperation, innovative organizational culture), intervening conditions (sanctions, rapid technological changes, legal barriers and customs regulations), strategies (demand forecasting, price optimization, logistics intelligence, human resource empowerment) and consequences (competitive advantage, global market penetration, increased customer satisfaction, cost reduction) constitute the model structure. In the

quantitative section, the composite reliability indices were all more than 0.7 and the convergent validity for most categories was more than 0.5. The results of the hypothesis test also indicated the complete confirmation of the relationships between the model categories with a significance level of $p<0.001$.

Conclusion

The present study was conducted with the aim of modeling and validating the role of artificial intelligence in enhancing the export capabilities of electronics industry companies: a mixed approach. The results of this study are in line with international studies such as Davenport et al. (2020), Mahmood (2023), and Wang et al. (2023), which introduced artificial intelligence as the main driving force of sustainable export advantage. At the national level, it is also in line with the findings of Rahimi Klor et al. (2024), which have shown that the application of smart technologies leads to agility, flexibility, and export resilience of Iranian companies.

Based on the findings, it is recommended:

1- Establishing the "Iranian Electronics Industry Export Data Center" to collect and analyze export data with intelligent algorithms.

2- Training and empowering export managers in data analysis and working with artificial intelligence systems to promote real decision-making.