WEP Warwick Evans Publishing

International Journal of Global Economics and Management

ISSN: 3005-9690 (Print), ISSN: 3005-8090 (Online) | Volume 3, Number 3, Year 2024
DOI: https://doi.org/10.62051/ijgem.v3n3.40
Journal homepage: https://wepub.org/index.php/IJGEM/index

A Comprehensive Analysis of Supply Chain Collaboration, Technological Upgrading, and Market Demand as a Framework for Increasing Competitiveness

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ABSTRACT

The purpose of this study is to evaluate how supply chain collaboration, technical advancement, and consumer demand affect manufacturing firms' ability to compete in Guangdong Province. The particular goals include testing the relationship between supply chain cooperation, technological innovation, and market demand development; evaluating technology maturity, adaptability, and cost-effectiveness; assessing supply chain coordination efficiency, supply chain risk management capability, and supply chain innovation capability; analyzing accuracy of market demand forecasting, speed of market demand response, and customer demand diversity; and developing a comprehensive framework for enhancing enterprise competitiveness. Using surveys, data analysis, and empirical research, this study uses a mixed-method approach that combines quantitative and qualitative analysis to examine the links between the variables and offer management recommendations.

KEYWORDS

Supply Chain Collaboration; Technological Advancement; Consumer Demand; Manufacturing Competitiveness

1. INTRODUCTION

In the context of rapid globalization and technological advancement, the manufacturing industry faces unprecedented challenges and opportunities. Particularly for manufacturing enterprises in Guangdong Province, China, maintaining and enhancing competitiveness amidst fierce market competition is a pressing issue. Technological upgrading, supply chain cooperation, and market demand are critical drivers of enterprise competitiveness. This study focuses on how to coordinate and optimize these factors to enhance enterprise competitiveness. By deeply exploring the interplay among technological upgrading, supply chain cooperation, and market demand, this study aims to provide an effective framework for enhancing enterprise competitiveness.

2. OBJECTIVES

The main objectives of this study are:

1) To assess technological upgrading in terms of technology maturity, technology adaptability, and cost-effectiveness of technology;

2) To determine supply chain cooperation in terms of supply chain coordination efficiency, supply chain risk management capability, and supply chain innovation capability;

3) To analyze market demand in terms of accuracy of market demand forecasting, speed of market demand response, and customer demand diversity;

4) To test the correlation between supply chain cooperation, technological innovation, and market demand development;

5) To develop a framework for enhancing enterprise competitiveness.

3. LITERATURE REVIEW

3.1. Technological Upgrading

Upgrading technology has become essential for maintaining competitiveness and promoting sustainable development in a number of industries in recent years. In addition to introducing and utilizing new technologies, technological upgrading also entails streamlining and improving current systems and procedures. Erdoğan (2021)examines the effects of technological innovation on carbon emissions in the building sector of BRICS countries, finding that increased technological innovation reduces carbon emissions, encouraging related investments. Technological upgrading provides a solid foundation for enhancing competitiveness and achieving sustainable development.

Technology maturity is a key indicator for assessing technological upgrading, reflecting the degree of maturity and stability of a technology in practical applications. Webster(2019) explores the concept of 'readiness' as it relates to innovation adoption, particularly focusing on 'technology readiness' levels. It argues that technology readiness should be part of a broader 'institutional readiness' framework to better understand the adoption of new technologies in organizational settings. Technology adaptability is a crucial factor in assessing the application capabilities of technology under different environments and conditions.

The cost-effectiveness of technology is a crucial metric for measuring the economic efficiency of technology in achieving its objectives. Syeed（2022）systematically reviews methods for measuring and valuing the attributes of innovative healthcare technologies, highlighting the importance of such innovations in improving patient well-being and overall health outcomes. The study suggests that traditional cost-effectiveness analysis often fails to capture the full benefits of these technologies and recommends more comprehensive approaches like multi-criteria decision analysis.

3.2. Supply Chain Cooperation

Supply chain collaboration has grown in importance as a tactic for businesses looking to boost sustainability and competitiveness in recent years. Supply chain collaboration includes resource integration and collaborative innovation in addition to information exchange and coordination between customers and suppliers.Baig(2021) highlights the value and importance of supply chain collaboration in innovation. Survey data from 269 supply chain professionals show that supplier collaboration leads to both radical and incremental innovation, which positively impacts market performance. Supply chain cooperation provides essential support for the comprehensive performance improvement of companies by enhancing resource utilization efficiency and promoting innovation.

The efficiency of supply chain coordination, which measures the capacity to plan and work together across various supply chain segments, is a crucial indicator of how well supply chain cooperation is working.Xue(2020) introduces a new information sharing framework and decentralized model based on blockchain technology to address issues of untimely feedback and distortion in supply chains. The study finds that blockchain-based operations help achieve supply chain management goals, reduce costs, improve quality, and enhance overall system efficiency.

A key component in guaranteeing the stability and continuity of the supply chain is the ability to manage supply chain risk.Pai(2022) proposes a methodology to recommend the most effective and cost-efficient protective measures to mitigate risks through risk analysis and assessment within the supply chain. The article discusses the two main phases of a risk management and mitigation system - the vulnerability and risk assessment phase, and the phase of mitigating risks by implementing protective measures.

The distributed ledger known as blockchain technology has garnered a lot of interest in supply chain management.Mahyuni（2020)reviews and maps blockchain's potentials in enhancing supply chain transparency, traceability, sustainability, trust, and cost-efficiency. Although practical applications are limited, blockchain helps improve various aspects of supply chain management. By optimizing risk management strategies and applying advanced technologies, companies can significantly enhance their supply chain risk management capability.

Being able to innovate in the supply chain is essential for improving business competitiveness and adapting to shifting market conditions. Based on survey data from 510 Chinese enterprises, Shan(2020) uses hierarchical regression analysis and a structural equation model to examine the impact of supply chain collaborative innovation on sustainable supply chain performance. Results show that dynamic capability mediates the relationship between collaborative innovation and performance, with technology collaborative innovation having the greatest direct impact.

3.3. Market Demand

Market demand involves understanding and predicting consumer needs to better meet market demands and enhance competitiveness. Bayrakta (2020) uses discrete-event simulation and structural equation modeling to analyze the causal relationships between order-fulfillment characteristics and retailer performance metrics. The findings indicate that forecast inaccuracy is the most critical factor in mitigating the bullwhip effect, while seasonality has limited impact on performance. Zozulov (2022) aims to develop a scheme for forming a company's growth strategy based on a system of indicators characterizing the level of market demand. Results indicate that market demand formation is a process influenced by various factors and characterized by both qualitative and quantitative components. Market demand analysis provides companies with critical market insights and strategic support.

For businesses to allocate resources and plan their production, accurate market demand forecasting is essential. Khan (2020) presents a demand forecasting model that combines business intelligence and machine learning to improve forecasting accuracy. The results show that the model achieves up to 92.38% accuracy in predicting future demand for goods. Haque (2023) enriches time series data of customer demand with macroeconomic variables, such as the Consumer Price Index (CPI), Index of Consumer Sentiment (ICS), and unemployment rates. By developing and comparing various regression and machine learning models, the study shows that using macroeconomic variables significantly improves demand forecasting accuracy. By adopting advanced data analysis techniques and optimizing forecasting models, companies can significantly improve the accuracy of market demand forecasting, thereby optimizing production and inventory management.

Maintaining a competitive advantage in quickly evolving market settings requires prompt responses to consumer demand. Hassani (2020) explores the implementation of Lean and Agile models in supply chain management, examining their impact on improving productivity and response speed. The study shows that implementing these models significantly enhances supply chain productivity and agility, helping companies respond to market uncertainties and fluctuations.

Customer demand diversity is an important consideration for companies in formulating product and service strategies. Pallant (2020) shows that understanding the heterogeneity in consumer demand for customization allows brand managers to more effectively develop and deliver customized services, thereby improving customer satisfaction. Ranjan (2022) proposes a management strategy to acquire

customer data through social media to devise customized products and services, enhancing customer satisfaction and sustainable competitive advantage.

4. METHODOLOGY

4.1. Research Design

The goal of this study is to create a framework for improving competitiveness in the manufacturing sector of Guangdong Province by thoroughly analyzing supply chain collaboration, technology upgrading, and market demand. Surveys and in-depth interviews are used with quantitative and qualitative methodologies in the study design. Prior to creating a questionnaire to measure these characteristics, a literature research was done to determine important variables and indicators. The questionnaire addresses topics like customer demand diversity, market demand forecasting accuracy, market demand response speed, technology maturity, adaptability, cost-effectiveness, supply chain coordination efficiency, supply chain risk management capability, and supply chain innovation capability. Secondly, in order to gather more specific qualitative data, a number of manufacturing companies were chosen for in-depth interviews. Descriptive statistics, correlation analysis, and Cronbach's Alpha reliability analysis will all be used in the data analysis process to confirm the questionnaire's internal consistency and the correlations between the variables.

4.2. Participants

The study's participants are recruited from Guangdong Province's industrial businesses, which include those in the electronics, mechanical, chemical, and textile industries. The heads of the departments in charge of marketing, supply chain, and technology as well as firm management are the major participants. To guarantee the diversity and representativeness of the sample, 200 businesses were chosen at random. A total of 400 questionnaires were sampled, with two important managers from each firm invited to complete the survey. Quantitative information on supply chain collaboration, technical advancement, and market demand will be gathered via the questionnaire. To fully comprehend the influence of these factors on firm competitiveness, these participants will offer insightful firsthand insights.

4.3. Research Tools

A well-crafted questionnaire and a semi-structured interview guide serve as the study's primary research instruments. The five-point Likert scale, which goes from "strongly disagree" to "strongly agree," is used to rate each item on the questionnaire, which is based on important variables found in the literature review. To guarantee its validity and operability, the questionnaire design was examined by specialists and put through a small-scale pilot test. With the goal of gaining in-depth understanding of the precise effects of these elements on firm competitiveness, the interview guide focuses on supply chain collaboration, technical upgrading, and market demand. The reliability of each variable will be ensured by utilizing Cronbach's Alpha to evaluate the questionnaire's internal consistency. Furthermore, correlation analysis will be used to investigate and evaluate the correlations between the variables.

4.4. Data Collection

There are two phases to the data collection process: in-depth interviews and questionnaire surveys. Initially, the surveys would be made available online and offline. The research team will present offline surveys in person and offer on-site help for completion. Online questionnaires will be distributed via email and company-owned internal communication platforms. Over 60% is the anticipated response rate for the questionnaire. Preliminary cleaning and coding will be applied to the

gathered questionnaire data to guarantee data accuracy and completeness. The study team will also arrange and carry out in-depth interviews, each of which will last roughly an hour. For further analysis, the interviews will be transcribed and recorded. All information will be kept private and safe to protect participant privacy and information security.

4.5. Data Analysis

The two categories of data analysis are going to be quantitative and qualitative. Software from SPSS will be used to examine quantitative data for reliability analysis, correlation analysis, and descriptive statistics, including Cronbach's Alpha. The sample characteristics and basic information on each variable will be summarized by descriptive statistics; correlation analysis will investigate the relationships between supply chain cooperation, technological upgrading, and market demand; and Cronbach's Alpha will evaluate the questionnaire's internal consistency, guaranteeing the scales' reliability. To complement and validate the findings of the quantitative analysis, Nvivo software will be used to code and thematically analyze qualitative data in order to identify important themes and patterns. This study will thoroughly demonstrate the effects of supply chain collaboration, technical advancement, and market demand on firm competitiveness by fusing quantitative and qualitative analysis.

4.6. Ethical Considerations

Participants' rights and confidentiality are protected by this study's careful adherence to ethical standards. Prior to any data collection, each participant will first get a thorough research briefing that covers the goals of the study, how the data will be used, and their rights. An informed consent form needs to be signed by participants to attest to their understanding and willingness to engage. Second, all information that could be used to identify participants in the questionnaire or interview will be eliminated, making the data anonymous. To secure data transfer and storage, the study team will put strict data security procedures in place. Furthermore, the legality and ethicalness of the research method have been guaranteed by this study's review and approval by the pertinent ethics review board. These precautions are all intended to safeguard the rights and privacy of study participants as well as the study's integrity and scientific validity.

5. FIDINGS AND DISCUSSION

Table 1
Summary Table on Technological Upgrading

Key Result Areas	Composite Mean	VI	Rank
Technology Maturity	3.19	Agree	2
Technology Adaptability	3.18	Agree	3
Cost-effectiveness of Technology	3.20	Agree	1
Grand Composite Mean	**3.19**	**Agree**	

Legend:3.50-4.00=Strongly Agree;2.50-3.49=Agree;1.50-2.49=Disagree;1.00-1.49=Strongly Disagree

The composite mean scores for the three major technological upgrade result areas—technological maturity, technological adaptability, and technological cost-effectiveness—are shown in Table 1. These indications show that respondents have assessed each area's performance and, on the whole, believe these to be very important in terms of technological upgrading. Overall, these findings show that in order to guarantee the effectiveness and success of technology implementation, businesses and organizations must concentrate on these crucial areas.

Cost-effectiveness of technology scored the highest, with a mean of 3.20, indicating that enterprises and organizations prioritize economic efficiency and cost-effectiveness in technological upgrading. Cost-effectiveness not only refers to the cost of the technology itself but also its impact on the overall

operational costs of the enterprise. Studies have shown that cost-effectiveness is one of the most important factors considered by enterprises when deciding whether to adopt new technology.

Perroni (2019), through case analysis, examines cost-benefit analysis methods for technology adoption, highlighting that cost-benefit analysis is a crucial tool in decision-making for firms, significantly enhancing performance and competitive advantage. Ling (2019) finds that early cost-effectiveness modeling can significantly improve decision-making in public research investment, especially in the development of personalized medicine technologies. Early cost-effectiveness analyses help identify key drivers and provide minimum criteria to support technology adoption.

Technology maturity, with a mean of 3.19, ranks second. Technology maturity reflects the stability and reliability of the technology, which is another crucial factor that enterprises consider in technological upgrading. Mature technologies have typically undergone extensive testing and application, demonstrating excellent performance in practical operations and reducing the costs associated with technical failures and maintenance.

Obienu (2020) proposed and validated a Generic Usability and Acceptance Model (GUAM) to measure behavioral intention in learning innovations. Results showed that GUAM significantly improved variance explained in behavioral intention and technology use compared to UTAUT, demonstrating the impact of technology maturity on user acceptance. Bu (2022) finds that high-tech enterprises' technology choices at different development stages are significantly influenced by technology maturity, with firms tending to choose technologies that have proven their market value and reliability to minimize technological risks.

Technology adaptability scored 3.18, slightly lower than technology maturity. Technology adaptability refers to the ability of technology to adapt to different environments and conditions, which is crucial for enterprises to maintain competitiveness in a rapidly changing market environment. Highly adaptable technologies help enterprises respond to changing market demands and the complexity of the technological environment, thereby maintaining their market advantage.

Coghlan (2020). proposes a biological adaptability approach to enhance SMEs' innovation capabilities. Through analyzing 37 firms in the agri-food sector, it was found that the strategic DNA of firms and their dynamic adaptability to the environment significantly impact technological innovation. Wei (2019) shows that IT outsourcing and technological adaptability are crucial tools for enterprises to enhance market competitiveness, particularly in technological innovation and expansion, emphasizing the importance of service providers' reputation and competence.

In summary, the key result areas of cost-effectiveness, maturity, and adaptability of technology in technological upgrading have received high ratings, indicating that respondents generally agree on the importance of these factors. Specifically, cost-effectiveness is the primary consideration in technology selection to ensure economic benefits. Technology maturity determines the reliability and user acceptance of technology, while adaptability ensures flexibility in varying environments.

Huawei, when implementing its technological upgrades, first conducted a detailed cost-benefit analysis to ensure that the introduced technology could bring significant economic benefits. Secondly, these technologies were extensively tested and validated, proving their reliability in various operational environments, thereby reducing technical failures and maintenance costs. Finally, Huawei's technology demonstrated high adaptability, being able to flexibly respond to changing market demands and the complexity of the technological environment, thereby improving overall production efficiency and market competitiveness.

Table 2
Summary Table on Supply Chain Cooperation

Key Result Areas	Composite Mean	VI	Rank
Supply Chain Coordination Efficiency	3.20	Agree	2
Supply Chain Risk management Capability	3.21	Agree	1
Supply Chain Innovation Capability	3.19	Agree	3
Grand Composite Mean	**3.20**	**Agree**	

Legend:3.50-4.00=Strongly Agree;2.50-3.49=Agree;1.50-2.49=Disagree;1.00-1.49=Strongly Disagree

The supply chain coordination efficiency, supply chain risk management capability, and supply chain innovation capability composite mean scores are displayed in Table 2 for the three main outcome categories in the process of supply chain collaboration. These indicators show that, on the whole, respondents have assessed each area's performance and believe it to be highly important for supply chain collaboration. The supply chain's competitiveness and smooth operation are dependent on these critical areas, as these findings collectively show that businesses and organizations must prioritize.

Supply chain risk management capability scored the highest, with a mean of 3.21, indicating that enterprises and organizations prioritize risk management capability in supply chain cooperation. Supply chain risk management involves not only identifying and assessing potential supply chain disruption risks but also developing and implementing strategies to ensure the continuity and stability of the supply chain. Studies have shown that supply chain risk management capability is a critical factor in maintaining supply chain resilience and reducing uncertainty.

Yang (2020) evaluates the antecedents and consequences of supply chain risk management capabilities, indicating that matching information processing capacities with requirements enhances supply chain risk management capabilities, thus improving supply chain resilience. Um (2020) explores the relationships between global supply chain risks, supply chain resilience, and mitigating strategies, emphasizing the critical role of supply chain resilience capability in addressing risks.

Supply chain coordination efficiency, with a mean of 3.20, ranks second. Supply chain coordination efficiency reflects the collaboration and coordination between different segments of the supply chain, which is another important factor that enterprises focus on in supply chain cooperation. Efficient supply chain coordination can reduce redundancy and waste, improving the overall operational efficiency of the supply chain, thereby enhancing the market competitiveness of enterprises.

Shaban (2019). proposes a new efficient collaboration model (IS-OUT) for multi-echelon supply chains. This model improves the transmission mechanism of order information, optimizing supply chain coordination and resource allocation, reducing inventory and transportation costs, and enhancing overall supply chain efficiency. Johari (2019). proposes a model for gaining competitive advantage through coordinating social welfare, recycling, and pricing decisions in the supply chain. The results show that the two-part tariff contract can simultaneously enhance environmental, economic, and social performance, increasing profits for supply chain members and consumer surplus.

Supply chain innovation capability scored 3.19, slightly lower than supply chain coordination efficiency. Supply chain innovation capability refers to the ability to innovate in technology, processes, and management within the supply chain, which is crucial for maintaining competitiveness in a rapidly changing market environment. Highly innovative supply chains can help enterprises continuously optimize supply chain processes, introduce new technologies and methods, and improve overall operational efficiency and flexibility.

Dai (2022) analyzes the supply chain innovation capabilities of Chinese manufacturing enterprises and their impact on firm performance, finding that supply chain innovation capabilities significantly enhance market competitiveness and sustainability. Sabahi (2020) finds that innovation capability significantly enhances firm resilience to supply chain disruptions through knowledge sharing, agility, and flexibility, thereby improving overall supply chain performance. The key result areas of supply chain risk management capability, supply chain coordination efficiency, and supply chain innovation

capability in supply chain cooperation have received high ratings, indicating that respondents generally agree on the importance of these factors.

Specifically, supply chain risk management capability is crucial for enterprises to handle supply chain disruptions and uncertainties, and effective risk identification and response strategies can enhance supply chain resilience and continuity. Supply chain coordination efficiency emphasizes the collaboration and cooperation between segments, improving overall operational efficiency and response speed through information sharing and resource optimization. Supply chain innovation capability focuses on continuous innovation in technology and management to address market changes and enhance competitiveness.

When it comes to supply chain management, Huawei prioritizes risk management. To guarantee stability and continuity, it has put in place extensive risk detection and response process. Through informatization and effective coordination methods, Huawei also reduces waste and redundancy while increasing coordination efficiency. In order to keep its competitive edge in the market, Huawei lastly aggressively fosters technical innovation throughout the supply chain by consistently implementing cutting-edge management techniques and technology.

Table 3
Summary Table on Market Demand

Key Result Areas	Composite Mean	VI	Rank
Accuracy of Market Demand Forecasting	3.22	Agree	1
Speed of Market Demand Response	3.19	Agree	2
Customer Demand Diversity	3.18	Agree	3
Grand Composite Mean	**3.20**	**Agree**	

Legend:3.50-4.00=Strongly Agree;2.50-3.49=Agree;1.50-2.49=Disagree;1.00-1.49=Strongly Disagree

The composite mean ratings for the three main outcome categories in the market demand management process—accuracy of demand forecasting, quickness of response to market demand, and diversity of customer demand—are shown in Table 3. These indicators show that respondents have assessed the effectiveness of each area and believe that these areas are generally very important in managing market demand. All things considered, these findings suggest that businesses and organizations should concentrate on these crucial areas in order to guarantee precise market demand forecasting, quick reaction to market developments, and satisfying a variety of client wants, all of which will increase market competitiveness.

Accuracy of market demand forecasting scored the highest, with a mean of 3.22, indicating that enterprises and organizations prioritize the accuracy of demand forecasting in market demand management. Accurate market demand forecasting helps enterprises formulate reasonable production plans and inventory management strategies, thereby avoiding resource waste and cost increases due to supply-demand mismatches. Studies have shown that the accuracy of market demand forecasting is a key factor for enterprises to optimize operations and improve customer satisfaction.

Jung (2020) performs deep learning-based production forecasting analysis using Long Short-Term Memory (LSTM) networks, providing references for sales target setting, facility investment, production planning, inventory control, supply chain management, and marketing strategy establishment.

Speed of market demand response, with a mean of 3.19, ranks second. The speed of market demand response reflects the ability of enterprises to react quickly to changes in market demand, which is a key factor in maintaining flexibility and adaptability in market competition. Efficient market demand response helps enterprises quickly meet customer needs, increase market share, and improve customer satisfaction. Di (2020) explores product logistics cost control strategies based on multi-source supply chain theory. It finds that optimizing supply chain structures enhances a company's ability to respond to market changes and improves overall competitiveness.

Customer demand diversity scored 3.18, slightly lower than the speed of market demand response. Customer demand diversity refers to the varied needs of different customer groups in the market, which is an important factor for enterprises to consider in product and service development. Meeting diverse customer needs helps enterprises expand market share, enhance customer loyalty, and improve market competitiveness. Tjahjaningsih (2020) examines the impact of service quality and product diversity on customer loyalty, finding that both service quality and product diversity positively influence customer loyalty through the mediation of customer satisfaction and word-of-mouth.

In summary, the key result areas of accuracy of market demand forecasting, speed of market demand response, and customer demand diversity in market demand management have received high ratings, indicating that respondents generally agree on the importance of these factors. Specifically, accuracy of market demand forecasting is the foundation for enterprises to formulate production and inventory management strategies, helping to optimize operations and improve customer satisfaction. The speed of market demand response emphasizes the ability of enterprises to react quickly to market changes by optimizing supply chain management and internal coordination, thereby increasing market share and customer satisfaction. Customer demand diversity is crucial in product and service development, helping enterprises meet diverse customer needs, expand market share, and improve customer loyalty and market competitiveness.

In order to increase accuracy in market demand forecasting and hence optimize supply chain management and production planning, Huawei uses sophisticated data analysis and forecasting algorithms. Additionally, Huawei establishes flexible supply chain management systems and quick reaction mechanisms to quickly fulfill customer demands and market changes, thereby improving the pace of market demand response. In order to improve market competitiveness and customer satisfaction, Huawei also focuses on studying the diversity of customer demand, examining the requirements and preferences of various client groups, and developing focused marketing strategies and plans for new product development.

Table 4
Relationship Between Technological Upgrading and Supply Chain Cooperation

Variables	rho	p-value	Interpretation
Technology Maturity			
Supply Chain Coordination Efficiency	0.478**	< .001	Highly Significant
Supply Chain Risk management Capability	0.435**	< .001	Highly Significant
Supply Chain Innovation Capability	0.443**	< .001	Highly Significant
Technology Adaptability			
Supply Chain Coordination Efficiency	0.44**	< .001	Highly Significant
Supply Chain Risk management Capability	0.398**	< .001	Highly Significant
Supply Chain Innovation Capability	0.426**	< .001	Highly Significant
Cost-effectiveness of Technology			
Supply Chain Coordination Efficiency	0.438**	< .001	Highly Significant
Supply Chain Risk management Capability	0.478**	< .001	Highly Significant
Supply Chain Innovation Capability	0.506**	< .001	Highly Significant

**. Correlation is significant at the 0.01 level

Table 4 presents the relationship between technological upgrading and supply chain cooperation. Specifically, it analyzes the impact of three dimensions of technological upgrading—technology maturity, technology adaptability, and cost-effectiveness of technology—on three key areas of supply chain cooperation: supply chain coordination efficiency, supply chain risk management capability, and supply chain innovation capability. The correlation coefficients (rho) and significance levels (p-value) show the extent and significance of the impact of different technological dimensions on key

areas of supply chain cooperation. These data indicate that different aspects of technological upgrading play a crucial role in supply chain management and can significantly improve various aspects of supply chain efficiency and capability.

In the technology maturity dimension, the correlation coefficient for supply chain coordination efficiency is the highest at 0.478, indicating a significant positive impact of technology maturity on supply chain coordination efficiency. This means that when a company's technology maturity is high, the collaboration and coordination among different segments of the supply chain will significantly improve. Tseng (2020) proposes an eco-efficient sustainable service supply chain management hierarchical model based on qualitative information and quantitative data, finding that technology and information management play key roles in enhancing supply chain stability and efficiency.

In the technology adaptability dimension, the correlation coefficient for supply chain coordination efficiency is 0.44, also indicating a significant impact of technology adaptability on supply chain coordination efficiency. Di (2020) analyzes product logistics cost control strategies based on multi-source supply chain theory, finding that efficient supply chain design optimization strategies help companies quickly respond to market changes and improve overall supply chain efficiency.They found that highly adaptable technologies can quickly respond to changes in market demand, optimize supply chain management, and improve overall operational efficiency.

In the cost-effectiveness of technology dimension, the correlation coefficient for supply chain coordination efficiency is 0.438, also showing a significant impact of cost-effectiveness of technology on supply chain coordination efficiency. By adopting cost-effective technologies, companies can optimize resource allocation, reduce waste, and enhance supply chain efficiency. This study examines the impact of strategic alliances of core technologies on resource optimization and efficiency improvement in emerging technology supply chains (Wang, 2023). Cost-effectiveness of technology helps companies reduce operational costs and improve supply chain coordination efficiency. They found that by adopting cost-effective technologies, companies can optimize resource allocation, reduce redundancy and waste, and improve overall supply chain efficiency and effectiveness.

In the technology maturity dimension, the correlation coefficient for supply chain innovation capability is 0.443, indicating a significant positive impact of technology maturity on supply chain innovation capability. Companies with high technology maturity can achieve technological innovation, optimize supply chain processes, and improve flexibility and adaptability, thereby gaining a competitive advantage. Sabina (2023) discusses the use of the latest IT technologies in logistics and their impact on enterprise competitiveness. Technology maturity drives supply chain innovation and enhances market competitiveness. They found that companies with high technology maturity are more likely to achieve technological innovation, optimize supply chain processes, and improve flexibility and adaptability, thereby gaining a competitive advantage in the market.

In the technology adaptability dimension, the correlation coefficient for supply chain innovation capability is 0.426, showing a significant impact of technology adaptability on supply chain innovation capability. Mao (2024) shows that highly adaptable technologies in the proposed marketing supply chain management model based on SICAS modeling help enhance supply chain innovation capability and allow for quick responses to market and customer demand. They found that highly adaptable technologies help companies quickly adapt to market changes, introduce new management methods and technologies, and enhance supply chain innovation capability.

In the cost-effectiveness of technology dimension, the correlation coefficient for supply chain innovation capability is the highest at 0.506, indicating a significant positive impact of cost-effectiveness of technology on supply chain innovation capability. Ghani (2024) analyses that by adopting cost-effective Industry 4.0 technologies like IoT, Big Data, and AI, companies can optimize resource allocation, drive supply chain innovation, and enhance overall competitiveness.They found that by adopting cost-effective technologies, companies can achieve optimal resource allocation, drive supply chain innovation, and enhance overall competitiveness.

In summary, the three dimensions of technological upgrading—technology maturity, technology adaptability, and cost-effectiveness of technology—have significant impacts on various key areas of supply chain cooperation. Technology maturity can improve supply chain coordination efficiency and innovation capability. Technology adaptability helps enhance supply chain flexibility and responsiveness, while cost-effectiveness of technology significantly promotes supply chain coordination and innovation. By improving these technological dimensions, enterprises can achieve higher efficiency, flexibility, and innovation capability in supply chain management, thereby maintaining a competitive edge in the market.

Enhancing technology maturity has helped Huawei become more innovative and capable of managing supply chains. Improving technology adaptability has made supply chains more flexible and responsive to market changes. Finally, by emphasizing cost-effectiveness, Huawei has optimized resource allocation and fostered ongoing innovation in the supply chain.

Table 5
Relationship Between Technological Upgrading and Market Demand

Variables	rho	p-value	Interpretation
Technology Maturity			
Accuracy of Market Demand Forecasting	0.420**	< .001	Highly Significant
Speed of Market Demand Response	0.476**	< .001	Highly Significant
Customer Demand Diversity	0.436**	< .001	Highly Significant
Technology Adaptability			
Accuracy of Market Demand Forecasting	0.427**	< .001	Highly Significant
Speed of Market Demand Response	0.418**	< .001	Highly Significant
Customer Demand Diversity	0.521**	< .001	Highly Significant
Cost-effectiveness of Technology			
Accuracy of Market Demand Forecasting	0.449**	< .001	Highly Significant
Speed of Market Demand Response	0.481**	< .001	Highly Significant
Customer Demand Diversity	0.452**	< .001	Highly Significant

**. Correlation is significant at the 0.01 level

Table 5 presents the relationship between technological upgrading and market demand. Specifically, it analyzes the impact of three dimensions of technological upgrading—technology maturity, technology adaptability, and cost-effectiveness of technology—on the accuracy of market demand forecasting, speed of market demand response, and customer demand diversity. The correlation coefficients (rho) and significance levels (p-value) show the extent and significance of the impact of different technological dimensions on key areas of market demand management. These data indicate that different aspects of technological upgrading play a crucial role in market demand management and can significantly improve the accuracy of market demand forecasting, response speed, and the ability to meet diverse customer needs.

In the technology maturity dimension, the correlation coefficient for the accuracy of market demand forecasting is 0.420, indicating a significant positive impact of technology maturity on the accuracy of market demand forecasting. This means that when a company's technology maturity is high, the accuracy of market demand forecasting will significantly improve. Wiljohn (2024) employs advanced forecasting models in the web-based ordering system for start-up businesses, enhancing demand forecasting precision, optimizing stock levels, and ensuring product availability. The higher the technology maturity, the better a company can utilize advanced forecasting models and algorithms to increase the precision of market demand forecasting.

In the technology adaptability dimension, the correlation coefficient for the accuracy of market demand forecasting is 0.427, also indicating a significant impact of technology adaptability on the accuracy of market demand forecasting. Zhang (2023) proposes a data-driven optimization method for supply chain management accounting demand forecasting by utilizing a mutual information filtering method for feature extraction of market demand, Support Vector Machine (SVM) for forecasting, and the improved Satin Bowerbird Optimization (ISBO) algorithm to optimize forecasting models, leading to improved forecasting accuracy and enhanced supply chain management. They found that highly adaptable technologies can quickly respond to changes in market demand, optimize demand forecasting models, and improve forecasting accuracy.

In the cost-effectiveness of technology dimension, the correlation coefficient for the accuracy of market demand forecasting is 0.449, the highest among the three dimensions, indicating a significant positive impact of cost-effectiveness of technology on the accuracy of market demand forecasting. Taseen (2023) explores the integration of AI technologies in the renewable energy supply chain, significantly improving the accuracy of demand forecasting and optimizing resource allocation, thus reducing costs, minimizing waste, and increasing efficiency. They found that by adopting cost-effective technologies, companies can optimize resource allocation, reduce redundancy and waste, and increase the efficiency and accuracy of demand forecasting.

In the technology maturity dimension, the correlation coefficient for customer demand diversity is 0.436, indicating a significant positive impact of technology maturity on customer demand diversity. Volianska-Savchuk (2023) proposes that "DIGITALIZATION" is considered a powerful factor in ensuring the high competitiveness of the enterprise by accelerating scientific and technological progress and innovative management methods through the development of digitalization processes. They found that companies with high technology maturity are more likely to achieve technological innovation, develop diverse products and services to meet different customer groups' needs, and thereby gain a competitive advantage in the market.

In the technology adaptability dimension, the correlation coefficient for customer demand diversity is the highest at 0.521, indicating a significant positive impact of technology adaptability on customer demand diversity. Bolatan (2022) explores how companies maintain competitiveness through the adoption and adaptation of new technologies. It shows that highly adaptable technologies help companies quickly adapt to market changes, develop diverse products and services to meet different customer groups' needs, thereby enhancing customer satisfaction and market competitiveness. They found that highly adaptable technologies help companies quickly adapt to market changes, develop diverse products and services to meet different customer groups' needs, and enhance customer satisfaction and market competitiveness.

In the cost-effectiveness of technology dimension, the correlation coefficient for customer demand diversity is 0.452, also indicating a significant positive impact of cost-effectiveness of technology on customer demand diversity. Lopatovska (2023) analyzes innovative cost management methods in the modern business environment. It finds that by adopting innovative cost management technologies, companies can achieve optimal resource allocation, develop diverse products and services to meet different customer groups' needs, and enhance market competitiveness.They found that by adopting cost-effective technologies, companies can achieve optimal resource allocation, develop diverse products and services to meet different customer groups' needs, and enhance market competitiveness.

In summary, the three dimensions of technological upgrading—technology maturity, technology adaptability, and cost-effectiveness of technology—have significant impacts on various key areas of market demand management. Technology maturity can improve the accuracy of market demand forecasting and the ability to meet customer demand diversity. Technology adaptability helps enhance the accuracy of market demand forecasting, response speed, and the ability to meet customer demand diversity. Cost-effectiveness of technology significantly promotes the accuracy of market demand forecasting, response speed, and the ability to meet customer demand diversity. By improving these

technological dimensions, enterprises can achieve higher accuracy, flexibility, and innovation capability in market demand management, thereby maintaining a competitive edge in the market.

Huawei's increased technological maturity has allowed it to better predict market demand and accommodate a wider range of consumer demands. It has improved technology adaptability to fulfill a variety of client needs by increasing the accuracy of market demand forecasts and response time. By emphasizing technology's cost-effectiveness, it has improved resource allocation and boosted market demand forecasting's accuracy and response time.

Table 6
Relationship Between Supply Chain Cooperation and Market Demand

Variables	rho	p-value	Interpretation
Supply Chain Coordination Efficiency			
Accuracy of Market Demand Forecasting	0.498**	< .001	Highly Significant
Speed of Market Demand Response	0.468**	< .001	Highly Significant
Customer Demand Diversity	0.480**	< .001	Highly Significant
Supply Chain Risk management Capability			
Accuracy of Market Demand Forecasting	0.456**	< .001	Highly Significant
Speed of Market Demand Response	0.432**	< .001	Highly Significant
Customer Demand Diversity	0.446**	< .001	Highly Significant
Supply Chain Innovation Capability			
Accuracy of Market Demand Forecasting	0.443**	< .001	Highly Significant
Speed of Market Demand Response	0.448**	< .001	Highly Significant
Customer Demand Diversity	0.499**	< .001	Highly Significant

**. Correlation is significant at the 0.01 level

Table 6 presents the relationship between supply chain cooperation and market demand. Specifically, it analyzes the impact of three dimensions of supply chain cooperation—supply chain coordination efficiency, supply chain risk management capability, and supply chain innovation capability—on the accuracy of market demand forecasting, speed of market demand response, and customer demand diversity. The correlation coefficients (rho) and significance levels (p-value) show the extent and significance of the impact of different supply chain cooperation dimensions on key areas of market demand management. These data indicate that different aspects of supply chain cooperation play a crucial role in market demand management and can significantly improve the accuracy of market demand forecasting, response speed, and the ability to meet diverse customer needs.

In the supply chain coordination efficiency dimension, the correlation coefficient for the accuracy of market demand forecasting is 0.498, indicating a significant positive impact of supply chain coordination efficiency on the accuracy of market demand forecasting. This means that when a company’s supply chain coordination efficiency is high, the accuracy of market demand forecasting will significantly improve. Haque (2023) conducts a comparative study for multivariate time series in retail demand forecasting. It shows that improving supply chain coordination efficiency can enhance the precision of market demand forecasting through more accurate models. They noted that mature supply chain coordination systems could provide more accurate and real-time data support,

helping companies conduct more effective demand forecasting and decision-making. By improving supply chain coordination efficiency, companies can better respond to market changes, accurately predict future demand, and optimize production and inventory management strategies.

In the supply chain risk management capability dimension, the correlation coefficient for the accuracy of market demand forecasting is 0.456, also indicating a significant impact of supply chain risk management capability on the accuracy of market demand forecasting. Kilimci (2019) developed an improved demand forecasting model combining deep learning methods and decision integration strategy to optimize demand forecasting in supply chains. The study demonstrates that highly capable risk management supply chains can quickly respond to market demand changes, optimize demand forecasting models, and improve forecasting accuracy. They found that highly capable risk management supply chains can quickly respond to changes in market demand, optimize demand forecasting models, and improve forecasting accuracy.

In the supply chain innovation capability dimension, the correlation coefficient for the accuracy of market demand forecasting is 0.443, indicating a significant impact of supply chain innovation capability on the accuracy of market demand forecasting. Sardar (2021) proposed a smart supply chain management method combining machine learning and RFID technology to improve demand forecasting accuracy. It shows that by adopting innovative supply chain technologies, companies can optimize resource allocation, reduce waste, and increase the efficiency and accuracy of demand forecasting. They found that by adopting innovative supply chain technologies and methods, companies can optimize resource allocation, reduce redundancy and waste, and increase the efficiency and accuracy of demand forecasting.

In the supply chain coordination efficiency dimension, the correlation coefficient for customer demand diversity is 0.480, indicating a significant positive impact of supply chain coordination efficiency on customer demand diversity. Jiménez (2019) investigates the direct impact of information technology (IT) and supply chain collaboration on product innovation in a competitive global business environment. The findings show that supply chain collaboration significantly fosters technological innovation, enhancing the company's ability to develop diverse products and services to meet different customer needs, thereby gaining a competitive advantage in the market.They found that companies with high supply chain coordination efficiency are more likely to achieve technological innovation, develop diverse products and services to meet different customer groups' needs, and thereby gain a competitive advantage in the market.

In the supply chain risk management capability dimension, the correlation coefficient for customer demand diversity is 0.446, indicating a significant impact of supply chain risk management capability on customer demand diversity. José (2023) discusses risk management and decision-making in supply chain management, emphasizing that effective supply chain management can enhance a company's ability to adapt to market changes, increase efficiency, and reduce costs by adjusting logistics, production capacity, and service offerings, thereby improving customer satisfaction and market competitiveness.They found that highly capable risk management supply chains help companies quickly adapt to market changes, develop diverse products and services to meet different customer groups' needs, and enhance customer satisfaction and market competitiveness.

In the supply chain innovation capability dimension, the correlation coefficient for customer demand diversity is the highest at 0.499, indicating a significant positive impact of supply chain innovation capability on customer demand diversity. Kovács (2019) shows that with the increase in population, customer consumption, and global market competition, natural resources are depleting and environmental damage is increasing. This study develops a global supply chain optimization method, including single-objective and multi-objective optimization to achieve efficient and sustainable operations. The study demonstrates that using this method, supply chain members can effectively meet sustainability design constraints, thus achieving profitable and sustainable global supply chain optimization.

Companies should focus on enhancing innovation capability in supply chain management to ensure sustained innovation and optimization in market demand management, enhancing market competitiveness. By improving supply chain innovation capability, companies can better develop diverse product portfolios, meet diverse customer needs, and enhance customer satisfaction and market competitiveness.

In summary, the three dimensions of supply chain cooperation—supply chain coordination efficiency, supply chain risk management capability, and supply chain innovation capability—have significant impacts on various key areas of market demand management. Supply chain coordination efficiency can improve the accuracy of market demand forecasting and the ability to meet customer demand diversity. Supply chain risk management capability helps enhance the accuracy of market demand forecasting, response speed, and the ability to meet customer demand diversity. Supply chain innovation capability significantly promotes the accuracy of market demand forecasting, response speed, and the ability to meet customer demand diversity. By improving these dimensions of supply chain cooperation, enterprises can achieve higher accuracy, flexibility, and innovation capability in market demand management, thereby maintaining a competitive edge in the market.

Through increased supply chain coordination efficiency, Huawei has increased the accuracy of its market demand forecasts and its capacity to satisfy a wide range of client demands. It has improved supply chain risk management capability, increasing the accuracy of market demand forecasts and response time to satisfy a variety of client needs. By emphasizing supply chain innovation capacity, it has improved resource allocation and boosted the precision and responsiveness of market demand forecasting.

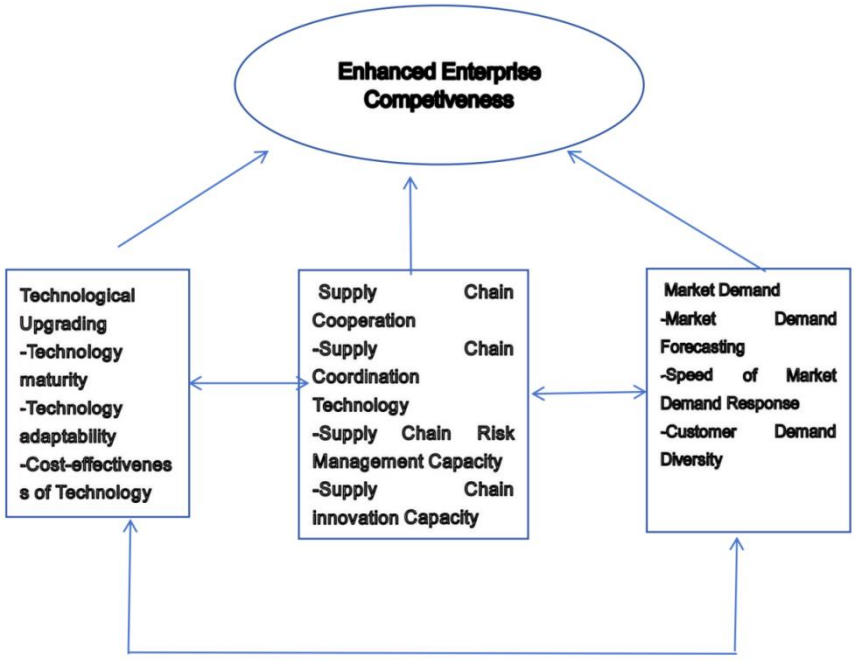

Figure 1. An Enhanced Enterprise Competition Framework

This Figure illustrates a framework for enhancing enterprise competitiveness, covering three main aspects: technological upgrading, supply chain cooperation, and market demand. This framework aims to enhance overall enterprise competitiveness by improving technology maturity and adaptability, optimizing supply chain management, and quickly responding to market demands. Enterprises need to continuously innovate and improve their technology and management strategies to maintain a competitive edge in a rapidly changing market environment and increasingly fierce competition. By integrating these key factors, businesses can better respond to market changes, improve operational efficiency and customer satisfaction, thereby gaining a competitive advantage in the global market.

Technological upgrading forms the foundation for enhancing enterprise competitiveness, including technology maturity, technology adaptability, and the cost-effectiveness of technology. Krupa (2024)suggests that the use of artificial intelligence and a digital database is the most optimal tactical solution for improving the technical and technological support for personnel management in a modern rural enterprise. Through digital transformation, enterprise competitiveness is significantly enhanced.

Technology maturity refers to the stability and reliability of technology in practical applications, where highly mature technology can significantly improve production efficiency and product quality. Furthermore, technology adaptability is the ability of enterprises to quickly adjust and apply new technologies according to market demands. Highly adaptable technology helps enterprises respond more flexibly to market changes, thereby enhancing competitiveness. Additionally, the cost-effectiveness of technology refers to maintaining high performance while controlling the costs of technology implementation, which is crucial for the long-term development of enterprises. Reasonable technology investment can improve productivity while reducing operating costs, thereby enhancing the market competitiveness of enterprises.

Supply chain cooperation is another key factor in enhancing enterprise competitiveness, including supply chain coordination, supply chain risk management capacity, and supply chain innovation capacity. Supply chain coordination refers to the effective communication and collaboration between enterprises and various links in the supply chain to ensure optimal resource allocation and efficient operation. Good supply chain coordination can significantly improve the overall efficiency of the supply chain and reduce operating costs. Supply chain risk management capacity is the ability of enterprises to respond to potential risks in the supply chain. Effective supply chain risk management helps enterprises quickly recover from supply chain disruptions or fluctuations, thereby maintaining competitiveness. Furthermore, supply chain innovation capacity refers to the introduction of new technologies and methods in supply chain management to improve efficiency and competitiveness. Yudi (2022) investigates the direct and indirect effects of information system security practices on the relationship between cyber supply chain risk management and supply chain performance in the Industry 4.0 era. Innovative supply chain management models can enhance the responsiveness and adaptability of the supply chain, thereby enhancing the market competitiveness of enterprises.

Market demand is the third important aspect of enhancing enterprise competitiveness, including market demand forecasting, market demand response speed, and customer demand diversity. Market demand forecasting is the ability of enterprises to predict future demand based on market trends and data analysis, which is crucial for formulating production and sales strategies. Gabdulin (2022) explores the importance of market demand forecasting using data mining methods under the development of the digital economy and high external environment uncertainty. The method, which involves building decision trees, has universal applicability across various industries, enabling enterprises to achieve target market shares by altering consumer product characteristics.Accurate market demand forecasting can help enterprises optimize inventory management and reduce inventory costs. Market demand response speed is the ability of enterprises to quickly respond to market changes. A fast market response can help enterprises seize market opportunities and increase market share. Customer demand diversity refers to the ability of enterprises to meet the diverse needs of different customer groups, which is important for enhancing customer satisfaction and loyalty. Diversified products and services can meet the needs of different customers, thereby enhancing the market competitiveness of enterprises.

By integrating the key factors of technological upgrading, supply chain cooperation, and market demand, the framework for enhancing enterprise competitiveness provides a systematic solution to help enterprises gain a competitive advantage in the global market. This framework can not only improve the overall operational efficiency and customer experience of enterprises but also enhance their innovation capabilities and market responsiveness. In the future, with the development of technology and changes in the market, this framework may further evolve and improve, but its core goal—enhancing enterprise competitiveness—will remain unchanged. Enterprises need to

continuously innovate and optimize their management strategies to adapt to dynamic market changes and stand out in fierce competition.

6. CONCLUSION AND RECOMMENDATIONS

This study proposes a comprehensive framework to help manufacturing enterprises in Guangdong Province enhance their competitiveness by exploring the relationships among technological upgrading, supply chain cooperation, and market demand. This framework provides theoretical guidance and practical references for enterprises to maintain and enhance competitiveness in a fiercely competitive market.

A comprehensive enhancement framework integrates technological upgrading, supply chain cooperation, and market demand response, providing a systematic solution for enterprises. Technological upgrading is the foundation for enhancing enterprise competitiveness; high maturity and adaptability of technology significantly improve production efficiency and product quality. Supply chain cooperation optimizes resource allocation and improves overall efficiency, providing significant competitive advantages for enterprises. Accurate and rapid market demand forecasting and response are crucial for success in competitive markets. An integrated framework considering technology, supply chain, and market demand helps enterprises maintain flexibility and adaptability in dynamic market environments.

Increase investment in technology research and application to improve production efficiency and product quality. Strengthen coordination and cooperation across supply chain links, establishing an efficient supply chain management system. Enhance market demand forecasting and analysis capabilities to quickly respond to market changes. Continuously optimize management strategies and operational models to maintain leadership in technology, supply chain, and market response. Focus on customer feedback and needs, establishing a comprehensive customer relationship management system to increase customer satisfaction and loyalty.

REFERENCES

[1] Baig, H., Ahmed, W., & Najmi, A. (2021). Understanding influence of supply chain collaboration on innovation-based market performance. *International Journal of Innovation Science.* https://doi.org/10.1108/ijis-03-2021-0054

[2] Bayraktar, E., Sari, K., Tatoğlu, E., Zaim, S., & Delen, D. (2020). Assessing the supply chain performance: a causal analysis. *Annals of Operations Research, 287, 37-60.* DOI: 10.1007/s10479-019-03457-y

[3] Bolatan, G. I., Giadedi, A., & Daim, T. (2022). Exploring Acquiring Technologies: Adoption, Adaptation, and Knowledge Management. *IEEE Transactions on Engineering Management, PP, 1-9.* https://doi.org/10.1109/TEM.2022.3168901

[4] Bu, H., Ouyang, L., & Shi, N. (2022). The influence of entrepreneurial growth stage on entrepreneurial performance of high-tech enterprises in the context of 5G. *2022 3rd International Conference on Electronics, Communications and Information Technology (CECIT), 316-322.* https://doi.org/10.1109/CECIT58139.2022.00062

[5] Coghlan, C., Labrecque, J., Ma, Y., & Dubé, L. (2020). A Biological Adaptability Approach to Innovation for Small and Medium Enterprises (SMEs): Strategic Insights from and for Health-Promoting Agri-Food Innovation. *Sustainability, 12(10), 4227.* DOI: 10.3390/su12104227

[6] Dai, X. (2022). Supply Chain Relationship Quality and Corporate Technological Innovations: A Multimethod Study. *Sustainability.* https://doi.org/0.3390/su14159203

[7] Di, C. (2020). Research on the Product Logistics Cost Control Strategy based on the Multi-source Supply Chain Theory. *Intelligent Automation and Soft Computing.* https://doi.org/10.31209/2020.100000173

[8] Erdoğan, S. (2021). Dynamic nexus between technological innovation and buildings sector's carbon emission in BRICS countries. *Journal of Environmental*

[9] Gabdulin, R. R., Lyaskovskaya, E., Korovin, A. M., & Rets, E. A. (2022). Forecasting demand in the market of road construction equipment using data mining. *Bulletin of the South Ural State University. Ser. Computer Technologies, Automatic Control & Radioelectronics.* https://doi.org/10.14529/ctcr220311

[10] Ghani, A. S. (2024). Revolutionizing Supply Chains: A Comprehensive Study of Industry 4.0 Technologies (IoT, Big Data, AI, etc.). *International Journal of Supply Chain Management, 3(4), 37-49.* https://doi.org/10.55041/ijsrem30037

[11] Haque, M. S., Amin, M. S., & Miah, J. (2023). Retail Demand Forecasting: A Comparative Study for Multivariate Time Series. *ArXiv.* https://doi.org/ 10.48550/arXiv.2308.11939

[12] Hassani, Y., Ceaușu, I., & Iordache, A. (2020). Lean and Agile model implementation for managing the supply chain. *Proceedings of the International Conference on Business Excellence.* https://doi.org/10.2478/picbe-2020-0081

[13] Johari, M., & Hosseini-Motlagh, S. M. (2019). Coordination of social welfare, collecting, recycling and pricing decisions in a competitive sustainable closed-loop supply chain: a case for lead-acid battery. *Annals of Operations Research.* https://doi.org/10.1007/s10479-019-03292-1

[14] Jiménez-Jiménez, D., Martínez-Costa, M., & Sánchez-Rodríguez, C. (2019). The mediating role of supply chain collaboration on the relationship between information technology and innovation. *Journal of Knowledge Management, 23(3), 548-567.* https://doi.org/10.1108/JKM-01-2018-0019

[15] Jung, H., & Park, S. (2020). A Study on the Deep Learning based Prediction of Production Demand by using LSTM under the State of Data Sparsity. *IOP Conference Series: Materials Science and Engineering, 926.* https://doi.org/10.1088/1757-899X/926/1/012031

[16] Khan, M. A., Saqib, S., Alyas, T., Rehman, A. U., Saeed, Y., Zeb, A., Zareei, M., & Mohamed, E. M. (2020). Effective Demand Forecasting Model Using Business Intelligence Empowered With Machine Learning. *IEEE Access.* https://doi.org/ 10.1109/ACCESS.2020.3003790

[17] Kilimci, Z. H., Akyuz, A., Uysal, M., Akyokuş, S., Uysal, M., Bulbul, B., & Ekmis, M. A. (2019). An improved demand forecasting model using deep learning approach and proposed decision integration strategy for supply chain. *Complexity.* https://doi.org/10.1155/2019/9067367

[18] Kovács, G., & Illés, B. (2019). Development of an Optimization Method and Software for Optimizing Global Supply Chains for Increased Efficiency, Competitiveness, and Sustainability. *Sustainability.* https://doi.org/ 10.3390/SU11061610

[19] Krupa, V., Oliinyk, I., Bazaka, R., Shtangret, A., & Sylkin, O. (2024). Technical And Technological Support for Personnel Management: Digital Transformation of Enterprise Competitiveness Through Artificial Intelligence. *International Journal of Operations Research, 16(2), 123-134.* https://doi.org/10.61707/d400cc80

[20] Li, J., Li, Z., Lin, R., & Chen, Z. (2021). The Technological Innovation, the Industrial Structure Upgrading and the Total Factor Productivity. *2021 2nd International Conference on Big Data Economy and Information Management (BDEIM), 106-109.* https://doi.org/ 10.1109/BDEIM55082.2021.00030

[21] Ling, D., Lynd, L., Harrison, M., Anis, A., & Bansback, N. (2019). Early cost-effectiveness modeling for better decisions in public research investment of personalized medicine technologies. *Journal of Comparative Effectiveness Research, 8(1), 7-19.* https://doi.org/10.2217/cer-2018-0033

[22] Lopatovska, O., & Ostrovskaya, O. (2023). Innovative Methods of Cost Management in Modern Business Conditions. *Herald of Khmelnytskyi National University. Economic sciences.* https://doi.org/10.31891/2307-5740-2023-322-5-37

[23] Mahyuni, L., Adrian, R., Darma, G., Krisnawijaya, N., & Dewi, I. G. A. A. P. (2020). Mapping the potentials of blockchain in improving supply chain performance. *Cogent Business & Management.* https://doi.org/10.1080/23311975.2020.1788329

[24] Mao, R., Liu, Y., & Yang, Y. (2024). Innovation of Marketing Supply Chain Management Model Based on SICAS Modeling. *Applied Mathematical Sciences, 12(4), 123-134.* https://doi.org/10.2478/amns-2024-0124

[25] Obienu, A. C., & Amadin, F. (2020). User acceptance of learning innovation: A structural equation modelling based on the GUAM framework. *Education and Information Technologies, 26, 2091-2123.* https://doi.org/ 10.1007/S10639-020-10341-X

[26] Pai, R. R. (2022). Supply Chain Risk Mitigation. *International Series in Operations Research & Management Science.* https://doi.org/ 10.1007/978-3-031-09183-4

[27] Pallant, J., Sands, S., & Karpen, I. (2020). Product customization: A profile of consumer demand. *Journal of Retailing and Consumer Services, 54, 102030.* https://doi.org/ 10.1016/j.jretconser.2019.102030

[28] Perroni, C., Pogrebna, G., Sandford, S., & Scharf, K. (2019). Are Donors Afraid of Core Costs? Economies of Scale and Contestability in Charity Markets. *The Economic Journal.* https://doi.org/ 10.1093/EJ/UEZ006

[29] Qi, N., Zhang, A., & Zhu, Q. (2023). Evolutionary Game of Vertical Cooperation and Innovation between Civilian and Military Enterprises: A Civilian-Military Integration Supply Chain System with Chinese Characteristics. *Complexity, 2023, 9963809.* https://doi.org/10.1155/2023/9963809

[30] Ranjan, R. (2022). Product Innovation and Personalization via Social Media. In Management Strategies for Sustainability, New Knowledge Innovation, and Personalized Products and Services. https://doi.org/ 10.4018/978-1-7998-7793-6.ch012

[31] Sabahi, S., & Parast, M. (2020). Firm innovation and supply chain resilience: a dynamic capability perspective. *International Journal of Logistics Research and Applications, 23(3), 254-269.* https://doi.org/ 10.1080/13675567.2019.1683522

[32] Sabina, S., & Kerimov, B. (2023). The significance of using the latest IT technologies in logistics. *Logistics and Transport, 31(4), 76-88.* https://dx.doi.org/10.53364/24138614_2023_31_4_76

[33] Sardar, S., Sarkar, B., & Kim, B. (2021). Integrating machine learning, radio frequency identification, and consignment policy for reducing unreliability in smart supply chain management. *Processes.* https://doi.org/10.3390/PR9020247

[34] Shan, H., Li, Y., & Shi, J. (2020). Influence of Supply Chain Collaborative Innovation on Sustainable Development of Supply Chain: A Study on Chinese Enterprises. *Sustainability.* https://doi.org/10.3390/su12072978

[35] Syeed, M., Poudel, N., Ngorsuraches, S., Diaz, J., & Chaiyakunapruk, N. (2022). Measurement and valuation of the attributes of innovation of healthcare technologies: a systematic review. *Journal of Medical Economics, 25, 1176-1184.* https://doi.org/10.1080/13696998.2022.2143170

[36] Taseen, M., Yongli, W., & Ali, E. (2023). Integration of Artificial Intelligence for Demand Forecasting and Resource Allocation in Renewable Energy Supply Chains. *IEEE International Conference on Emerging Technologies (INMIC), 17(11), Article 10465757.* https://doi.org/10.1109/INMIC60434.2023.10465757

[37] Tjahjaningsih, E., Ningsih, D. H. U., & Utomo, A. (2020). The Effect of Service Quality and Product Diversity on Customer Loyalty: The Role of Customer Satisfaction and Word of Mouth. *Journal of Asian Finance, Economics and Business, 7, 481-490.* https://doi.org/10.13106/jafeb.2020.vol7.no12.481

[38] Tseng, M., Chen, C.-C., Wu, K.-J., & Tan, R. (2020). Eco-efficient sustainable service supply chain management hierarchical model based on qualitative information and quantitative data. *Management of Environmental Quality: An International Journal, 31, 961-984.* https://doi.org/10.1108/meq-08-2019-0179

[39] Um, J., & Han, N. (2020). Understanding the relationships between global supply chain risk and supply chain resilience: the role of mitigating strategies. *Supply Chain Management: An International Journal.*https://doi.org/ 10.1108/scm-06-2020-0248

[40] Volianska-Savchuk, L., Rudneva, V. Y., & Radishevska, V. V. (2023). Digitalization As A Powerful Factor In Ensuring High Competitiveness Of The Enterprise. *Visnyk of Economics, 68, 84-95.* https://doi.org/10.24025/2306-4420.68.2023.284572

[41] Wang, Y., & Ma, J. (2023). Innovative Research and Development of Strategic Alliance of Core Technologies in The Emerging Technology Supply Chain. *Frontiers in Business, Economics and Management, 8(1), 57-70.* https://dx.doi.org/10.54097/fbem.v8i1.6057

[42] Webster, A., & Gardner, J. (2019). Aligning technology and institutional readiness: the adoption of innovation. *Technology Analysis & Strategic Management, 31(10), 1229-1241.* https://doi.org/10.1080/09537325.2019.1601694

[43] Wei, C.-L., & Ho, C. (2019). Exploring signaling roles of service providers' reputation and competence in influencing perceptions of service quality and outsourcing intentions. *Journal of Organizational and End User Computing, 31(1), 86-109.* DOI: 10.4018/JOEUC.2019010105

[44] Wiljohn, F., Prince, L., Marvile, S., & Estrella, C. J. (2024). Web-based ordering system for Start-UP business with forecasting. *World Journal of Advanced Research and Reviews, 22(3), Article 1721.* https://doi.org/10.30574/wjarr.2024.22.3.1721

[45] Xue, X., Dou, J., & Shang, Y. Y. (2020). Blockchain-driven supply chain decentralized operations - information sharing perspective. *Business Process Management Journal, 27(2), 184-203.* https://doi.org/ 10.1108/bpmj-12-2019-0518

[46] Yang, J., Xie, H., Yu, G., & Liu, M.-Y. (2020). Antecedents and consequences of supply chain risk management capabilities: an investigation in the post-coronavirus crisis. *International Journal of Production Research, 59, 1573-1585.*https://doi.org/ 10.1080/00207543.2020.1856958

[47] Zeebaree, M., Ismael, G., Nakshabandi, O. A., Saleh, S., & Aqel, M. J. (2021). Impact of Innovation Technology in Enhancing Organizational Management. *Journal of Engineering Education Transformations, 38(4), 3970.*https://doi.org/ 10.25115/eea.v38i4.3970

[48] Zhang, L. (2023). A Data-driven Optimization Method for Supply Chain Management Accounting Demand Forecasting. *Proceedings of the ACM International Conference on Machine Learning and Soft Computing, 87(2), Article 3640878.* https://doi.org/10.1145/3640872.3640878

[49] Zhao, Y., & Fang, L. (2022). Resource Allocation for Supply Chains Based on Pareto-Optimal Two-Stage Cross-Efficiency Model. *RAIRO - Operations Research, 56(2), 29-42.* https://dx.doi.org/10.1051/ro/2022029

[50] Zozulov, O., & Tsareva, T. (2022). The system of demand indicators as a factor in the formation of the growth strategy of the enterprise. *Marketing and Digital Technologies.* https://doi.org/10.15276/mdt.6.4.2022.3