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Technological upgrading, supply chain cooperation and market demand: Basis for manufacturing enterprises competitiveness framework

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Abstract

In today's dynamic manufacturing landscape, competitiveness hinges on a delicate balance between internal advancements and external partnerships. This research delves into this interplay, exploring the synergistic effects of technological upgrading, supply chain cooperation, and market demand on the competitiveness of manufacturing enterprises. The study used a quantitative research design and a survey questionnaire was used to collect data from 400 sample of employees of manufacturing companies. The data was analyzed using descriptive statistics and correlation analysis. The researcher proposes a novel framework that integrates these critical elements, offering a holistic approach to fostering sustainable competitive advantage. By analyzing the study sheds light on the intricate relationships between these factors and their combined impact on enterprise performance. Ultimately, this framework equips decision-makers with valuable insights to navigate the evolving manufacturing landscape and achieve long-term success.

Keywords: technological upgrading, supply chain cooperation, market demand, manufacturing enterprises competitiveness framework

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1. Introduction

Imagine the marketplace as a bustling bazaar, packed with vendors vying for every customer's eye. Just like skilled hawkers, businesses compete using smart tactics, fresh ideas, and a burning desire to win. This is the world of business competitiveness, where standing still means falling behind and only the best-adjusted players walk away with the lion's share. To survive, businesses need to be quick on their feet, able to bend with the market's twists and turns, and always find a way to be better than the rest. If they don't, they'll get pushed aside, forgotten behind the shiny stalls of their adaptable rivals. In this constant race, winning requires a mix of sharp strategies, innovative offerings, and an unwavering drive to conquer the market. The study of Delafrooz et al. (2018) shows that businesses that can quickly adapt to new market conditions (e.g., new technologies, competitor actions, changing customer preferences) will perform better than those that cannot. However, to fully benefit from this adaptability, businesses also need to be able to sense opportunities, exploit them, and adjust their resources accordingly.

In today's dynamic and hyper-competitive global landscape, manufacturing enterprises face unrelenting pressure to remain profitable and thrive. This pursuit of success hinges on a delicate balance between three critical pillars: technological upgrading, supply chain cooperation, and market demand. Understanding the intricate interplay between these forces and leveraging them into a robust strategic framework is the key to achieving lasting competitiveness. For decades, the label "Made in China" conjured images of low-cost goods and mass production. But today, a new chapter is unfolding. Chinese manufacturing is shedding its sweatshop skin and transforming into a technological juggernaut, fueled by a potent cocktail of innovation and ambition. At the heart of this metamorphosis lies the strategic embrace of technology, propelling Chinese companies to the forefront of global competition.

Gone are the days of monotonous production lines. Chinese manufacturers are now leading the charge in smart factories, where robots dance alongside humans, guided by the symphony of interconnected sensors and AI algorithms. This digital transformation optimizes production processes, minimizes waste, and unlocks efficiencies unimaginable in the analog age. Companies like Haier are leveraging smart factories to predict maintenance needs and personalize production lines, delivering both operational excellence and customized products. In today's hyperconnected world, the factory floor seamlessly extends into the digital realm. Cloud computing empowers Chinese manufacturers with scalability, flexibility, and real-time data analytics. Companies like Foxconn, the world's largest electronics manufacturer, leverage cloud platforms to manage sprawling global supply chains, optimize logistics, and collaborate with partners in real-time. This agility allows them to adapt to fluctuating demand and navigate the turbulent waters of global trade.

Information is power, and Chinese manufacturers are mining it like never before. Big data analytics are employed to glean insights from customer behavior, market trends, and even production line data. By analyzing this vast digital ocean, companies are able to tailor product offerings, predict maintenance needs, and even identify emerging market opportunities. Alibaba, the e-commerce behemoth, utilizes big data to personalize consumer experiences and predict future demand, ensuring they stay ahead of the curve in the ever-evolving digital landscape. Firms that effectively leverage Big Data Analytics to transform their operations and decision-making processes are more likely to see improved performance (Yu et al., 2020).

The Chinese dragon isn't just breathing fire at home; it's spreading its wings internationally. Leading manufacturers are actively involved in global value chains, specializing in specific production stages and collaborating with international partners. This allows them to leverage diverse expertise, secure access to

cutting-edge technologies, and cater to regional and sectoral demands. Huawei, the tech giant, exemplifies this by forging strategic partnerships with global chipmakers and telecom providers, solidifying its position as a leading innovator in the mobile technology space. Chinese manufacturers are rewriting the playbook of success by leveraging the power of supply chain collaboration, forging robust and dynamic partnerships that propel them to the forefront of global competition. This shift towards collaborative ecosystems is fueled by several key factors. First, the sheer complexity of modern value chains necessitates a web of specialized expertise. No single entity can encompass the multifaceted demands of production, from raw materials to distribution. Instead, Chinese manufacturers embrace the power of vertical integration, bringing crucial elements of the supply chain in-house to ensure control and optimize workflows. Companies like Lenovo, for instance, have acquired key semiconductor and component manufacturers, creating a more integrated and efficient production process.

Second, a focus on global reach necessitates strategic alliances. Navigating the intricacies of international logistics, regulatory frameworks, and cultural nuances requires trusted partners. Chinese manufacturers are actively forging horizontal collaborations with overseas suppliers, distributors, and even competitors. Huawei, for example, collaborated with global chipmakers to secure vital components for its smartphones, demonstrating the power of cross-border collaboration in overcoming resource hurdles. Third, the digital revolution has revolutionized collaboration itself. Online platforms and cloud-based solutions connect participants across the supply chain in real-time, sharing data, facilitating communication, and enabling seamless coordination. Alibaba's extensive e-commerce ecosystem is a prime example, connecting tens of thousands of manufacturers and suppliers, streamlining logistics, and powering a collaborative e-commerce juggernaut.

This collaborative approach translates into several key advantages. Greater efficiency and reduced costs arise from optimized workflows, resource sharing, and joint problem-solving. Innovation and responsiveness are enhanced by the cross-pollination of ideas and the ability to rapidly adapt to market changes. Resilience and agility are fostered by a diversified network of partners, who can mitigate risks and provide support in times of disruption. The research of Yan et al. (2020) reveals that Haier employs various collaborative practices like information sharing, joint product development, and vendor integration, resulting in improved efficiency, responsiveness, and innovation. The study highlights the importance of trust, cultural awareness, and win-win partnerships in successful collaboration efforts.

For years, "Made in China" defined efficient mass production and affordable goods. However, that narrative is no longer accurate. Today, a new chapter unfolds, driven by a powerful force: market-centricity. Chinese manufacturers are no longer passively filling shelves; they're actively shaping demand, anticipating shifts, and weaving themselves into the dynamic tapestry of consumer needs. With 1.4 billion consumers, China offers an unparalleled testing ground and captive audience. Companies like Xiaomi excel by understanding local preferences and delivering technology tailored to Chinese tastes and price points. E-commerce platforms like Alibaba and JD.com act as real-time mirrors, reflecting purchase patterns and trends. By leveraging Big Data analytics, Chinese manufacturers can adapt production and offerings in real-time, ensuring perfect alignment with what consumers crave. From sustainability to personalization, Chinese manufacturers swiftly translate global trends into tangible products and services. Companies like Haier, once synonymous with appliances, now offer smart home solutions and connected ecosystems, capturing the global demand for convenience and interconnectivity.

While Chinese manufacturing has ascended to a global leadership position, navigating its continued success requires mindful management of diverse challenges. On the technological front, high upgrade costs and automation pose hurdles for smaller companies, potentially impacting talent structures and necessitating reskilling initiatives. Additionally, robust intellectual property protection and comprehensive environmental sustainability strategies are paramount for responsible growth. Moving beyond individual entities, the collaborative landscape brings its own obstacles. Cultivating trust and fostering open communication across cultural and linguistic boundaries is crucial, while complex supply chains necessitate robust cybersecurity measures to safeguard sensitive data and intellectual property. Finally, the dynamic market demands agility and

swift adaptation, but chasing trends can be a double-edged sword, potentially leading to costly inventory overruns or missed opportunities. Furthermore, prioritizing trend over quality or sustainability can raise ethical concerns and damage brand reputations. In essence, navigating these interconnected challenges with strategic foresight and operational dexterity is crucial for Chinese manufacturing to secure its future as a global powerhouse.

This paper digs deep into the world of manufacturing and what makes companies successful. It looks at how things like new technology, working with other companies, and understanding what customers want all play a part. The research shows why these things are important and how companies can use them to stay ahead of the competition over time.

Objectives of the Study - The study investigated the interplay between technological upgrading, supply chain cooperation, and market demand in enhancing competitiveness for Chinese manufacturers. It resulted in a comprehensive framework that helps businesses align their technological investments, forge strategic partnerships, and tailor their offerings to achieve sustainable success in dynamic markets. Specifically, assessed technology upgrading in terms of efficiency, streamlining of process & risk control; determined supply chain cooperation, in terms of supply chain collaboration and integration capabilities, supply chain risk management, partner and resource sharing; determine market demand in terms of market size, value, profitability and growth rate; test the correlation between supply chain cooperation, technological innovation, and market demand development; and developed a framework for enterprise competitiveness.

2. Methods

Research Design - This research employs a descriptive design, utilizing survey questionnaires to gather quantifiable data from respondents. This approach is well-suited for identifying common processes and practices within a population (Habon et al., 2019). By choosing a descriptive design, the research aims to characterize and describe the current state of technological upgrading, supplier collaboration and market demand in manufacturing firms. The use of surveys allows for efficient and standardized data collection from a large number of participants, ensuring the generalizability of the findings to the target population. This methodological approach offers a valuable tool for gaining comprehensive insights into the competitiveness of the manufacturing companies.

Participants of the Study - To gather data, 400 survey questionnaires were distributed online to members of supply chain cooperation units, sales teams, and production teams within the top five manufacturing companies in Henan, China. While ideally all individuals would be surveyed, practical limitations like time, cost, and accessibility often necessitate sampling techniques (Sharma, 2017). Therefore, this study employed convenience sampling, strategically targeting readily available and accessible individuals within the chosen companies who were willing to participate (Etikan et al., 2016). While this approach offers advantages in terms of feasibility and efficiency, it's important to acknowledge that the sample may not perfectly represent the wider population of the manufacturing industry. Future research could explore alternative sampling methods, such as stratified sampling, to potentially enhance the generalizability of the findings.

Instrument of the Study - To ensure the questionnaire's validity and reliability for this study, it underwent a two-step evaluation process. First, experts in the field reviewed and approved the content for its relevance and accuracy. Next, a dry-run was conducted with 20 randomly selected participants from an elderly care service company. The collected data was analyzed by a statistician using Cronbach's Alpha, yielding a score of 0.90, exceeding the standard for good to excellent reliability. This confirmed the internal consistency and stability of the questionnaire's items. Finally, participants were offered the option to complete the survey either as a hard copy or through a Google Form link, increasing accessibility and response rates. The study employs three distinct questionnaires to assess three key aspects of manufacturing companies: technological upgrading, supplier collaboration, and market demand. Each questionnaire adheres to the multi-item measurement principle,

utilizing at least five questions per dimension to capture its specific concept comprehensively. All measurements in the study leverage the well-established Likert scale. Respondents express their agreement with each statement using a 4-point scale, where 1 represents "strongly disagree," 2 signifies "disagree," 3 indicates "agree," and 4 reflects "strongly agree." This approach allows for nuanced data collection and analysis of respondents' perceptions on the investigated areas. The questionnaire's reliability analysis yielded positive results, confirming the validity of all variables, as detailed in Table 1. Notably, the Cronbach's alpha values for technological upgrading (0.928), supplier collaboration (0.926), and market demand (0.921) all exceed commonly accepted thresholds, indicating excellent internal consistency within each respective set of items. This implies that the individual questions within each section consistently measure the intended concepts, strengthening the overall confidence in the data collected.

Data Gathering Procedure - Following the title approval, the researcher secured authorization from the relevant organizational heads and authorities to conduct a dry-run and the main data collection process. With permissions granted, the questionnaire was distributed electronically via Google Forms and in hard copy format. Participants were assured of strict anonymity and that their data would be used solely for academic and professional purposes, respecting confidentiality. To optimize response rates while adhering to the paper's deadline, a reasonable timeframe was given to complete the questionnaire. Upon retrieval, the data underwent statistical analysis with double-checking procedures to ensure accuracy and reliability of the results. This diligent approach allowed for informed interpretation and robust analysis of the collected data.

Data Analysis - Weighted mean and rank were used to assess technology upgrading in terms of efficiency, streamlining of process & risk control; to determine supply chain cooperation, in terms of supply chain collaboration and integration capabilities, supply chain risk management, partner and resource sharing; and to determine Market Demand in terms of market size, value, profitability and growth rate. The result of Shapiro-Wilk Test showed that p-values of all variables were less than 0.05 which means that the data set was not normally distributed. Therefore, Spearman rho was used as part of the non-parametric tests to determine the significant relationship. All analyses were performed using SPSS version 28.

Ethical Considerations - Adhering to the Code of Ethics, the researcher ensured informed consent from all participants by attaching a concise information sheet to each questionnaire. This outlined the study's purpose, anonymity guarantees, and data usage policies, ensuring respondents participated freely and voluntarily. This commitment to ethical research practices not only respects and values participants' integrity but also fosters trust and encourages honest and effective responses. Furthermore, the study strictly adhered to the Data Privacy Act of 2012, safeguarding respondents' personal information and demonstrating the researcher's commitment to data privacy regulations.

3. Result and discussion

Table 1

Summary Table on Technology Upgrading

Key Result Areas	Composite Mean	VI	Rank
Efficiency	3.06	Agree	2
Streamlining of Process	3.05	Agree	3
Risk Control	3.14	Agree	1
Grand Composite Mean	3.08	Agree	

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

Table 1 shows summary of technological upgrading of manufacturing companies. It shows that all the domains in assessing technological upgrading are agreed with the grand composite mean of 3.08. All items were assessed by the respondents and among the indicators risk control got the highest composite mean of 3.14. This ranking suggests a possible shift in manufacturing priorities, with companies placing greater emphasis on mitigating operational risks compared to immediate efficiency gains or optimized process flows. This might be

driven by factors like increasing regulatory pressure, rising safety concerns, or growing awareness of potential financial and reputational losses associated with operational accidents and disruptions. The high ranking of risk control implies a recognition of its importance in achieving overall operational excellence. This might lead to a more integrated approach to technology adoption, where risk mitigation considerations are prioritized alongside traditional efficiency and process optimization goals.

Companies might be increasingly seeking and adopting technological solutions specifically designed for risk control, such as advanced safety systems, predictive maintenance tools, and Cybersecurity solutions. Research can explore the types of technologies companies find most effective for risk mitigation and identify trends in technological development within this domain. Focusing solely on risk control might come with its own challenges and trade-offs. Research can explore potential drawbacks like increased costs, slower decision-making due to risk assessments, or unintended consequences for efficiency and process optimization. It's crucial to investigate the long-term impact of prioritizing risk control on various performance metrics. Research can track changes in safety incidents, environmental compliance, financial stability, and overall productivity to assess the effectiveness of this approach in achieving sustainable success.

Comparing companies that prioritize risk control through technology with those focusing on other domains can reveal valuable insights into different strategies and their advantages and disadvantages. This can inform best practices for technology adoption and risk management in the manufacturing industry. The high ranking of risk control might necessitate revising traditional frameworks for measuring technological upgrades. Research can explore adapting existing metrics or developing new ones to better capture the value of risk-control technologies and their contribution to overall performance.

Galán et al. (2016) introduces a decision support system for selecting process improvement projects in the automotive industry, considering both risk and cost factors. While not solely focused on technology upgrades, it demonstrates how a risk-first approach can be integrated into project selection for manufacturing improvements. This aligns with the findings of the present study by implying that technological upgrades within manufacturing should prioritize risk mitigation alongside traditional efficiency and cost considerations. In another study, Geng et al. (2019) explores the integration of safety and environmental risk management in the process industry using big data technology, it demonstrates how technological advancements can enable comprehensive risk mitigation encompassing both safety and environmental concerns.

Table 2

Summary Table on Supply Chain Cooperation

Key Result Areas	Composite Mean	VI	Rank
Supply Chain Collaboration and Integration Capabilities	3.16	Agree	1
Supply Chain Risk Management	3.09	Agree	3
Partner and Resource Sharing	3.14	Agree	2
Grand Composite Mean	3.13	Agree	

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

Table 2 shows summary of Supply Chain Cooperation. It shows that all the domains in assessing Supply Chain Cooperation are agreed with the grand composite mean of 3.13. All items were assessed by the respondents and Supply Chain Collaboration and Integration Capabilities got the highest composite mean of 3.16. Agreement on all domains suggests respondents share a common understanding of what constitutes supply chain cooperation.

The unanimous agreement validates the importance of considering all three domains as interconnected pillars of effective supply chain cooperation. It suggests that neglecting any aspect can hinder overall performance and resilience. This consensus highlights the need for companies to prioritize seamless integration and alignment between these domains. Research can explore strategies for integrating collaborative practices with risk management processes and resource-sharing initiatives to maximize synergy and optimize performance. The universal recognition of these domains opens the door for developing robust bench marking frameworks and

identifying best practices across all aspects of supply chain cooperation. This can provide valuable guidance for companies seeking to improve their own collaborative strategies.

Digital technologies play a crucial role in enhancing collaboration, facilitating risk management, and optimizing resource utilization. Research can explore how specific technologies like data analytics, blockchain, and collaborative platforms can support each domain and further strengthen supply chain cooperation. While all domains are important, their relative emphasis might vary depending on the industry, risk profile, and operational context of a company. Tracking the long-term impact of strong cooperation across all domains on key performance metrics like cost reduction, lead times, innovation, and resilience is crucial. This can provide evidence for the benefits of a holistic approach and inform strategic decision-making for companies seeking to enhance their overall supply chain performance. Collaboration, risk management, and resource sharing should be guided by ethical principles. The study of Christopher et al., (2019) concludes that digital technologies hold significant potential for building operational resilience in manufacturing. By investing in appropriate technologies, adopting data-driven approaches, and fostering collaboration, manufacturers can navigate disruptions more effectively and achieve greater agility and performance in today's dynamic business environment.

Table 3

Summary Table on Market Demand

Key Result Areas	Composite Mean	VI	Rank
Market Size	3.03	Agree	3
Value	3.15	Agree	1
Profitability and Growth Rate	3.10	Agree	2
Grand Composite Mean	3.09	Agree	

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

Table 3 shows summary of market demand of manufacturing companies. It shows that all the domains in assessing market demand are agreed with the grand composite mean of 3.09. All items were assessed by the respondents and among the domain value got the highest composite mean of 3.14. Agreement on all domains suggests respondents share a common understanding of what constitutes market demand in manufacturing. Endorsement of all domains indicates a multi-dimensional approach to market demand measurement. This avoids pitfalls of relying on single metrics and acknowledges the interplay between market size, profitability, and growth in manufacturing success. High agreement across domains can increase the reliability and validity of the data collected. This allows for more robust statistical analysis and potentially stronger conclusions about market dynamics.

Among the domain, market value obtains the highest composite mean of 3.15, prioritizing market value emphasizes the absolute size and economic importance of the market. This can be particularly relevant for investors, policymakers, and companies seeking large-scale opportunities. Market value can be seen as a cumulative indicator reflecting the combined contributions of other factors like market size, profitability, and growth potential. This provides a broad overview of the market's overall attractiveness and potential future performance. Unlike subjective indicators like growth rate or perceived profitability, market value is often based on quantifiable data like market capitalization or total annual revenue. This can simplify analysis and facilitate comparisons across different markets and companies. Niraj et al., (2017) propose a framework for managing market expansion in manufacturing firms. This framework incorporates factors like market attractiveness, competitive landscape, firm capabilities, and strategic agility to guide decision-making and resource allocation. Ranganathan et al., (2019) critiques the overemphasis on market size in traditional strategy frameworks. However, it acknowledges the strategic importance of considering market size within a broader context that includes factors like market growth potential, competitive landscape, and technological disruptions. This resonates with the notion that market value should be understood in relation to other factors for informed decision-making in volatile manufacturing environments.

In another study Lee et al. (2017) investigates the joint influence of market size and cultural distance on

global market entry decisions for manufacturing firms. While focusing on entry strategies, it highlights the importance of considering not just the absolute size but also the growth potential and complexity of different markets. This aligns with the concept of evaluating market value along various dimensions for strategic decisions.

Table 4

Relationship Between Technology Upgrading and Supply Chain Cooperation

Variables	Rho	p-value	Interpretation
Efficiency			
Supply Chain Collaboration and Integration Capabilities	0.333**	<.001	Highly Significant
Supply Chain Risk Management	0.203**	<.001	Highly Significant
Partner and Resource Sharing	0.199**	<.001	Highly Significant
Streamlining of Process			
Supply Chain Collaboration and Integration Capabilities	0.324**	<.001	Highly Significant
Supply Chain Risk Management	0.213**	<.001	Highly Significant
Partner and Resource Sharing	0.195**	<.001	Highly Significant
Risk Control			
Supply Chain Collaboration and Integration Capabilities	0.407**	<.001	Highly Significant
Supply Chain Risk Management	0.377**	<.001	Highly Significant
Partner and Resource Sharing	0.262**	<.001	Highly Significant

**. Correlation is significant at the 0.01 level

As seen in the table, the computed rho-values ranging from 0.195 to 0.407 indicate a very weak to moderate direct relationship among the sub variables of technology upgrading and supply chain cooperation. There was a statistically significant relationship between technology upgrading and supply chain cooperation because the obtained p-values were less than 0.01. The strong link suggests that technology upgrading and supply chain cooperation can work together in a mutually reinforcing way. Upgrading technology can drive the need for closer collaboration with suppliers for expertise, resources, and integration, while stronger supply chain partnerships can facilitate access to advanced technologies and knowledge sharing. This relationship can foster a more innovative ecosystem within the supply chain. Technology upgrades can create new opportunities for collaboration on product development, process improvements, and joint research ventures. Closer cooperation with suppliers can lead to better information sharing, optimized logistics, and reduced lead times. Upgraded technologies can further enhance these efficiencies through automation, data analytics, and digital integration. Companies that effectively leverage both technology upgrading and supply chain cooperation can gain a significant competitive edge. They can offer more advanced products and services, respond faster to market changes, and optimize their cost structures.

Overall, a high significant relationship between technology upgrading and supply chain cooperation presents exciting opportunities for innovation, efficiency, and competitive advantage. However, it's crucial to understand the complexities of this relationship, address implementation challenges, and consider ethical implications to fully realize its potential for sustainable and responsible growth within diverse industries. Koufteros et al. (2017) investigates the relationship between information systems, a key aspect of technology upgrading, and supply chain performance. It finds a strong positive correlation, confirming the notion that technology advancements can act as catalysts for more successful collaboration and improved performance within supply chains. Li et al. (2020) proposes a framework for measuring market potential for green innovations, acknowledging the dynamic interplay between technology, market size, and environmental factors. This approach aligns with the notion that the impact of technology upgrading on supply chain cooperation can be influenced by the specific market context and industry characteristics.

As seen in the table 5, the computed rho-values ranging from 0.213 to 0.304 indicate a weak direct relationship among the sub variables of technology upgrading and market demand. There was a statistically significant relationship between technology upgrading and market demand because the obtained p-values were less than 0.01.

Table 5

Relationship Between Technology Upgrading and Market Demand

Variables	Rho	p-value	Interpretation
Efficiency			
Market Size	0.213**	<.001	Highly Significant
Value	0.243**	<.001	Highly Significant
Profitability and Growth Rate	0.257**	<.001	Highly Significant
Streamlining of Process			
Market Size	0.223**	<.001	Highly Significant
Value	0.242**	<.001	Highly Significant
Profitability and Growth Rate	0.253**	<.001	Highly Significant
Risk Control			
Market Size	0.273**	<.001	Highly Significant
Value	0.293**	<.001	Highly Significant
Profitability and Growth Rate	0.304**	<.001	Highly Significant

**. Correlation is significant at the 0.01 level

Technology upgrades can enable companies to develop new and improved products and services with better features, functionality, and user experience. This can lead to increased market demand, attracting new customer segments and driving sales growth. Technological advancements can optimize production processes, enhance operational efficiency, and reduce costs. This can result in more competitive pricing, faster delivery times, and higher quality products, further boosting market demand and customer satisfaction. Upgraded technology can offer greater flexibility and agility to respond to changing customer needs and market trends. This enables companies to tailor their offerings and marketing strategies to specific segments, catering to diverse demands and further stimulating market growth. Continuous technology upgrades can foster a culture of innovation within a company, leading to the development of cutting-edge products and services that surpass competitor offerings. This can establish a strong brand image and secure a sustainable competitive advantage in the market. Overall, a high significant relationship between technology upgrading and market demand signifies exciting opportunities for growth, innovation, and competitive advantage. However, it's crucial to address the challenges, understand the complexities, and consider ethical implications to unlock the full potential of this relationship and achieve sustainable success in a dynamic and technologically driven global market.

Rungtusan et al., (2018) proposes a framework for understanding the relationship between technological innovation and firm performance. It highlights the various ways technology upgrades can enhance market demand, including improved product quality, increased production efficiency, and better customer satisfaction. This framework could be applied to investigate the specific mechanisms underlying the technology-demand relationship in your context. Huang et al. (2016) analyzes the synergistic effects of technology innovation and green management on economic growth, particularly in the context of Chinese manufacturing industries. It demonstrates how advancements in eco-friendly technologies can not only drive sustainable production but also create new market opportunities and increase demand for environmentally conscious products. This aligns with the concept of technology upgrades generating market demand through innovative solutions addressing emerging societal concerns. Bharadwaj et al. (2018) investigates the economic benefits of investments in artificial intelligence (AI), a cutting-edge technological advancement. It finds that AI adoption can lead to significant increases in productivity, efficiency, and product innovation, ultimately translating into higher market demand and revenue growth. This demonstrates how specific technology upgrades can directly impact demand through improved operations and product offerings.

As seen in the table, the computed rho-values ranging from 0.184 to 0.412 indicate a very weak to moderate direct relationship among the sub variables of supply chain cooperation and market demand. There was a statistically significant relationship between supply chain cooperation and market demand because the obtained p-values were less than 0.01. Stronger collaboration within the supply chain enables companies to react faster to changing market trends and customer preferences. This allows them to adjust product offerings, adapt marketing strategies, and optimize production processes quickly, ultimately leading to higher demand and sales.

Table 6

Relationship Between Supply Chain Cooperation and Market Demand

Variables	Rho	p-value	Interpretation
Supply Chain Collaboration and Integration Capabilities			
Market Size	0.412**	<.001	Highly Significant
Value	0.383**	<.001	Highly Significant
Profitability and Growth Rate	0.354**	<.001	Highly Significant
Supply Chain Risk Management			
Market Size	0.244**	<.001	Highly Significant
Value	0.345**	<.001	Highly Significant
Profitability and Growth Rate	0.245**	<.001	Highly Significant
Partner and Resource Sharing			
Market Size	0.232**	<.001	Highly Significant
Value	0.184**	<.001	Highly Significant
Profitability and Growth Rate	0.222**	<.001	Highly Significant

***. Correlation is significant at the 0.01 level*

Cooperation among supply chain partners can lead to better information sharing, coordination, and joint problem-solving. This can result in higher quality products, fewer defects, and shorter lead times, further boosting market demand and customer satisfaction. Collaborative efforts within the supply chain can foster joint research and development initiatives, co-creation of new products and services, and knowledge sharing. This can lead to more innovative offerings, faster technology adoption, and improved value propositions, increasing market appeal and demand. Efficient collaboration can streamline logistics, reduce redundant processes, and optimize resource allocation within the supply chain. This can lead to lower production costs, better pricing strategies, and improved cost competitiveness, further strengthening market position and attracting new customer segments.

Laftarakis et al., (2022) explores the specific application of blockchain technology, a tool to enhance transparency and collaboration, within the wine industry supply chain. It demonstrates how blockchain can facilitate trust, information sharing, and traceability, ultimately leading to better quality products, higher consumer confidence, and potential sales growth. On the other hand Runktusan and Kassim (2018) proposes a framework for understanding the relationship between innovation and firm performance, acknowledging the role of supply chain collaboration. It highlights how technological advancements can be leveraged effectively within collaborative partnerships to develop innovative products, improve operational efficiency, and ultimately increase market demand and sales.

The framework focuses on factors that contribute to the overall competitiveness of manufacturing companies. The key components are technology upgrading, this refers to the process of adopting and implementing new technologies to improve efficiency, productivity, and product quality. Supplier collaboration, this involves establishing close relationships with suppliers to optimize the supply chain, reduce costs, and ensure high-quality materials and components. And market demand, this considers factors such as market size, growth rate, customer preferences, and profitability to align production and offerings with market needs.

The arrows connecting the three components indicate that they are interrelated and mutually reinforcing. Technology Upgrading can enhance Supplier Collaboration by enabling better communication, data sharing, and joint innovation. Supplier Collaboration can improve Market Demand by ensuring reliable delivery of high-quality products at competitive prices. Market Demand can inform Technology Upgrading by highlighting the need for new technologies to meet evolving customer needs and market trends. Efficiency, streamlining of process: this emphasizes the importance of optimizing internal operations to reduce waste and improve production efficiency. Risk control, supply chain risk management, this highlights the need to manage risks associated with the supply chain, such as disruptions, quality issues, and price fluctuations. Partner and resource sharing, this suggests the importance of building strong partnerships with key stakeholders and managing resources effectively. Overall, the framework suggests that manufacturing enterprises can achieve and sustain

competitiveness by: continuously investing in technological advancements, fostering close collaboration with suppliers, aligning their offerings with market needs and trends and optimizing internal operations and managing risks effectively.

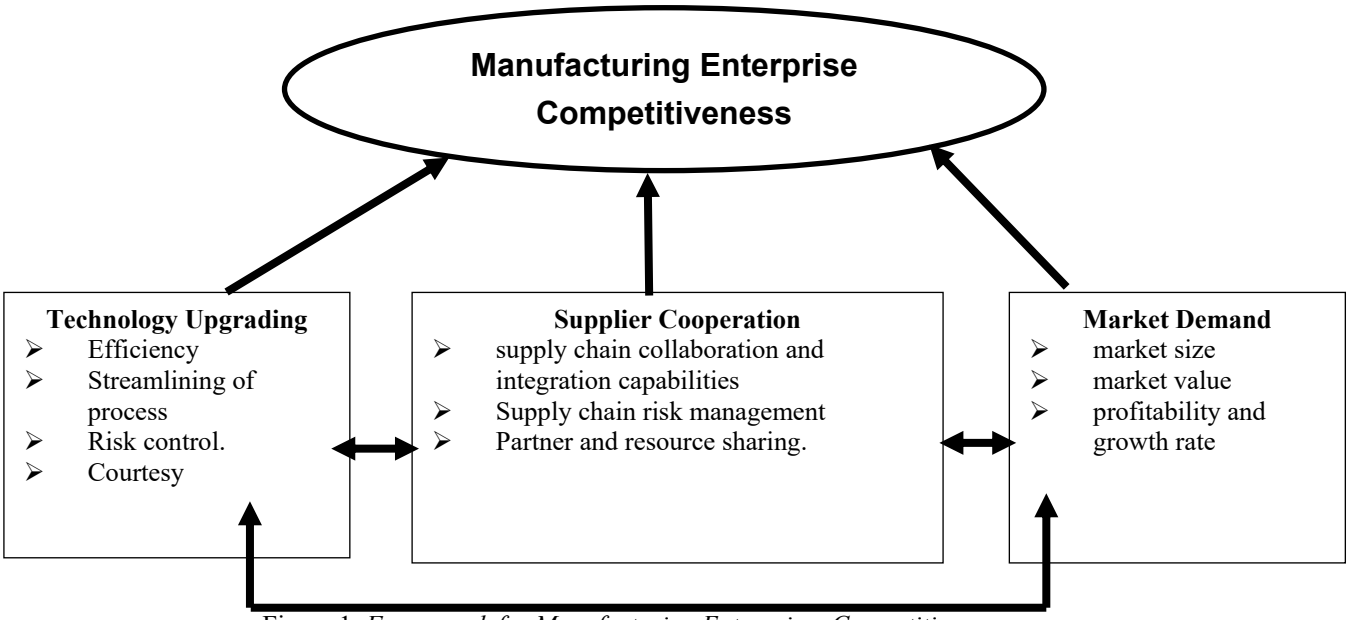

Figure 1. *Framework for Manufacturing Enterprises Competitiveness*

4. Conclusion and recommendation

The respondents have moderate assessment in the company's technology upgrading in terms of efficiency, streamlining of process & risk control. The respondents agreed that there is moderate supply chain cooperation, in terms of supply chain collaboration and integration capabilities, supply chain risk management, partner and resource sharing. The respondents moderately agreed that there is market demand for their product in terms of market size, value, profitability and growth rate. The findings revealed that there is highly significant relationship between technology upgrading, supply chain cooperation and market demand. A framework has been developed for enterprise competitiveness. The firm may conduct a technology audit to identify areas for improvement and conduct a cost-benefit analysis to identify technologies that offer the highest return on investment for the company's specific needs. The firm may implement technology platforms that facilitate communication, data exchange, and joint planning between the company and its supply chain partners. The firm may utilize market research data and industry trends to create detailed forecasts for market size, value, and growth potential over a specific time frame. The firm may adopt the framework to enhance enterprise competitiveness by leveraging its data-driven decision-making and process optimization tools. Future research may focus analyzing the long-term impact of technological upgrading and supply chain cooperation, how these factors influence a company's sustainable competitive advantage and long-term market performance.

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