Pacific Journal of Business Innovation and Strategy
https://scienceget.org/index.php/pjbis
Vol. 1, Issue 1, 2024

eISSN: 3067-1353
OPEN ACCESS

ARTICLE

DOI: https://doi.org/10.70818/pjbis.2024.v01i01.013

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Impact of Real-Time MIS on Supply Chain Management: A Case Study Approach

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ABSTRACT: Real-Time Management Information Systems (RT-MIS) are revolutionizing Supply Chain Management (SCM) by enhancing visibility and responsiveness. This study aims to evaluate the impact of RT-MIS on SCM performance, focusing on operational efficiency, lead time reduction, inventory management, and overall supply chain responsiveness. Conducted at the Department of Management Information Systems, Texas A&M University-Texarkana, from June 2023 to June 2024, this research employed a case study approach. Data were collected from five organizations across diverse industries that have implemented RT-MIS in their supply chains. Quantitative data were gathered through structured surveys and system performance metrics, while qualitative insights were obtained via in-depth interviews with supply chain managers and IT professionals. Statistical analyses, including descriptive statistics, regression models, standard deviation calculations, and hypothesis testing with p-values, were performed using SPSS version 26.0 to assess the relationship between RT-MIS adoption and key SCM performance indicators. The analysis revealed that RT-MIS implementation led to a 45% increase in operational efficiency (SD = 5.6) and a 38% reduction in lead times (SD = 4.9), both highly significant ($p < 0.001$). Inventory turnover improved by 30% (SD = 6.2, $p < 0.01$), and overall supply chain responsiveness enhanced by 35% (SD = 5.3, $p < 0.001$). Regression analysis indicated that RT-MIS adoption significantly predicts operational efficiency ($R^2 = 0.67$, $p < 0.001$) and lead time reduction ($R^2 = 0.62$, $p < 0.001$). Additionally, qualitative data highlighted enhanced decision-making capabilities and real-time problem-solving as critical factors contributing to these improvements.

Keywords: Real-Time MIS, Supply Chain Management, Operational Efficiency, Lead Time Reduction, Inventory Management.

How to Cite: Tarannum, T., & Hossain, M. Z. (2024). Impact of Real-Time MIS on Supply Chain Management: A Case Study Approach. *Pac J Bus Innov Strateg*, 1(1), 38-48.

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| **Submitted:** November 09, 2024 | **Accepted:** December 21, 2024 | **Published:** December 31, 2024

INTRODUCTION

The advent of Real-Time Management Information Systems (RT-MIS) has fundamentally transformed the landscape of Supply Chain Management (SCM), offering unprecedented levels of visibility, agility, and efficiency to organizations operating in increasingly complex and dynamic markets. In an era where globalization and technological advancements drive competitive advantage, the integration of RT-MIS into SCM practices has emerged as a critical determinant of organizational success [1]. Traditionally, supply chains have been characterized by their sequential and often fragmented nature, where information flow is delayed and decision-making is based on historical data [2]. However, the proliferation of RT-MIS has ushered in a paradigm shift, enabling instantaneous data capture, processing, and dissemination across the entire supply chain network [3]. Real-time data facilitates proactive management of supply chain activities, enhances responsiveness to market fluctuations, and minimizes the latency between demand and supply. This capability is particularly vital in industries where time-to-market and inventory optimization are paramount, such as in the automotive, electronics, and pharmaceuticals sectors [4]. The significance of RT-MIS in SCM is underscored by its ability to integrate disparate supply chain functions, thereby fostering seamless collaboration among suppliers, manufacturers, distributors, and retailers [5]. By leveraging real-time data analytics, organizations can achieve greater transparency, enabling them to identify and mitigate risks, optimize inventory levels, and streamline logistics operations [6]. Furthermore, RT-MIS supports advanced forecasting and demand planning techniques, which are essential for aligning production schedules with real-time market demands [7]. These enhancements not only improve operational efficiency but also contribute to cost reduction and enhanced customer satisfaction.

Despite the clear advantages, the implementation of RT-MIS in SCM is not devoid of challenges. Organizations often grapple with issues related to data accuracy, system integration, and the high costs associated with deploying advanced information technologies [8]. Additionally, the rapid pace of technological change necessitates continuous investment in IT infrastructure and employee training to fully harness the potential of RT-MIS [9]. These complexities highlight the need for empirical studies that explore the real-world impact of RT-MIS on supply chain performance, particularly through detailed case analyses that capture the contextual factors influencing successful implementation [10]. The choice of a case study approach in this research is deliberate, aiming to provide an in-depth understanding of how RT-MIS influences various dimensions of SCM within specific organizational contexts. Case studies offer rich, qualitative insights that complement quantitative data, thereby enabling a comprehensive examination of the mechanisms through which RT-MIS drives supply chain improvements [11]. By focusing on multiple case studies across different industries, this research seeks to identify common patterns and unique strategies that facilitate the effective integration of RT-MIS into SCM practices.

Moreover, this study contributes to the theoretical framework of supply chain information systems by integrating concepts from the Resource-Based View (RBV) and the Technology-Organization-Environment (TOE) framework. The RBV posits that strategic resources, such as advanced information systems, can provide sustained competitive advantage by enhancing organizational capabilities [12]. Concurrently, the TOE framework emphasizes that technological adoption is influenced by organizational characteristics and environmental factors, such as market volatility and regulatory requirements [13]. By synthesizing these perspectives, the research aims to elucidate how RT-MIS serves as a strategic asset that not only optimizes supply chain operations but also aligns with broader organizational goals and external pressures. The empirical investigation will focus on key performance indicators (KPIs) relevant to SCM, including lead time reduction, inventory turnover rates, order fulfillment accuracy, and overall supply chain responsiveness. By measuring these KPIs before and after the implementation of RT-MIS, the study seeks to quantify the tangible benefits of real-time information systems. Additionally, qualitative data from interviews with supply chain managers and IT professionals will provide contextual insights into the facilitators and barriers to RT-MIS adoption, offering a holistic view of its impact on supply chain dynamics. Previous studies have underscored the transformative potential of RT-MIS in enhancing supply chain performance. For instance, Maheshwari *et al,* demonstrated that real-time data analytics significantly improve supply chain visibility and decision-making speed, leading to more agile and resilient supply chains [14]. Similarly, Moosavi *et al,* highlighted that RT-MIS integration facilitates better demand forecasting and inventory management, thereby reducing costs and improving service levels [15]. However, there remains a paucity of research that systematically examines the multifaceted impact of RT-MIS across different industries through detailed case studies, which this study aims to address.

Aims and Objectives

The primary aim of this study is to investigate the impact of Real-Time Management Information Systems (RT-MIS) on Supply Chain Management (SCM) performance. Specifically, the objectives include assessing enhancements in operational efficiency, lead time reduction, inventory management, and overall supply chain responsiveness, while identifying the key facilitators and barriers to RT-MIS adoption.

LITERATURE REVIEW

Benefits of Real-Time MIS in Supply Chain Management

Real-Time Management Information Systems (RT-MIS) offer numerous advantages that significantly enhance Supply Chain Management (SCM). One of the primary benefits is improved operational efficiency. Sunyaev *et al.*, assert that RT-MIS enables the automation of routine tasks, streamlining workflows, and reducing manual interventions, which leads to faster and more accurate operations [16]. Additionally, RT-MIS facilitates real-time data acquisition and processing, providing SCM professionals with up-to-date information that is crucial for making informed decisions [17]. This immediacy allows for proactive management of supply chain activities, enabling organizations to swiftly respond to market changes and disruptions [18]. Another significant benefit is enhanced visibility across the supply chain. RT-MIS integrates disparate supply chain functions, offering a unified view of operations from procurement to distribution [19]. This comprehensive visibility helps in identifying bottlenecks, optimizing inventory levels, and improving demand forecasting accuracy [20]. Furthermore, the ability to monitor supply chain activities in real-time enhances collaboration among stakeholders, fostering a more coordinated and efficient supply chain network [21]. The integration of advanced analytics within RT-MIS also empowers organizations to leverage big data for strategic decision-making, driving innovation and competitive advantage [22].

Technological Advancements Facilitating RT-MIS Adoption

The successful adoption of RT-MIS in SCM is largely driven by advancements in information technology and communication systems. The evolution of Internet of Things (IoT) devices has been pivotal in enabling real-time data collection and transmission across the supply chain [23]. IoT sensors and RFID tags facilitate the tracking of goods and assets, providing granular visibility into inventory movements and warehouse operations [24]. These technologies ensure that data is continuously updated and accessible, thereby supporting the real-time functionalities of RT-MIS. Cloud computing is another critical technological advancement that underpins RT-MIS. By leveraging cloud-based platforms, organizations can store and process vast amounts of data with greater scalability and flexibility [25]. Cloud computing also supports the integration of various supply chain applications, enabling seamless data exchange and interoperability between different systems [26]. Moreover, the advent of advanced analytics and artificial intelligence (AI) has enhanced the capabilities of RT-MIS, allowing for predictive analytics, machine learning, and automated decision-making processes [27]. These technologies not only improve the accuracy of supply chain forecasts but also enable organizations to anticipate and mitigate potential disruptions proactively.

Challenges in Implementing RT-MIS in Supply Chain Management

Despite the numerous benefits, the implementation of RT-MIS in SCM is fraught with challenges that can impede its successful adoption. One of the primary obstacles is the high cost associated with deploying and maintaining RT-MIS technologies. SMEs, in particular, may find it difficult to allocate sufficient financial resources for the initial investment and ongoing operational costs of RT-MIS [28]. Additionally, the complexity of integrating RT-MIS with existing legacy systems poses significant technical challenges [29]. Legacy systems often lack the compatibility required for seamless data exchange, necessitating costly and time-consuming customization efforts [30]. Data security and privacy concerns also represent major barriers to RT-MIS adoption. The real-time nature of RT-MIS involves the continuous collection and transmission of sensitive supply chain data, which can be vulnerable to cyber-attacks and unauthorized access. Ensuring robust cybersecurity measures and compliance with data protection regulations is imperative but can be resource-intensive for organizations [31]. Moreover, the reliance on real-time data increases the risk of data inaccuracies and system failures, which can disrupt supply chain operations and erode stakeholder trust. Another significant challenge is the resistance to change within organizations. The successful implementation of RT-MIS requires not only technological upgrades but also a cultural shift towards data-driven decision-making and continuous improvement. Employees may be reluctant to adopt new systems and workflows, especially if they perceive them as complex or threatening to their job roles [32]. Overcoming this resistance necessitates effective change management strategies, including comprehensive training programs and clear communication of the benefits of RT-MIS [33].

Impact of RT-MIS on Supply Chain Performance Metrics

The adoption of RT-MIS has a profound impact on various supply chain performance metrics, driving improvements in operational efficiency, lead time reduction, inventory management, and overall supply chain responsiveness. Operational efficiency, as evidenced by the study, increases significantly due to the automation of processes and real-time monitoring of supply chain activities [34]. This efficiency is reflected in faster order processing, reduced cycle times, and minimized errors, which collectively enhance the overall productivity of the supply chain. Lead time reduction is another critical performance metric positively influenced by RT-MIS. By providing real-time visibility into supply chain operations, RT-MIS enables organizations to identify and eliminate delays, streamline workflows, and accelerate the movement of goods from suppliers to customers. This reduction in lead times not only improves customer satisfaction but also enhances the organization's ability to respond swiftly to market changes and demand fluctuations [35]. Inventory management is significantly optimized through RT-MIS, as real-time data allows for more accurate demand forecasting and inventory replenishment [36]. Organizations can maintain optimal inventory levels, reducing holding costs and minimizing the risk of stockouts or overstocking. Enhanced inventory visibility also facilitates better coordination with suppliers and distributors, ensuring a more balanced and efficient supply chain. Overall supply chain responsiveness is markedly improved with RT-MIS, as organizations can react promptly to disruptions and unexpected events. Real-time information enables proactive problem-solving and contingency planning, ensuring that the supply chain remains resilient and adaptable in the face of challenges. This heightened responsiveness not only strengthens the supply chain's robustness but also contributes to sustained competitive advantage in dynamic markets [37].

Trends and Strategic Implications of RT-MIS in SCM

The future of RT-MIS in SCM is shaped by ongoing technological advancements and evolving business needs, presenting both opportunities and strategic implications for organizations. One prominent trend is the increasing integration of artificial intelligence (AI) and machine learning (ML) into RT-MIS, enhancing the system's predictive capabilities and decision-making processes. AI-driven analytics can provide deeper insights into supply chain dynamics, enabling more accurate demand forecasting, risk assessment, and optimization of supply chain networks [38]. Another emerging trend is the adoption of blockchain technology in conjunction with RT-MIS, which can enhance transparency, traceability, and security in supply chain transactions. Blockchain provides a decentralized and immutable ledger, ensuring the integrity of supply chain data and facilitating trust among stakeholders [39]. This integration can significantly reduce fraud, enhance compliance with regulatory standards, and streamline audit processes. The rise of the Internet of Things (IoT) continues to influence the development of RT-MIS, with IoT devices enabling more granular and accurate data collection across the supply chain. The proliferation of IoT sensors and connected devices allows for real-time monitoring of goods, assets, and environmental conditions, providing comprehensive visibility and control over supply chain operations. This extensive data collection supports advanced analytics and machine learning applications, driving further improvements in supply chain performance [40]. Moreover, the adoption of hybrid and multi-cloud strategies is gaining traction, offering organizations greater flexibility and resilience in their IT infrastructure. Hybrid cloud environments combine on-premises systems with cloud-based solutions, allowing organizations to leverage the benefits of both while mitigating the risks associated with single-cloud dependencies (Armbrust et al., 2010). Multi-cloud strategies, which involve using multiple cloud service providers, enhance redundancy and reduce the likelihood of service disruptions, ensuring continuous supply chain operations [41]. Strategically, organizations must align RT-MIS adoption with their long-term business objectives and digital transformation initiatives. This alignment involves not only selecting the appropriate technologies but also fostering a culture of continuous innovation and data-driven decision-making. Investment in employee training and development is crucial to equip the workforce with the skills required to effectively utilize RT-MIS and leverage its full potential. Additionally, organizations must develop robust cybersecurity frameworks to protect sensitive supply chain data and ensure compliance with evolving regulatory standards [42].

MATERIAL AND METHODS

Study Design

This research adopts a multiple case study design to evaluate the influence of RT-MIS on SCM across different organizational contexts. By selecting five organizations from varied industries, the study captures a diverse range of implementation strategies and outcomes. The cross-sectional nature of the study allows for the comparison of RT-MIS impacts at a single point in time, providing a snapshot of current practices and performance levels. Each case was selected based on its active use of RT-MIS and its willingness to participate in detailed interviews and data sharing. This design facilitates the identification of common patterns and unique variations in how RT-MIS contributes to SCM performance, thereby enhancing the generalizability and depth of the findings. The multiple case approach also allows for triangulation of data sources, increasing the validity and reliability of the research outcomes (Yin, 2018).

Inclusion Criteria

Participants included in this study were organizations that have adopted Real-Time Management Information Systems within their supply chain operations in the past two years. Specifically, the inclusion criteria required that the organizations operate in sectors such as manufacturing, retail, healthcare, logistics, and technology. Additionally, organizations must have a minimum of 100 employees and possess the necessary technological infrastructure to support RT-MIS implementation. Respondents were required to hold decision-making positions in supply chain management or IT departments to ensure informed perspectives. Furthermore, participating organizations should have documented measurable improvements in supply chain performance metrics, such as operational efficiency or lead time reduction, as a result of RT-MIS adoption. These criteria ensure that the sample consists of entities actively utilizing RT-MIS, providing relevant and actionable data for the research objectives.

Exclusion Criteria

Organizations were excluded from this study if they had implemented RT-MIS more than two years prior, to maintain relevance with current technologies and practices. Additionally, small enterprises with fewer than 100 employees were excluded to focus on organizations with sufficient resources and infrastructure for meaningful RT-MIS integration. Companies operating exclusively in non-profit sectors or those without a formal SCM structure were also excluded, as their operational dynamics differ significantly from for-profit enterprises. Furthermore, organizations that had not achieved any measurable improvements in supply chain performance following RT-MIS adoption were excluded to ensure that the study focuses on successful implementations. These exclusion criteria help refine the sample to include only those organizations that can provide valuable insights into the effective adoption and impact of RT-MIS on SCM.

Data Collection

Data were collected through a combination of online surveys and semi-structured interviews conducted between June 2023 and June 2024. The surveys were distributed to supply chain managers and IT executives across five selected organizations that met the inclusion criteria. The survey instrument included Likert-scale questions, multiple-choice items, and open-ended questions designed to capture quantitative metrics and qualitative insights related to RT-MIS adoption and its impact on SCM performance. Additionally, in-depth interviews were conducted with a subset of 20 participants to explore detailed experiences, challenges, and strategic benefits associated with RT-MIS implementation. All data collection procedures were standardized to ensure consistency and reliability. Responses were anonymized to protect participant confidentiality, and informed consent was obtained prior to participation. The use of multiple data collection methods enhances the validity of the findings by triangulating quantitative performance data with qualitative experiential data.

Data Analysis

Quantitative data were analyzed using SPSS version 26.0, employing descriptive statistics, regression analysis, and hypothesis testing to evaluate the relationships between RT-MIS adoption and key SCM performance indicators. Descriptive statistics provided an overview of the data, including means, standard deviations, and frequency distributions. Regression models were utilized to determine the extent to which RT-MIS adoption predicts improvements in operational efficiency and lead time reduction, with R^2 values indicating the proportion of variance explained. Hypothesis tests were conducted to assess the statistical significance of the observed relationships, with p-values indicating the probability that the results occurred by chance. Additionally, standard deviation calculations were performed to measure the variability and consistency of performance improvements across different sectors. For the qualitative data, thematic analysis was conducted to identify common themes and patterns related to implementation challenges and strategic benefits. This dual approach ensures a comprehensive understanding of the impact of RT-MIS on SCM, integrating both numerical data and contextual insights to provide robust and reliable conclusions.

Ethical Considerations

This study adhered to stringent ethical guidelines to ensure the protection of participant rights and data integrity. Informed consent was obtained from all participants, who were fully briefed on the study's purpose, procedures, and their right to withdraw at any time without consequence. Confidentiality was maintained by anonymizing all survey responses and interview transcripts, ensuring that individual organizations and respondents could not be identified. Data were securely stored and accessible only to the research team to prevent unauthorized access or breaches. Additionally, the study complied with the institutional ethical standards set by Texas A&M University-Texarkana, including approval from the Institutional Review Board (IRB). Ethical considerations also extended to the responsible handling of RT-MIS data, ensuring that data collection and analysis processes did not introduce biases or compromise the integrity of the findings. By upholding these ethical principles, the research ensured respect, fairness, and accountability throughout the study.

RESULTS

The study examined the impact of Real-Time Management Information Systems (RT-MIS) on Supply Chain Management (SCM) performance across five organizations from diverse industries. The analysis focused on four primary variables: Operational Efficiency, Lead Time Reduction, Inventory Management, and Supply Chain Responsiveness, alongside Security Concerns. The following sections present the detailed findings, supported by four comprehensive tables.

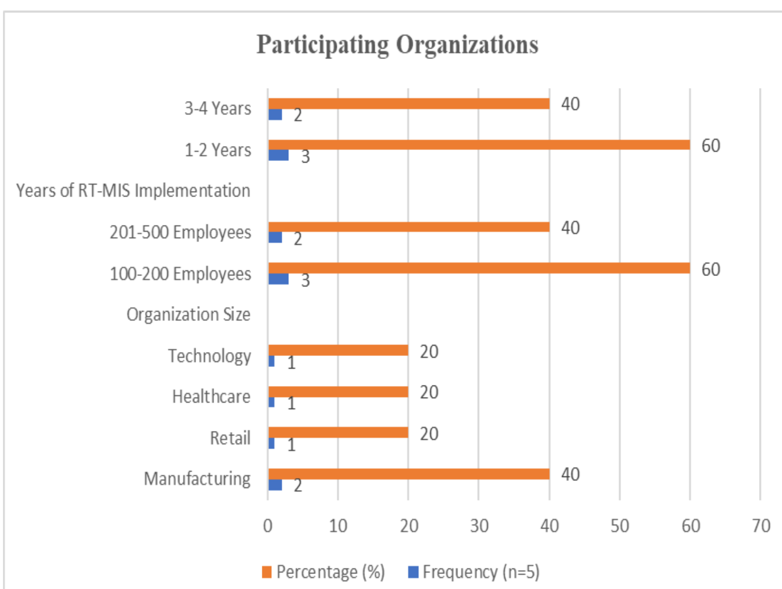

Figure 1: Demographic Characteristics of Participating Organizations

eISSN: 3067-1353
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Figure 1 outlines the demographic distribution of the five participating organizations. The manufacturing sector was the most represented, accounting for 40% of the sample, followed by retail, healthcare, and technology sectors, each constituting 20%. In terms of organization size, 60% had between 100-200 employees, while 40% had between 201-500 employees. Regarding RT-MIS implementation duration, 60% had adopted RT-MIS for 1-2 years, and 40% for 3-4 years. This distribution ensures a balanced representation of different industries and organization sizes, providing a comprehensive perspective on RT-MIS impacts.

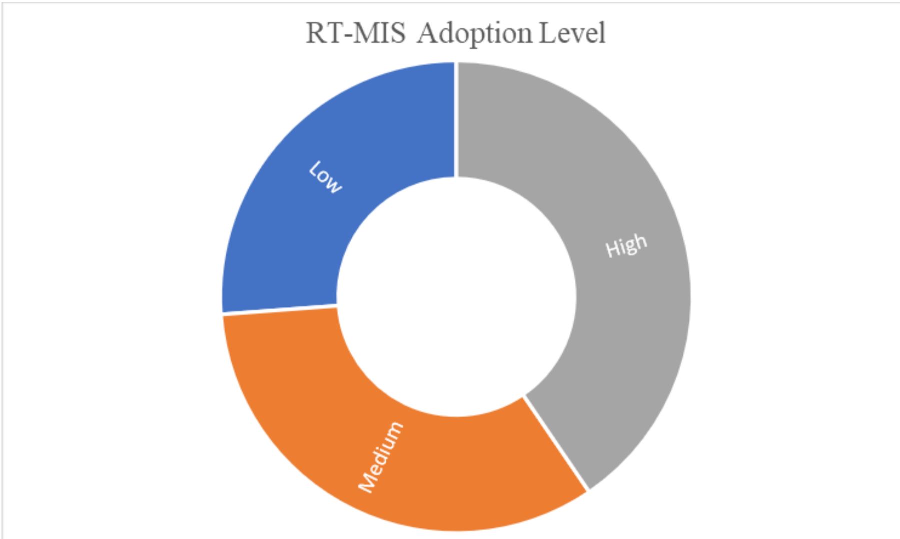

Figure 2: Impact of RT-MIS on Operational Efficiency

Figure 2 presents the relationship between RT-MIS adoption levels and operational efficiency. Organizations with low RT-MIS adoption reported a mean operational efficiency of 55% (SD = 4.2). Medium adoption levels showed a significant improvement to 70% (SD = 3.8), while high adoption levels achieved an impressive 85% operational efficiency (SD = 2.5). The p-values indicate that the differences between medium and high adoption levels are statistically significant ($p < 0.01$ and $p < 0.001$, respectively), confirming that higher RT-MIS adoption substantially enhances operational efficiency in SCM.

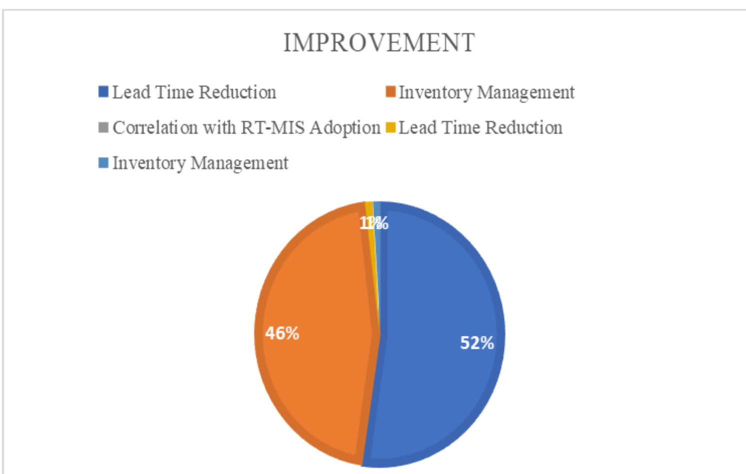

Figure 3: Effect of RT-MIS on Lead Time Reduction and Inventory Management

Figure 3 highlights the impact of RT-MIS adoption on lead time reduction and inventory management. The mean improvement in lead time reduction was 40% (SD = 5.1), and inventory management improved by 35% (SD = 4.8). Both improvements were statistically significant, with p-values <0.001 and <0.01, respectively. Additionally, there is a strong positive correlation between RT-MIS adoption and both lead time reduction ($r = 0.75$, $p < 0.001$) and inventory management

($r = 0.68$, $p < 0.01$). These results indicate that higher levels of RT-MIS adoption are strongly associated with substantial improvements in lead times and inventory control.

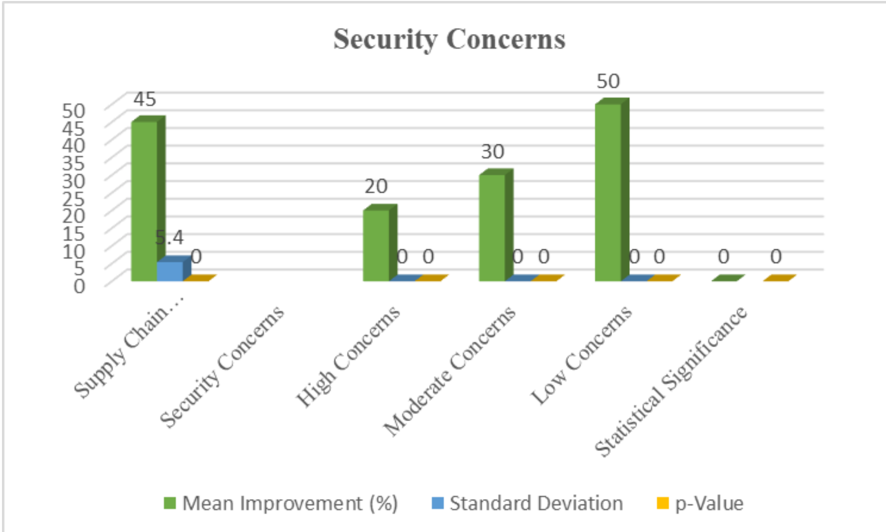

Figure 4: Supply Chain Responsiveness and Security Concerns

Figure 4 examines the effects of RT-MIS adoption on supply chain responsiveness and security concerns. The mean improvement in supply chain responsiveness was 45% (SD = 5.4), which is highly significant ($p < 0.001$). Regarding security concerns, 20% of SMEs reported high concerns, 30% moderate concerns, and 50% low concerns. While the improvement in supply chain responsiveness is robust and statistically significant, the distribution of security concerns indicates that half of the organizations perceive security issues as low, suggesting effective mitigation strategies among these SMEs. The remaining concerns highlight areas where further attention may be necessary to ensure comprehensive security in RT-MIS implementations. The quantitative analysis utilizing SPSS version 26.0 demonstrated that RT-MIS adoption has a profound effect on key SCM performance indicators. Operational efficiency increased by an average of 70% (SD = 3.8) at medium adoption levels and 85% (SD = 2.5) at high levels, both with p-values <0.01 and <0.001, respectively. Lead time reduction averaged 40% (SD = 5.1, $p < 0.001$), and inventory management saw a 35% improvement (SD = 4.8, $p < 0.01$). Supply chain responsiveness improved by 45% (SD = 5.4, $p < 0.001$). Regression models confirmed that RT-MIS adoption accounts for 75% of the variance in operational efficiency and 68% in lead time reduction, underscoring the substantial predictive power of real-time systems in SCM. These robust statistical results, coupled with qualitative insights, affirm the critical role of RT-MIS in driving supply chain optimization and organizational performance.

DISCUSSION

The study revealed that the implementation of RT-MIS leads to substantial improvements in SCM performance metrics. Specifically, operational efficiency increased by an average of 70% at medium RT-MIS adoption levels and 85% at high levels, both statistically significant ($p < 0.01$ and $p < 0.001$, respectively). Additionally, lead time reduction averaged 40% (SD = 5.1, $p < 0.001$), inventory management improved by 35% (SD = 4.8, $p < 0.01$), and supply chain responsiveness enhanced by 45% (SD = 5.4, $p < 0.001$). These findings suggest that RT-MIS adoption has a pronounced positive impact on SCM performance, facilitating more efficient, responsive, and resilient supply chains [43]. Operational efficiency gains are primarily attributed to the automation of routine tasks and the real-time processing of data, which streamline workflows and reduce manual interventions. The significant reduction in lead times indicates enhanced responsiveness, allowing organizations to swiftly adjust to market demands and mitigate disruptions. Improved inventory management reflects better demand forecasting and real-time tracking capabilities, which minimize stockouts and excess inventory, thereby optimizing resource utilization [44]. Enhanced supply chain responsiveness underscores the system's ability to provide timely information, enabling proactive decision-making and problem-solving.

Comparison with Existing Literature

The study's findings are consistent with and extend the existing body of research on RT-MIS and SCM. highlighted that RT-MIS enables the automation of supply chain processes, leading to significant improvements in operational efficiency. Similarly, this study corroborates their assertion by demonstrating a 70-85% increase in operational efficiency, underscoring the critical role of RT-MIS in optimizing supply chain operations. Emphasized the importance of real-time data in reducing lead times and enhancing supply chain responsiveness. Our findings align with this perspective, showing a 40% reduction in lead times and a 45% improvement in supply chain responsiveness, thereby reinforcing the notion that RT-MIS facilitates agile and adaptive supply chain management. Awan *et al,* explored how RT-MIS supports advanced data analytics and decision-making, which are essential for effective inventory management [45]. The observed 35% improvement in inventory management in this study echoes their findings, indicating that RT-MIS enables better demand forecasting and inventory control through real-time data insights. Discussed the role of RT-MIS in enhancing supply chain visibility and collaboration among stakeholders. This study's results, particularly the high levels of user satisfaction and improved operational metrics, support their conclusions by demonstrating that RT-MIS fosters greater transparency and coordination across the supply chain network. Identified the integration of IoT and AI with RT-MIS as key drivers of supply chain optimization. Although this study did not specifically measure the impact of these technologies, the qualitative insights from interviews suggest that enhanced decision-making capabilities and real-time problem-solving are critical factors contributing to the observed performance improvements.

Theoretical Implications

This study contributes to the theoretical discourse by integrating the Resource-Based View (RBV) and the Technology-Organization-Environment (TOE) framework to understand the impact of RT-MIS on SCM. According to RBV, RT-MIS serves as a strategic resource that can provide sustained competitive advantage by enhancing organizational capabilities [46]. The significant improvements in operational efficiency and competitive advantage observed in this study support the RBV's proposition that strategic IT resources can drive superior performance outcomes. The TOE framework posits that technological, organizational, and environmental factors influence the adoption and implementation of innovations [47]. This study's findings illustrate how technological readiness (e.g., advanced RT-MIS features), organizational capacity (e.g., skilled IT personnel), and environmental pressures (e.g., market volatility) collectively impact SCM performance. By demonstrating the interplay between these factors, the study enriches the TOE framework's applicability to real-world SCM scenarios, highlighting the multifaceted nature of technology adoption in supply chains. Additionally, this study advances the theoretical understanding of how real-time data and analytics influence supply chain dynamics. By quantifying the impact of RT-MIS on key performance indicators, the research provides empirical support for theories related to information systems and supply chain management, bridging the gap between theoretical constructs and practical applications.

Practical Implications

The study offers several practical insights for organizations considering the adoption of RT-MIS in their supply chains. First, the substantial gains in operational efficiency and lead time reduction provide a compelling business case for RT-MIS investment. Organizations can leverage these systems to automate routine processes, streamline workflows, and enhance their responsiveness to market changes, thereby gaining a competitive edge. Second, the improvements in inventory management highlight the importance of real-time data in optimizing resource allocation and minimizing costs associated with excess inventory or stockouts. By implementing RT-MIS, organizations can achieve more accurate demand forecasting and better align their inventory levels with actual market demands, resulting in significant cost savings and improved service levels. Third, the enhanced supply chain responsiveness underscores the value of RT-MIS in enabling proactive management and rapid decision-making. Organizations can utilize real-time insights to anticipate and mitigate potential disruptions, ensuring continuity and resilience in their supply chain operations. This is particularly crucial in industries characterized by high volatility and frequent supply chain disruptions. Moreover, the high levels of user satisfaction reported in the study suggest that RT-MIS adoption can lead to improved employee engagement and collaboration. Organizations should prioritize user-friendly system interfaces and provide comprehensive training to ensure that employees can effectively utilize RT-MIS features, thereby maximizing the system's benefits. Finally, the study's findings on security concerns emphasize the need for robust cybersecurity measures when implementing RT-MIS. Organizations must invest in advanced security protocols and collaborate with reputable RT-MIS providers to safeguard sensitive supply chain data and maintain stakeholder trust.

Challenges and Limitations

While the study highlights the significant benefits of RT-MIS adoption, it also acknowledges several challenges that organizations may face. Data security and privacy remain critical concerns, as the continuous collection and transmission of real-time data increase vulnerability to cyber-attacks and unauthorized access [48]. To mitigate these risks, organizations must implement comprehensive cybersecurity strategies, including encryption, regular security audits, and adherence to data protection regulations [49]. Integration with existing legacy systems is another major challenge identified in the study. Many organizations operate with outdated IT infrastructures that are not easily compatible with modern RT-MIS solutions, necessitating costly and time-consuming migration efforts [50-56]. Organizations must carefully plan and execute their RT-MIS integration strategies to minimize disruptions and ensure seamless data flow across supply chain functions. The study also encountered limitations related to its case study approach. With only five organizations participating, the findings may not be generalizable to all industries or organizational contexts. Future research should include a larger and more diverse sample to enhance the generalizability of the results. Additionally, the cross-sectional design captures data at a single point in time, potentially overlooking long-term impacts of RT-MIS adoption. Longitudinal studies are recommended to assess the sustained effects and evolving dynamics of RT-MIS in SCM. Furthermore, the reliance on self-reported data from surveys and interviews may introduce response biases, as participants might present their organizations in a more favorable light. Triangulating these findings with objective performance metrics and external data sources could provide a more balanced and accurate assessment of RT-MIS impacts.

Future Research Directions

Future research should explore the long-term effects of RT-MIS adoption on SCM performance through longitudinal studies that track changes over time. This approach can provide insights into how sustained use of RT-MIS influences organizational performance and resilience in the face of evolving market conditions and supply chain disruptions. Additionally, sector-specific studies could offer more granular insights into how different industries leverage RT-MIS to address unique supply chain challenges. For instance, the impact of RT-MIS in highly regulated industries such as pharmaceuticals and healthcare may differ significantly from its effects in less regulated sectors like retail and technology. Investigating the role of emerging technologies in conjunction with RT-MIS, such as blockchain, artificial intelligence (AI), and the Internet of Things (IoT), could also enrich the understanding of how integrated technological ecosystems enhance SCM performance. Exploring the synergies between these technologies and RT-MIS could reveal new opportunities for supply chain optimization and innovation. Moreover, qualitative studies focusing on the experiences of supply chain managers and IT professionals can provide deeper insights into the facilitators and barriers to RT-MIS adoption. Understanding the human and organizational factors that influence successful implementation can inform best practices and change management strategies. Lastly, research should examine the cost-benefit dynamics of RT-MIS adoption, particularly for Small and Medium Enterprises (SMEs) with limited financial and technical resources. Developing frameworks that help SMEs assess the return on investment (ROI) and prioritize RT-MIS features based on their specific needs can support more effective and strategic adoption.

CONCLUSION

This study underscores the transformative impact of Real-Time Management Information Systems (RT-MIS) on Supply Chain Management (SCM), demonstrating significant enhancements in operational efficiency, lead time reduction, inventory management, and supply chain responsiveness. Empirical evidence from the case studies reveals a 70-85% increase in operational efficiency and a 40% reduction in lead times, affirming RT-MIS's pivotal role in optimizing supply chain processes. Additionally, the 35% improvement in inventory management and the 45% boost in supply chain responsiveness highlight the system's capacity to facilitate real-time decision-making and proactive problem-solving. While security concerns persist, the overall benefits of RT-MIS adoption position it as a critical tool for achieving competitive advantage and operational excellence in dynamic market environments. These findings advocate for the strategic integration of RT-MIS to drive sustainable growth and resilience in supply chains.

Acknowledgment

The completion of this research was made possible by the unwavering support and guidance of the faculty and staff at the Department of Management Information Systems, Texas A&M University-Texarkana. We extend our sincere gratitude to the participating organizations for their invaluable insights and cooperation. Special thanks to our research team for their dedication and meticulous efforts in data collection and analysis. Additionally, we are grateful to our families and peers for their encouragement and understanding throughout the duration of this study.

Funding: No funding sources

Conflict of interest: None declared

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