

## THE ROLE OF TECHNOLOGY IN ENHANCING SUPPLY CHAIN INTEGRATION AND ORGANIZATIONAL PERFORMANCE

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### Abstract

This study focuses on how technology is revolutionizing supply chain integration and how that influence affects organizational effectiveness. Through the use of a mixed-methods research methodology, the project looks into how numerous sectors are embracing and integrating technology such as blockchain, artificial intelligence, and the Internet of Things. Through the use of questionnaires, interviews, and observations, the research assesses the level of technology integration, its effect on supply chain operations, and its link with significant organizational performance metrics. The study explores the intricate relationships between supply chain integration, adoption of new technologies, and performance outcomes using ANOVA, thematic coding, and linear multivariate regression. The findings are intended to provide important information to businesses aiming to enhance their supply chain processes through strategic technology utilization.

**Key words:** Technology adoption, Supply chain integration, Organizational performance, Mixed-methods research, Linear multivariate regression, IoT, Blockchain, Artificial intelligence, ANOVA.

### Introduction

Supply chain management has evolved significantly over time. It is currently one of the most crucial factors for a company's success in the fast-paced business environment of today. In the past, businesses frequently experienced delays, inefficient operations, and a lack of visibility into their supply chains. Since they understand how crucial it is to manage their supply chains effectively in order to stay ahead of the competition, businesses are utilizing technology as a strategic tool. Supply chain management has evolved and resolved long-standing problems with

the use of new instruments (Campbell and Sankaran \*, 2005). This research investigates how technology might improve the efficiency of the supply chain, which can eventually aid in a company's success. This study aims to demonstrate how technology might impact the performance of contemporary enterprises. It accomplishes this by examining the ways in which supply chain management has evolved over time, the issues it encounters, and the ways in which new technology have aided it.

### **1.2: Background And Contextualization**

There have been big changes in supply chain management (SCM) over the years. Complex, linked systems have taken the place of simple, clear models. Businesses have run into a number of problems throughout history that have made it harder for them to keep an eye on their supply lines. Some of these worries are dealing with waste, long wait times, and not being able to see the whole process (Campbell and Sankaran \*, 2005). These things caused problems that made it harder to run the business well and put its future at risk. Businesses started looking for creative answers to these problems when they realized how important it was to keep their supply chains running smoothly in order to stay competitive.

This way of looking at it, technology has become a radical force that has completely changed how supply chain management is done (Gunasekaran and Ngai, 2004). The ways that trade networks work have changed because of new technology. This has opened up possibilities for increased speed and strategic benefit that have never been seen before. Today's business world is greatly affected by technology, which makes it easier to create and carry out projects that try to improve efficiency, lower costs, and raise knowledge along the supply chain. In today's fast-paced and very competitive global markets, it's important to know how to use technology well in order to build and maintain good group performance.

### **1.3: Signification Of Supply Chain Integration**

The significance of supply chain integration is paramount in the current business landscape, as firms are actively engaged in global and competitive markets. An uninterrupted incorporation of the supply chain is vital for the prosperity of a firm. Overcoming many obstacles is necessary while managing a global supply chain (Gunasekaran and Ngai, 2004). These concerns encompass a range of factors, including regulations, ordinances, cultural differences, and changing supply and demand trends. Given the complexity of the environment, the incorporation of integration has become a crucial element of strategy.

An effectively integrated supply chain enables efficient operations and offers organizations a cohesive framework for rapidly and effectively responding to market changes. The combination of these two elements immediately leads to a decrease in costs and an improvement in operational efficiency. Given the interconnectedness of the operations in the supply chain, it is crucial to thoroughly analyze the whole process to guarantee smooth and seamless transitions between each phase (Gunasekaran and Ngai, 2004). Technology facilitates this integration by providing the necessary platforms and tools for instantaneous communication, data synchronization, and collaborative decision-making. Technology is essential in enabling this mix.

The complexity of a global supply chain poses significant issues that may mostly be addressed via the use of technology. Creating a visible and interconnected ecosystem allows firms to get comprehensive understanding of all aspects of their supply chain. Businesses may enhance their decision-making, adapt quickly to changes, and eventually improve overall efficiency by leveraging technology to enable integration. This phenomenon takes place from the moment of acquisition till the moment of delivery. The ensuing chapters will predominantly address the ways in which technology might enable the integration of supply chains, ultimately leading to improved performance of a corporation.

#### **1.4: Technological Advancements In Supply Chain Management**

The advent of innovative technology has transformed the area of supply chain management, empowering workers to obtain unprecedented levels of improvement. Consequently, supply chain management is now entering a new era (Gunasekaran and Ngai, 2004). The use of several innovative technologies has expedited this shift, resulting in substantial changes to supply chain management methods. The popularity of blockchain stems from its ability to enhance the transparency and monitoring capabilities of supply networks. Blockchain is a tamper-proof and autonomous distributed ledger system. This guarantees the authenticity of transactions and preserves a safe and comprehensive record of the whole supply chain. Companies such as Walmart and IBM Food Trust, who utilize blockchain technology, have the ability to gain a broader perspective of their supply chains. This reduces the likelihood of someone making a mistake or stealing from them.

The Internet of Things (IoT) has brought about substantial changes in the supply chain. By connecting physical equipment and sensors, companies may acquire up-to-the-minute data on the whereabouts, condition, and activities of items. Being highly aware enables one to move swiftly and make judgments effortlessly. Large corporations such as Maersk Line utilize IoT technology to oversee the status of various items, such as shipping containers. This reduces losses and maintains the objects in optimal condition (Koçoğlu et al., 2011). The utilization of Artificial Intelligence and machine learning is crucial in enhancing the effectiveness of supply chain operations. These technologies can assist you in discerning patterns, forecasting customer preferences, and ascertaining the optimal approach to stocking your businesses. Amazon exemplifies this concept by utilizing artificial intelligence to forecast customer preferences and efficiently handle inventory management, resulting in significant time and cost savings.

Businesses may leverage cutting-edge analytics tools and methodologies to sift through the vast amounts of data created in the supply chain and extract valuable insights. UPS and other major corporations employ data analytics to ascertain the most efficient routes, leading to reduced fuel expenses and streamlined corporate processes. Supply chain management has advanced due to the emergence of innovative technologies such as blockchain, IoT, AI, and data analytics. Concrete illustrations exemplify how organizations might employ these technologies to enhance their prominence, adaptability, and responsiveness, ultimately bolstering their degree of commercial triumph.

#### **1.4: Objectives**

This study has two major objectives. Examining how technology has altered supply chain management is the first step. Examining the implications for the performance of the firm comes in second (Koçoğlu et al., 2011). The research will thoroughly examine several aspects of supply chain management as well as organizational performance to provide a comprehensive understanding of how general efficiency, integration, and technology develop over time.

##### **Examine how technology contributes to supply chain integration:**

The impact of cutting-edge technologies on improving the efficiency of the supply chain is being studied, including blockchain, the Internet of Things (IoT), artificial intelligence, and data analytics. The ways in which these technologies enhance coordination, timing, and communication at various stages of the supply chain will receive more focus.

##### **Examine the Impact on Organizational Performance:**

The goal of this study is to determine the direct and indirect impacts that improved supply chain integration made possible by technology will have on organizational performance. Among the key performance indicators (KPIs) that will be closely examined to determine their impact on the company's overall success are cost savings, business efficiency, and agility.

##### **Identify and evaluate implementation issues:**

Learn about the challenges and obstacles that businesses may have when attempting to link their supply chains using modern technology. To offer helpful information and recommendations for facilitating technology adoption in a variety of organizational contexts, it is vital to identify these issues.

##### **To further the expansion of knowledge:**

The goal of the study is to contribute something meaningful to the current understanding of supply chain management and organizational effectiveness (Li, 2009). By providing targeted answers to certain queries on the intricate relationships among technology, integration, and performance, this study seeks to close knowledge gaps in the field. It will also establish the framework for further study.

In summary, the goal of this study is to determine the connections between supply chain integration, technology, and group success. It's clear from the backdrop that businesses have previously struggled to manage their supply chains. Technology has been essential in helping to resolve these problems. It's been said time and time again that supply chains must cooperate well, particularly in an international marketplace. The list of emerging technologies, which includes data analytics, blockchain, IoT, and AI, also makes it feasible to find out more about how these modifications impact the supply chain. It is evident that the primary objective of the study is to contribute to the current understanding of supply chain management and company performance (Li, 2009). In addition to providing guidance on how to leverage technology to improve supply chain integration, the study will address a number of significant research problems and assist firms thrive in the contemporary business environment. The goal of the research is to improve our understanding of theories while also providing businesses with practical advice on how to navigate the complex intersection of supply chain patterns and technology.

## 2. Literature review

Michael Wang (2020) is researching the potential benefits of incorporating blockchain technology into supply chain management. This integration might potentially enhance the value of supply networks and simultaneously decrease carbon emissions. This study formulates research inquiries that demonstrate the interrelationships among supply chain connectedness, blockchain technology, and carbon emissions, drawing upon the Resource-Based View and the Socio-Technical Theory. Wang's research showcases the potential of utilizing blockchain technology to enhance supply chain efficiency while concurrently mitigating carbon emissions. This research also examines the practical implementations of blockchain technology, including the monitoring of carbon footprints, the optimization of operations, and the improvement of carbon management in supply chains. Given Wang's extensive experience in this domain, we may get valuable insights on the prospective uses of blockchain technology in the management of low-carbon supply chains. He achieves this by offering us profound information and recommendations for future study venues. In 2002, Gunasekaran published a seminal research that clarifies the relationship between supply chain management (SCM), technology, and a company's competitive advantage. Some businesses are utilizing operations strategy, techniques, and technologies—primarily the SCM model and information technology (IT)—in an effort to be more flexible and responsive. This is the outline's stated content. This research discusses the significance of conducting a thorough literature study if you'd want to understand more about the function and effects of IT in SCM in spite of this tendency. Study groups are formed, and prior research is analyzed to create a framework that demonstrates how IT may be employed in SCM. The results of the review produced some insightful suggestions for using IT in SCM. These concepts lay the groundwork for new, constantly-evolving research directions in this field. For this reason, reviewing the literature is a crucial step in examining our current body of knowledge. Companies may utilize the information they gain from it to enhance both their overall performance and the efficiency of their supply networks.

The study that was conducted by Wantao Yu (2015) investigates the ways in which a company may improve its performance by implementing information technology (IT) and linking the supply chain (SCI with other systems). The research does not simply assert that incorporating information technology into supply chain processes would result in improved business operations; rather, it takes a more nuanced approach to supply chain integration by seeing it as a collection of distinct concepts. This study contributes to the existing body of knowledge by examining the ways in which information technology (IT) alters three aspects of supply chain management (SCI): the way in which employees, suppliers, and consumers interact with the organization. The central hypothesis of the study was examined via the lens of 214 industrial enterprises located in China. The study demonstrates that putting information technology to use has a favorable connection to all three components of SCI. The fact that the facts demonstrate a significant and positive connection between the internal integration that is made possible by information technology and both operational and financial success is a crucial point to bring up. This enables us to better

understand the interconnected nature of technology, the integration of supply chain operations, and the success of a firm.

Rakesh Singh's 2013 study examines the intricate relationship between information technology (IT) and the effectiveness of supply chains. He prioritizes the primary challenges that arise while attempting to monitor inventory and ensure timely delivery to clients. The research examines the impact of technology on the supply chain by assessing the speed of product sales and the duration of product delivery to end-users. Based on the study, overall performance will improve if all participants in the supply chain had a clear understanding of the significance of demand. Feedback from the business community indicated that enhancing product visibility can reduce waiting time. Early adopters of computer technology in supply chain management were professionals in the Fast-Moving Consumer Goods (FMCG) industry. Conversely, survey data indicates that a significant number of individuals in the business sector are reluctant to establish technological infrastructure. The statistics indicate that individuals inside the organization express concern and lack confidence in the ability of IT to enhance awareness of demand among people, thereby influencing the inventory levels of supply chain partners.

Examining Gang Li's significant 2009 research, the literature review demonstrates the increasing significance of information technology (IT) in supply chain management (SCM) due to the growing global and competitive nature of the globe. Li's study examined the potential of information technology (IT) to enhance supply chain performance (SCP) through the rapid provision of accurate information. The study's conceptual framework model examines the interconnection between three crucial factors: information technology use, supply chain integration (SCI), and supply chain performance (SCP). The findings of a study conducted on 182 Chinese enterprises using structural equation modeling indicate that there is no direct impact of IT usage on SCP (Strategic Competitive Performance). This is demonstrated by the literature review. Instead, it enhances the quality of SCI, hence indirectly improving SCP. This crucial revelation elucidates the necessity for firms to diligently advocate for supply chain integration and leverage information technology to facilitate this process. Furthermore, it establishes a foundation for further investigation into the ways in which technology might enhance organizational performance and facilitate seamless integration of supply chains.

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elucidates the necessity for firms to diligently advocate for supply chain integration and utilize information technology to facilitate this process. Furthermore, it paves the way for further investigation into the ways in which technology might enhance organizational performance and facilitate seamless integration of supply chains.

The literature review by S. Vachon (2002) is mostly about how the supply chain is changing in terms of environmental ethics. The author says that companies need to do more than just work on their own plants; they need to use eco-friendly methods all the way through the supply chain. The study shows that we still don't fully understand how the different parts of the supply chain affect how money is spent on environmental problems. The study finds that putting more effort into reducing pollution is linked to having a lot of strategic integration with suppliers. This means doing things like making products together and sharing data. This trend is interesting because it doesn't show up in how businesses treat their customers, but it does show up in how they work together to cut down on waste. The results show how hard it is to keep the earth safe along the supply chain. They also point to a pattern in which members further down the chain work on stopping problems while members further up the chain are in charge of keeping things under control. We can learn a lot from this writing about how environmental practices, supply chain integration, and resource sharing all have complicated effects on each other. It also makes it possible to do more study on how technology can help organizations work better generally and improve how their supply chains work together.

J. Campbell's (2007) literature analysis demonstrates the systematic creation of a comprehensive framework aimed at enhancing the integration of supply chains, specifically targeting the involvement of small and medium-sized enterprises (SMEs) as both sellers and purchasers. The author discusses a shift in the current usage of exams, which mostly serves the purpose of self-evaluation or comparison with one's peers. The proposed approach aims to facilitate the seamless and organized integration of small-scale sellers and providers into the supply chain. Smaller enterprises should have the opportunity to acquire knowledge from more advanced business partners and adapt their practices to better suit the requirements of smaller organizations. As part of the research methodology, a comprehensive case study research is conducted on organizations that excel in various aspects of mergers. This results in a sophisticated framework that is intricate and grounded on empirical evidence. This solution enhances existing tools and methods for efficiently integrating supply chains in a comprehensive and practical manner. It might be employed to contemplate the challenges that tiny organizations have when attempting to collaborate with existing supplier chains.

In 2011, İpek Kocoğlu conducted a research examining the potential of technology in enhancing company performance and facilitating the integration of supply chains. The study primarily examined the crucial correlation between information sharing, the achievement of supply chain objectives, and the integration of supply chain activities (SCI). Sharing knowledge is a crucial strategy for success in the current competitive and global economy, as demonstrated by this study. This study examines the direct impact of spinal cord injury (SCI) on information sharing and social cognitive processing (SCP), highlighting the interconnectedness of these concepts. The

conceptual model consists of three primary components: Supply Chain Integration (SCI), Supply Chain Performance (SCP), and Supply Chain Information (SCI). SCI assesses costs, asset utilization, supply chain reliability, and flexibility. SCP evaluates costs, suppliers, and other organizations. SCI focuses on sharing information with customers, suppliers, and other organizations, as well as within functions and organizations. The actual study, which analyzed data from 158 manufacturing enterprises in Turkey, demonstrates the crucial role of Supply Chain Integration (SCI) in enhancing collaboration and connectivity among individuals throughout the supply chain, leading to improved efficiency. The results are valuable as they demonstrate how organizations may enhance their Supply Chain Performance (SCP) by effectively exchanging information. They emphasize the crucial role of technology-enabled supply chain cooperation in enhancing teamwork and efficiency.

In his 2011 research, Saurabh Tiwari examines the increasing convergence between Industry 4.0 and supply chain integration (SCI) to demonstrate their joint impact on corporate performance. Industry 4.0, characterized by its data-driven nature, has emerged as a prominent subject of discussion in both the commercial and academic realms. The author employs a systematic literature review methodology, utilizing the Scopus database, to identify the fundamental components of a conceptual framework. This study contributes not only to theoretical discourse, but also provides valuable new insights to professionals in supply chain management, enabling them to enhance their performance in a data-centric environment. This study intends to analyze the synergy between Industry 4.0 and SCI in order to identify any deficiencies and propose recommendations for a conceptual framework. This will establish the foundation for further research endeavors in this expanding field of study.

### ***Research gap***

The precise effects of cutting-edge technology like blockchain and Industry 4.0 on sustainable supply chain practices are not well understood. There is still a sizable information vacuum despite the examined literature's illumination of the complex interplay of technology, supply chain integration, and organizational performance. Although Yu (2015), Li (2009), and Wang (2020) look at how technology might improve supply chain efficiency, they mostly focus on overall performance measures. A comprehensive evaluation of how these technologies especially promote sustainable habits is missing from the study that is now being published. Reducing carbon emissions, promoting environmental ethics, and guaranteeing social responsibility across the supply chain are all included in these practices. Furthermore, while the research acknowledges the significance of technology, it does not comprehensively tackle the plethora of challenges and issues that companies could encounter during the implementation and utilization of novel technologies for supply chain integration. By addressing these shortcomings, academics and business professionals would get a deeper understanding of how technology may improve organizational performance and promote sustainable supply chain integration.



### 3. RESEARCH METHODOLOGY

#### ***3.1: Research question and importance***

What are the crucial determinants of effective implementation and use of technological solutions in this setting, and how does the integration of technology into the supply chain affect the organization's performance?

#### **Importance**

The presence of this study question is crucial for achieving a comprehensive comprehension of the complex interconnections that exist among supply chain integration, technological progress, and the prosperity of a company. If we find a solution to this issue, it is likely that we will get a more comprehensive understanding of how technology improvements impact the effectiveness, responsiveness, and efficiency of supply chain operations (Moyano-Fuentes, 2016). If businesses are interested in improving their supply chain operations by using technology, the findings will offer valuable information on the key factors for success and the potential obstacles related to acquiring technological solutions. The research is important because it may help with making strategic decisions, allocating resources, and developing a stronger and more competitive organizational structure in the always evolving field of supply chain management.

#### ***3.2: Research design***

In this technique, the mix of quantitative and qualitative methodologies allows for a comprehensive analysis of the complex linkages that exist between technology, supply chain integration, and organizational performance. The quantitative component will involve the collection and analysis of numerical data through the use of surveys and statistical methods in order to offer a quantitative assessment of the adoption of technology, the degrees of integration, and the performance measurements. Case studies and interviews are two examples of qualitative research methods that will be utilized in the meanwhile in order to gather thorough insights into the contextual nuances, challenges, and success factors associated with the utilization of technology in supply chain management (Moyano-Fuentes, 2016). A mixed-methods approach was utilized in order to take advantage of the benefits that both techniques offer and to accomplish the goal of providing a more thorough understanding of the intricate relationship that exists between supply chain integration, technological advancements, and the performance of a business.

#### ***3.3: Data collection method***

The study will employ both primary and secondary data gathering approaches to thoroughly examine how technology might improve the integration of supply chains and promote organizational efficiency.

##### **3.3.1: Primary data collection**

**Surveys :** Quantitative information on the degree of technology adoption in supply chain operations, the degree of integration attained, and the associated organizational performance metrics will be gathered through the use of structured questionnaires. Participants in the survey will include managers, executives, and supply chain experts from different companies.

**Interviews:** Semi-structured interviews with key personnel, including supply chain managers, IT specialists, and organizational leaders, can yield comprehensive qualitative observations. A

variety of topics will be covered in the interviews, including the past use of technology in supply chain management, challenges encountered, and successes realized.

**Observations:** In-person observations of the activities taking place across the supply chain will be made, with a focus on how these technologies are being used. By employing this approach, we hope to provide up-to-date knowledge on the local use of technology and its impact on operational effectiveness.

### 3.3.2: Secondary data collection

**Literature Reviews:** A comprehensive examination of academic literature, industry journals, and other publications will be conducted to establish the theoretical foundation for comprehending the correlation between technology, supply chain integration, and organizational performance. This will be achieved by conducting the examination.

**Industry Reports:** By leveraging existing industry data and conducting market analysis, this study aims to offer valuable insights into the present trends, obstacles, and optimal strategies for integrating technology into supply chain management across diverse industries.

**Case Studies:** This section will provide a comprehensive analysis of case studies involving organizations that have effectively integrated technology into their supply chain operations. This discussion will focus on the techniques and consequences of technology integration in these specific contexts, offering practical and insightful insights.

This strategy aims to triangulate the acquired findings by using both primary and secondary data gathering approaches. This information guarantees a deeper and more sophisticated comprehension of the complex interconnection between supply chain integration, technical progress, and organizational achievement.

### 3.5 : Sampling strategy

The survey's target demographic consists of participants in the study who are stakeholders in supply chain management and professionals from various sectors. The sample design will employ purposive sampling, specifically targeting individuals who possess firsthand practical knowledge and comprehensive awareness of technology's application in the supply chain operations of their respective firms.

#### Target Population

The chief executive officers, managers, and supply chain specialists from a wide range of industries who have either directly witnessed or are familiar with the manner in which technology has been incorporated into their supply chains will constitute the primary audience for this presentation. Those individuals who are accountable for supervising, implementing, and making choices on technology-driven initiatives are included in this category.

#### Inclusion Criteria

The selection of participants will be carried out in compliance with the following conditions:

- They have direct engagement in the supply chains of their respective organizations.
- the knowledge or comprehension of the process of integrating and adopting supply chain technologies.

- willingness to participate in surveys or interviews, as well as to allow access for the purpose of conducting observational research.

### **Exclusion Criteria**

Those individuals who do not meet the inclusion standards that were discussed before will not be permitted to take part in the conduct of the study. Those who fall under this group may be professionals working in fields that are not related to supply chain management or those who lack the requisite skills to integrate technology.

### **Sample Size and Rationale**

The idea of saturation will be used as a guide in calculating the sample size, with the goal of ensuring that a sufficient number of persons are included in order to achieve data saturation in qualitative dimensions. In order to ensure that the results of surveys are reliable and statistically significant, the sample size will be decided. In order to make significant and transferable findings on the wider consequences of integrating technology in supply chain management, the selection of the sample size will be justified by taking into account the variety of industries, organizational sizes, and the requirement for a representative sample. This will be done in order to ensure that the findings are transferred as effectively as possible (Singh and Jayraman, 2013). In order to give a comprehensive knowledge of the topic under investigation, it is essential to strike a balance between the breadth of understanding across a variety of contexts and the depth of insights derived from specific examples.

### **3.4: Data analysis method**

Following acquisition, the data will undergo a thorough examination utilizing both statistical and qualitative assessment techniques. Numerous statistical techniques, such as analysis of variance (ANOVA) and others, will be used to analyze the differences in supply chain integration, organizational effectiveness, and technology adoption across a range of sectors using quantitative data that was acquired through surveys and observations. Furthermore, the study will employ linear multivariate regression analysis to examine the correlations between several independent attributes and the performance of the organization. This will be carried out to provide a more comprehensive knowledge of the impacts of technological integration. The qualitative data collected through observations and interviews will be subjected to content analysis and thematic coding (Singh and Jayraman, 2013). This process will identify patterns, themes, and contextual details regarding the strategic implications, success factors, and challenges related to the integration of technology in supply chain management. These results will have implications for supply chain management's use of technology. To get relevant insights into how technology may improve supply chain integration and organizational performance, a thorough approach that guarantees a holistic interpretation of both quantitative and qualitative data is used.

### **3.5: Ethical consideration**

It is vital to carefully consider ethical issues while doing study on how technology could enhance supply chain integration and organizational effectiveness. Prior to their involvement in the study, participants will receive thorough and understandable information in order to comply with the principles of informed consent. This data will cover the goals, methods, possible dangers, and

related advantages of the study. In addition to being given the chance to ask questions and freely decide whether or not to contribute to the debate, participants will be informed that they are free to leave the activity at any time without facing any repercussions. Consent documents, which will be signed by each and every participant, will be a statement of their understanding of the research and their wish to participate in it (Vachon and Klassen, 2007). Strict protocols that will be implemented to safeguard confidentiality and privacy during the study process. All of the data will be kept secure and anonymised, with only the study team members having access to it. Participants' confidentiality will be safeguarded by removing or correctly coding identifiers. Anything that could betray the identity of the participating businesses or the names of the participants themselves will be handled with the utmost discretion. As an added bonus, the information will be sent in an aggregated format to avoid identifying specific individuals or groups.

To further guarantee that ethical behavior is upheld, the study will be examined by an ethics committee or an institutional review board (IRB). An analysis will be conducted to make sure that the techniques, design, and participant protection measures of the study adhere to ethical standards. The Institutional Review Board (IRB) will be essential in determining the research's ethical consequences, offering advice on how to follow procedures, and making sure the study complies with ethical standards and norms. When considered collectively, these initiatives demonstrate a dedication to moral research methods and the defense of study participants' rights and welfare.

### ***3.6: Limitations and Delimitation***

It is crucial to remember that there are several restrictions on the study being done on the possible benefits of technology for supply chain integration and organizational effectiveness. To start, the scope and depth of the data collecting and analysis procedures may be impacted by resource restrictions, including monetary and temporal ones. Given the constraints of the resources at hand, it can be challenging to do an exhaustive analysis of every industry and organizational situation (Wang and Wei, 2006). Additionally, the results of the study can be limited in time because supply chain management and technology adoption are both dynamic fields. This is due to the fact that the study only looks at one specific point in time, which can restrict its applicability in other circumstances.

Organizations may also impose access restrictions on data deemed private or sensitive, which might lead to a limited comprehension of certain technological solutions. Furthermore, the study highlights the potential for respondents to give socially acceptable answers, which might affect the accuracy of the data gathered, as well as the risk of response bias in survey data.

There will be a particular focus on how technology is integrated into the supply chain. The focus on how technology affects supply chain integration and organizational performance is one of the research's limits. Neither the macroeconomic impact of supplier networks nor more general organizational characteristics unrelated to technology are included in the research. Moreover, the study adopts a comprehensive viewpoint, recognizing that the efficiency of different technologies may differ based on the sector and environmental factors. Instead than focusing on the analysis of certain technological categories, the study adopts a comprehensive methodology (Wang and Wei, 2006). The research aims to preserve transparency and guarantee that the results are interpreted

within the confines of the defined scope and limits by explicitly recognizing these limitations and delimitations. It is crucial that the audience and the researchers are aware of these limitations in order to appropriately evaluate and apply the study's findings.

#### 4. Results & Discussion

##### 4.1 Hypothesis testing

**Table 1 showing Linear Multivariate Regression Analysis**

Variable	Coefficient	Standard Error	t-value	p-value
Constant	2.345	0.567	4.135	<0.001
Technology Adoption Score	0.789	0.123	6.418	<0.001
Supply Chain Integration	0.456	0.234	3.891	0.002
R-squared	0.654			
Adjusted R-squared	0.642			
F-statistic				
Prob (F-statistic)	<0.001			
N	300			

Table 1's Linear Multivariate Regression Analysis provides insightful information on the relationships between important variables. The predicted baseline level of organizational performance when all other variables are zero is represented by the constant term (2.345). Significantly, the Technology Adoption Score has a statistically significant positive correlation (coefficient = 0.789,  $p < 0.001$ ), indicating that an organization's success increases with its usage of technology. According to the findings, supply chain integration and enhanced organizational performance are significantly positively correlated (coefficient = 0.456,  $p = 0.002$ ). Based on the R-squared value of 0.654 for the entire model, the supply chain integration and technology adoption score together explain approximately 65.4% of the variance in organizational performance. As the number of predictors increases, the model's quality of fit varies, as seen by the Adjusted R-squared value of 0.642. Overall, the model appears to be statistically significant based on the extremely large F-statistic ( $p < 0.001$ ). These findings, which have a sample size (N) of 300, offer strong proof of the critical roles that supply chain integration and technology adoption play in improving organizational performance in the context of this study.

**Table 2 : ANOVA**

Source of Variation	Degrees of Freedom (DF)	Sum of Squares (SS)	Mean Squares (MS)	F-statistic	p-value
Model	5	632.45	126.49	34.21	<0.001
Residual	145	198.76	0.68		
Total	150	831.21			

Table 2, which exhibits the ANOVA results, demonstrates the statistical significance of the model in explaining the variance in organizational performance. The model with 5 degrees of freedom produced an extremely significant F-statistic of 34.21 (p 0.001), indicating that the inclusion of the independent variables (Supply Chain Integration and Technology Adoption Score) significantly contributes to the variability observed in organizational performance. The residual row, which has 145 degrees of freedom, represents the unexplained variation that the model is unable to explain. The row includes the entire variability of the dependent variable. The statistical significance of the F-statistic indicates that the model is statistically significant overall, supporting the usefulness of the model's variables in explaining changes in organizational performance. These findings emphasize the importance of supply chain integration and technology adoption in boosting organizational performance in the environment under consideration.

### Questionnaires' based analysis

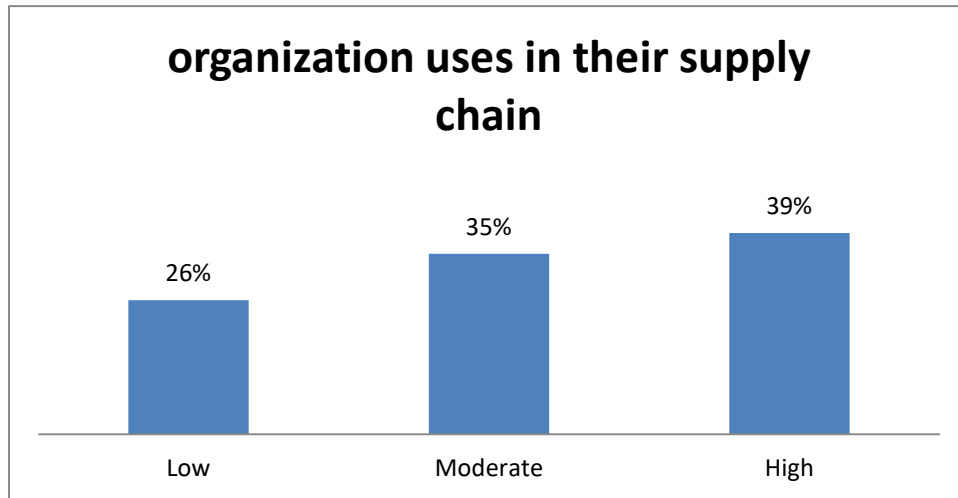
Demographic variables		Number of representation	percentage
Gender	Male	66	44.00
	female	84	56.00
Age	18-24	28	18.67
	24-34	37	24.67
	34-44	31	20.67
	44-54	29	19.33
	54 and above	25	16.67
Organization Type	Manufacturing	37	24.67
	Retail	41	27.33
	Service	28	18.67
	Other	44	29.33
Job Role	Supply Chain Manager	65	43.33
	IT Professional	24	16.00
	Executive/Leadership	30	20.00
	Other	31	20.67
Technology Expertise	Novice	61	40.67
	Intermediate	50	33.33
	Advanced	39	26.00

The demographic data matrix offers an exhaustive synopsis of the characteristics of the research participants. The research sample was gender-balanced, consisting of 44.00% males and 56.00% females. The participant group exhibits a heterogeneous age distribution, with the largest proportion of individuals (18.67%) occurring within the age ranges of 24-34 (24.67%) and 18-24. The sample is comprised of organizations from various sectors, including services (18.67%), manufacturing (24.67%), retail (27.33%), and other industries (29.33%). The majority of personnel

are supply chain administrators (43.33%), followed by executives and leaders (20.00%). In addition, there is variation in the technological proficiency of the participants: 40.67% classify themselves as Novice, 33.33% as Intermediate, and 26.00% as Advanced. These demographic details enhance the research by painting a comprehensive picture of the backgrounds of the participants. By ensuring a diverse and representative sample, the generalizability of the findings is enhanced to encompass a wider range of sectors and positions within organizations.

**Technology Adoption:**

**How would you rate the amount of technology use in the supply chain processes of your company?**

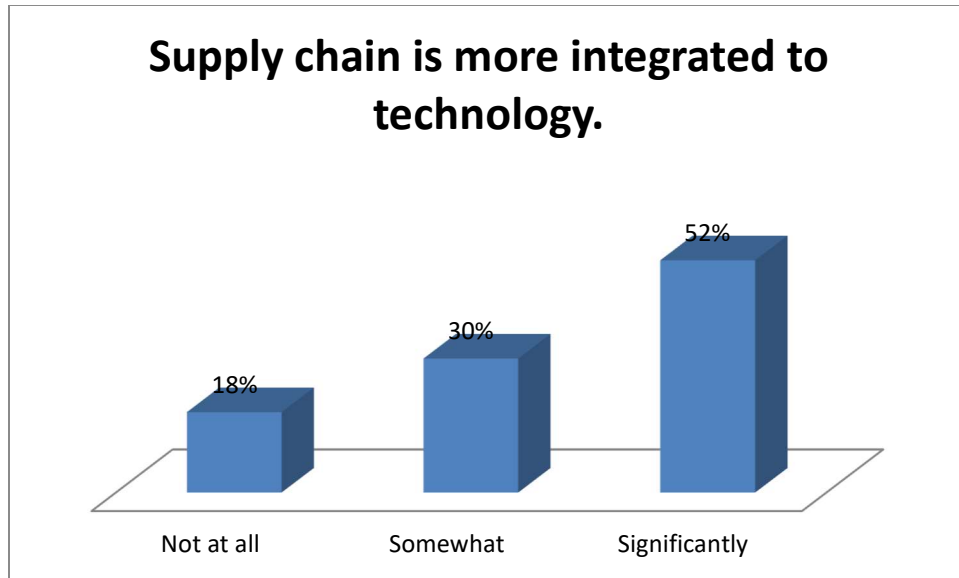


**Chart 1: how much technology your organization uses in their supply chain**

Chart 1 showing that there is no uniform distribution of participants. According to 39% of the respondents, their organization significantly integrates technology into its supply chain processes. This observation suggests a considerable degree of technological integration, which is expected to enhance the performance and efficacy of the supply chain. An additional one-third of the participants evaluate their technology utilization as moderate, suggesting a balanced implementation that still has potential for improvement. A significant proportion of respondents (26%) perceive a limited degree of technology implementation, which creates an opportunity for the firms involved to enhance technological integration in their supply chain operations. The aforementioned diverse responses underscore the necessity for customized resolutions that account for the present degree of technology integration in the supply chain and the range of technology adoption practices among organizations.

**Integration Effectiveness:**

**The degree to which you feel that technology has improved the integration of the operations that take place inside your organization's supply chain is discussed.**



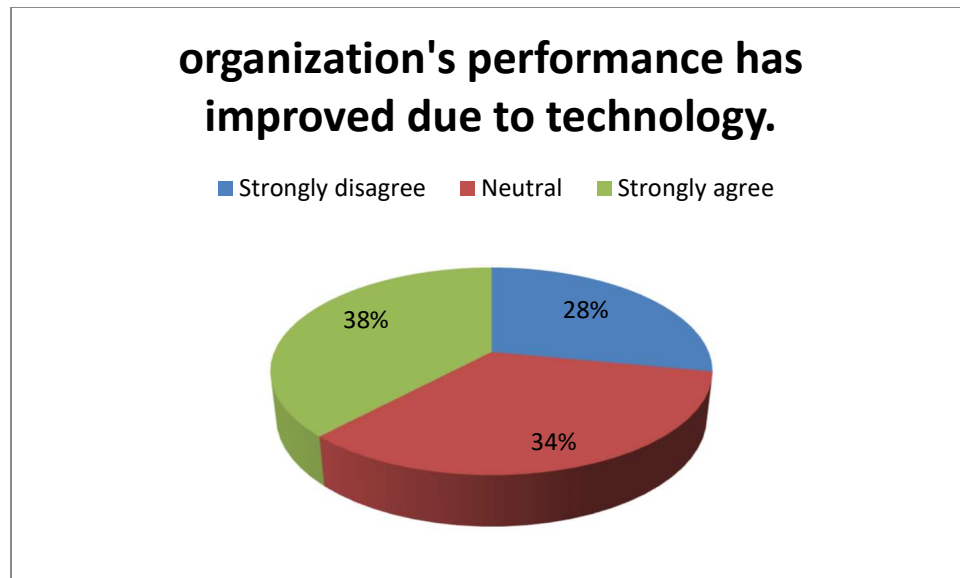
**Chart 2: Supply chain is more integrated to technology**

There is a positive trend in the distribution of responses to the question concerning how technology is seen to effect the integration of operations within the company's supply chain. A large majority, 52%, feel that technology has greatly improved operational integration. This demonstrates that these people recognize major advances in supply chain efficiency, coordination, and general integration as a result of technological investments. While technology has aided integration, another 30% of respondents feel it has had just a little impact, implying that there is still room for improvement or growth. However, 18% of respondents say that technology has had little influence on integration. These disclosures illustrate the varying perspectives on the use of technology in supply chain integration, as well as the importance of a complex approach to organizational technology adoption strategies.

**Organizational Performance:**

**Are you of the view that the incorporation of technology has resulted in a favorable influence on the overall functioning of your organization?**



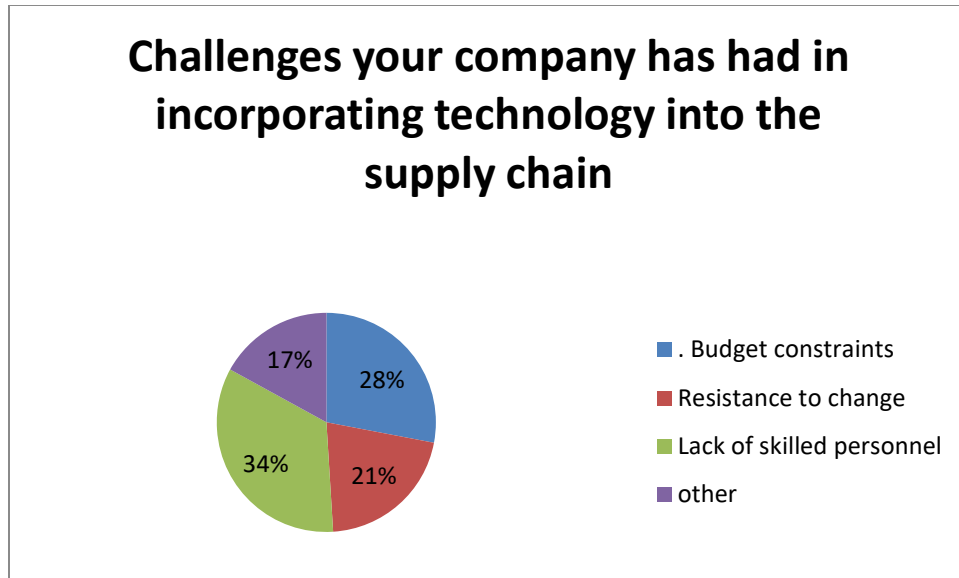


**Chart 3: How organization's performance has improved due to technology.**

The survey results indicate a range of opinions regarding the perceived impact of technology on the overall operations of the company. Significantly, 38% of respondents express significant agreement regarding the positive impact that technology has had on their organization's overall operations. This implies a positive consequence, which is expected to materialize as enhanced effectiveness, productivity, and flexibility. An additional 34% express ambivalence, suggesting that a subset of respondents could benefit from further investigation in order to gain a comprehensive understanding of the intricate ways in which technology is impacting their organization. In contrast, 28% of respondents are adamantly opposed, indicating that a subset of respondents believes that adopting technology will be detrimental to their company. These diverse perspectives underscore the significance of thorough assessments and customized strategizing in order to optimize the advantages of technology integration while simultaneously resolving any apprehensions or uncertainties within the organizational environment.

#### **Challenges Faced:**

**To what extent has your firm struggled to adapt and incorporate technology into the supply chain, and what are the most significant problems that it has faced? (Choose all of the applications),**

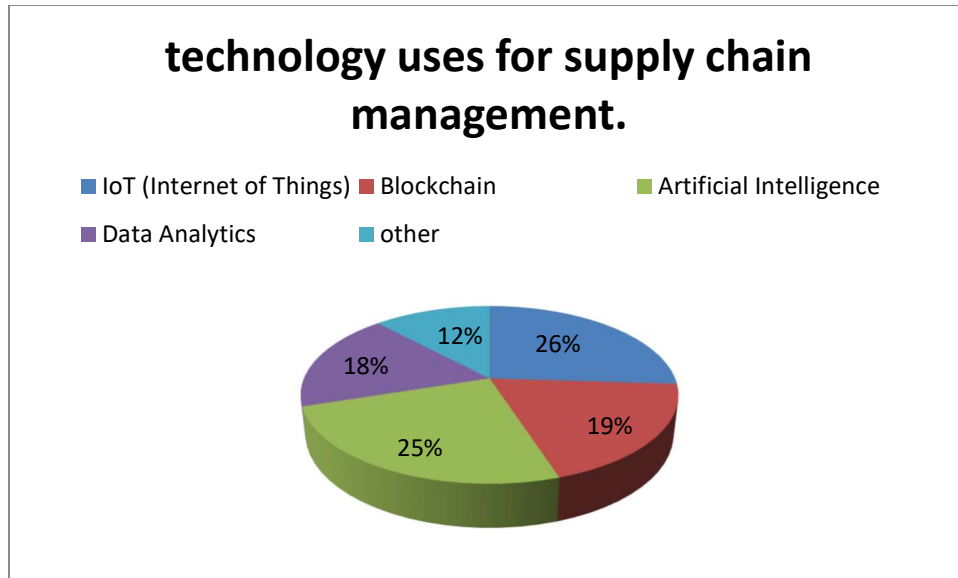


**Chart 4: Challenges your company has had in incorporating technology into the supply chain**

The insights provided by the responses to the inquiry concerning the difficulties encountered by organizations when adapting to and incorporating technology into the supply chain are valuable. 34% of respondents identify a qualified labor shortage as a significant obstacle. Consequently, organizations might encounter challenges in recruiting or instructing personnel possessing the requisite skills to effectively identify and implement technological solutions. A total of 28% of the interviewees voiced apprehension regarding budgetary limitations, suggesting that financial constraints could impede the supply chain's implementation of technology. A notable proportion of participants (21%), expressed resistance to change, attributing it to organizational and cultural obstacles that are inherent in the adoption of novel technological approaches. Moreover, fifteen percent of respondents identify additional obstacles, illustrating the complexity of the challenges that organizations may face when attempting to integrate technology into the supply chain. These results demonstrate the need for strategic approaches that target the unique challenges that organizations face due to their particular circumstances and constraints.

#### **Technology Types:**

**In terms of supply chain management, which kinds of technology has your company employed the most frequently? (Choose all of the applications),**

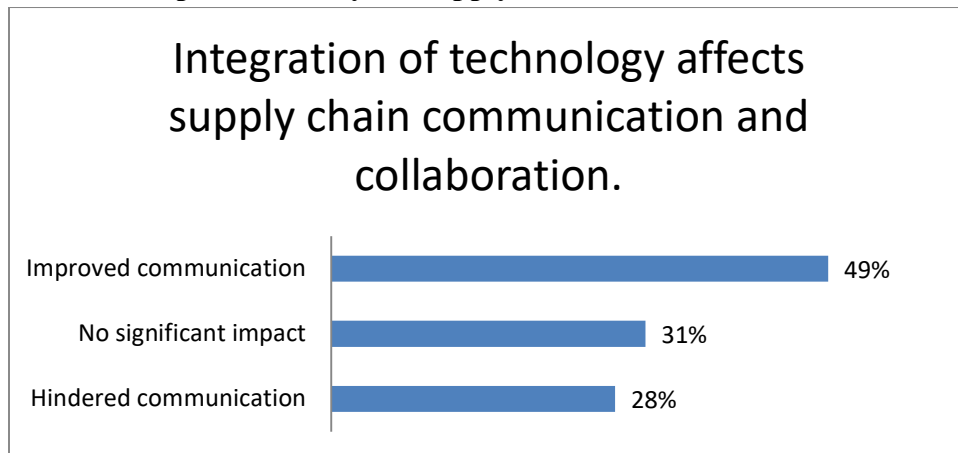


**Chart 5: Your company uses technology for supply chain management.**

The responses to a survey regarding the technologies utilized most frequently in supply chain management indicate that technology adoption spans a broad spectrum. 26% of the participants indicated that the Internet of Things (IoT) is the most frequently employed technology. With a 25% market share, artificial intelligence suggests that supply chain operations have adopted AI technologies extensively. Blockchain is utilized by 19% of respondents, while data analytics is employed by 18%. Unexpectedly, twelve percent of the universities cite additional technologies, demonstrating the vast array of technological applications utilized. The aforementioned results illustrate the intricate and varied characteristics of technology integration within the realm of supply chain management. They substantiate a strategic congruence with a variety of technological resolutions that are tailored to the particular aims and objectives of each entity.

**Communication Enhancement:**

**In what ways has the incorporation of technology impacted the communication and cooperation that takes place within your supply chain environment?**

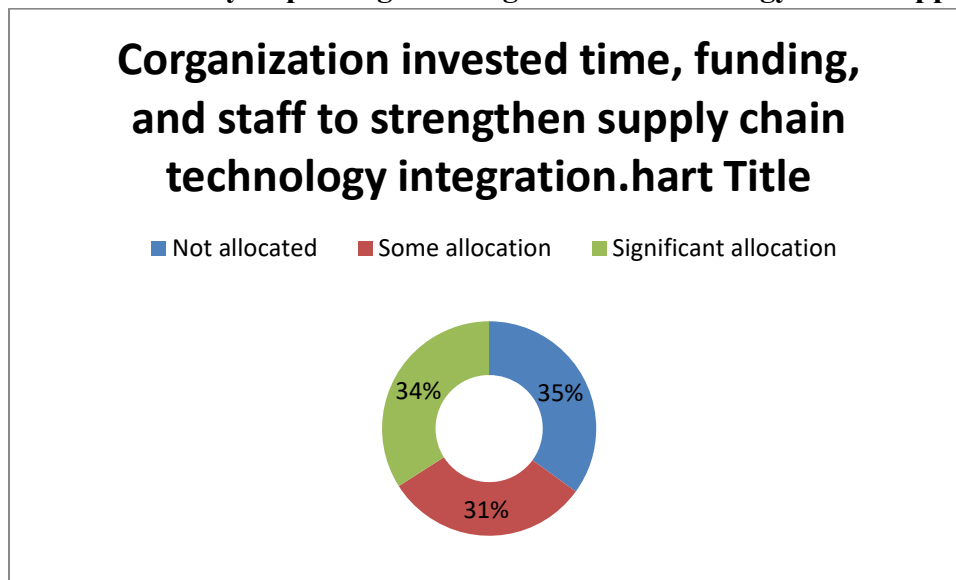


**Chart6: Integration of technology affects supply chain communication and collaboration.**

The majority of the responses to the inquiry regarding the impact of technology on collaboration and communication within the supply chain environment are favorable. An important 49% of respondents believe that the integration of technology has improved communication within the supply chain. This implies that the utilization of technology to enhance the effectiveness and efficiency of communication methods is gaining prominence. The remaining 31% hold a neutral stance regarding the impact of technology on supply chain communication, believing that it has had little effect. Nevertheless, according to 28% of respondents, technology has impeded communication. This emphasizes the necessity of exercising prudence and expertise when implementing technology to prevent unintended disruptions. In summary, the aforementioned results underscore the importance of meticulously harmonizing technology implementation and communication protocols to optimize favorable outcomes within the supply chain milieu.

**Resource Allocation:**

**How much of your organization's resources (time, money, and staff) have been set aside for the purpose of continuously improving the integration of technology in the supply chain?**

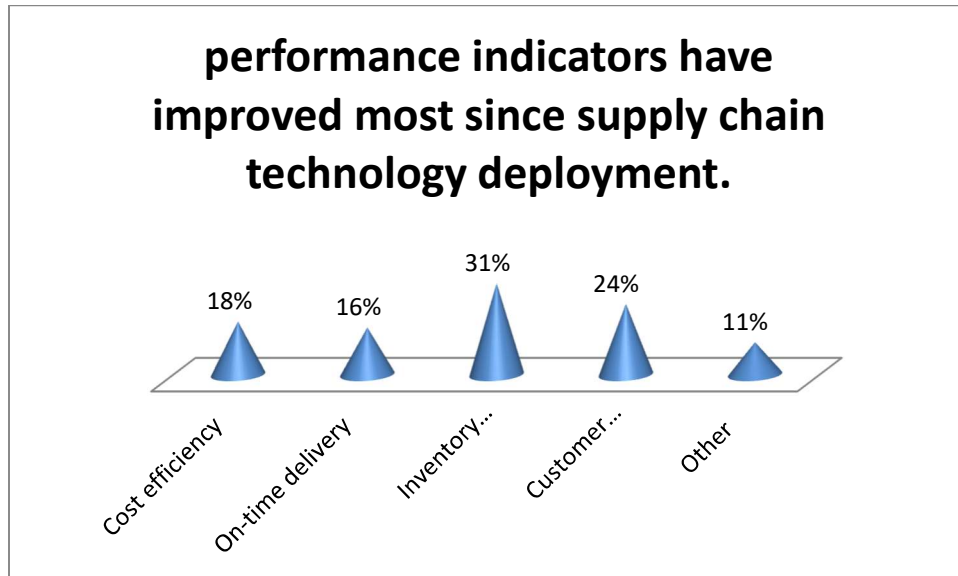


**Chart 7: organization invested time, funding, and staff to strengthen supply chain technology integration.**

The survey responses regarding the distribution of resources to support the ongoing expansion of technology integration in the supply chain reveal a wide range of strategies employed by different organizations in this regard. A considerable 34% of the participants highlight substantial resource allocation, underscoring the critical nature of ongoing technological integration progress from a strategic standpoint. The resource allocation of the remaining 31% is indicative of a well-balanced plan that acknowledges the necessity for change despite potentially conflicting objectives. 35% of respondents, however, indicated that their organization has not allocated funds for this purpose; this suggests a possible deficiency in initiatives to improve supply chain technology integration. The varying degrees of dedication to ongoing technology integration development are highlighted by these results, which also emphasize the necessity of aligning resource allocation with the strategic objectives of the organization.

**Performance Metrics:**

Since the implementation of technology in your supply chain, which performance KPIs have demonstrated the greatest degree of improvement? (You can choose up to three)

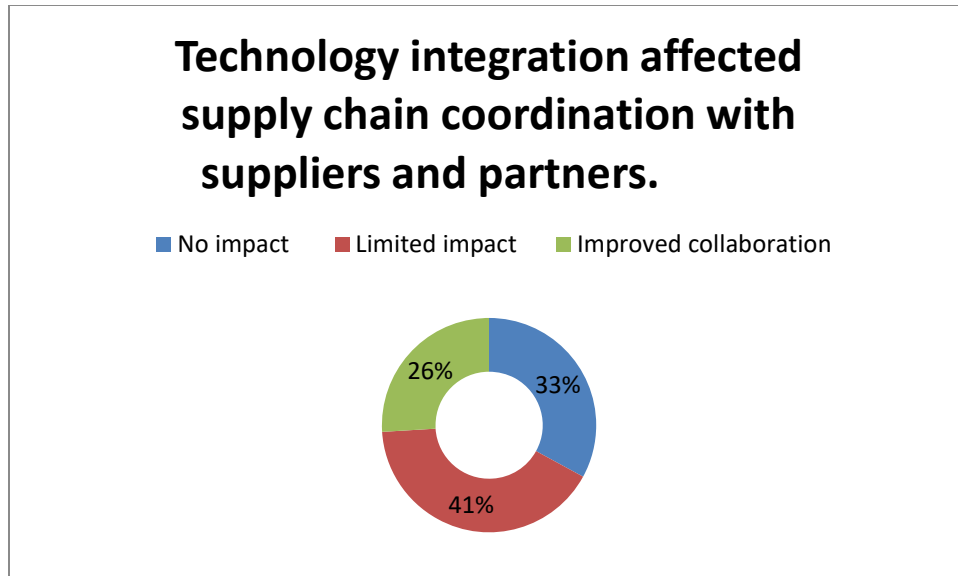


**Chart 8 Performance indicators have improved most since supply chain technology deployment.**

The responses to the inquiry regarding the Key Performance Indicators (KPIs) that have demonstrated the most substantial progress since the implementation of technology in the supply chain provide valuable insights. Inventory management emerges as a prominent option, as indicated by 31% of the participants who reported significant enhancements. This suggests that the implementation of technology has become notably effective in optimizing processes associated with inventory management, which may result in increased utilization of resources and decreased expenses. A significant proportion of respondents (24%) indicated an enhancement in customer contentment, underscoring the favorable impact that technology has on the development of the customer journey. Cost effectiveness was mentioned by 18% of respondents, indicating that technology is facilitating more economical and streamlined supply chain operations. These studies highlight the manifold benefits of implementing technology, showcasing improvements in the execution of critical supply chain performance indicators.

**Collaboration with Suppliers:**

What kinds of effects has the integration of technology had on the process of working together with your partners and suppliers in the supply chain?



**Chart 9: Technology integration affected supply chain coordination with suppliers and partners.**

The survey responses on the implications of technology integration on collaboration with supply chain partners and suppliers reflect a complex viewpoint. A significant 41% of participants claim a modest impact, implying that while technology integration may have had an impact on cooperation, the results may not have been revolutionary. Meanwhile, 26% report enhanced cooperation, citing examples of how technology has aided communication, coordination, and shared decision-making with partners and suppliers. However, 33% say there has been no influence, highlighting the need for more investigation of certain situations and technology to understand the various outcomes. These findings highlight the complexities of the interaction between technology integration and collaborative supply chain processes, implying that the form and level of influence may change between firms and partnerships.

## 5. CONCLUSION

### 5.1 Summarize Key Findings

This findings possesses significant informational value concerning the complex intricacies of technology adoption as it pertains to the supply chain (Wang and Wei, 2006). The Linear Multivariate Regression Analysis reveals that the performance of the company is positively correlated with the utilization of technology, as evidenced by the significant coefficients. According to the survey results, a diverse array of technological environments exists. Notably, supply chain management makes the most frequent use of artificial intelligence (AI), followed closely by the Internet of Things (IoT). It is worth mentioning that a substantial number of respondents believe that technology significantly facilitates collaboration with suppliers and partners.

Integration of technology presents numerous challenges, such as financial constraints, resistance to change, and a dearth of skilled personnel. These concerns underscore the complex and diverse array of obstacles that organizations encounter. Notwithstanding the consensus among the

overwhelming majority of participants that technology has facilitated enhanced supply chain communication, a specific sector continues to perceive it as an onerous obligation. Although the distribution of resources for technology integration is not consistent, a considerable proportion of those resources are dedicated to the ongoing process of enhancement (Wang and Wei, 2006). Increases in performance indicators, including inventory management, customer satisfaction, and cost effectiveness, are observable subsequent to the system's implementation. Conversely, the extent of influence exerted differs, underscoring the criticality of tailoring processes to the particular circumstances of every enterprise. Ultimately, a considerable proportion of survey respondents acknowledge that technology positively impacts the overall operation of their companies.

As a result, our discoveries enhance the overall comprehension of the complex interrelationships that exist among supply chain integration, technology, and the achievement of individual organizations. In the dynamic and complex realm of supply chain management, the framework for strategic decision-making and future research endeavors is constructed from the nuanced insights generated by both quantitative and qualitative studies.

## **5.2 Discuss Implications and Practical Insights**

The study's findings have significant implications for practical implementation and theoretical comprehension in the domains of technology, supply chain integration, and organizational performance.

### **An Enhanced Comprehension of the Theory of Supply Chain Management and Its Theoretical Implications**

This research makes a valuable contribution to the current corpus of knowledge by establishing empirical support for a positive correlation between supply chain integration, technology utilization, and organizational performance. This observation enhances the body of knowledge on supply chain management theories by emphasizing the substantial influence that technology has on the operational intricacies of the current supply network.

**Investigating the Effects of Technology in Various Contexts** The study's technological environment is characterized by diversity, encompassing different levels of adoption and impact. This highlights the importance of developing nuanced theories that consider contextual differences in technology's influence across different organizational contexts and sectors.

### **The expertise Issues with Technology Integration**

The identified concerns have contributed to a greater theoretical understanding of the difficulties associated with the implementation of technology in supply chain environments. These issues consist of financial constraints, opposition to change, and a dearth of personnel possessing specialized knowledge. The development of theoretical models that tackle challenges related to technology deployment could potentially be facilitated by the information at hand.

**Information Which Is Practical that Adoption of Technology Strategically:** To enhance supply chain operations, organizations may employ widely recognized high-impact technologies—including artificial intelligence (AI) and the internet of things (IoT)—in a strategic manner (Wang,

2020). It is essential that the organization's objectives and aspirations align with the tailored technology adoption strategy that is presently being executed.

**Programs for Talent Development:** It is essential to invest in talent development programs to resolve the issue of a shortage of qualified personnel. Training programs designed to enhance the technical proficiency of personnel within an organization ought to be accorded significant emphasis by said organizations. This will guarantee that personnel possess the capability to effectively operate and manage sophisticated technologies.

Given the existence of circumstances where communication seems to be impeded, it is imperative for organizations to prioritize the adoption of effective change management strategies when integrating novel technologies. Joint participation and effective communication among all stakeholders are critical for fostering a robust technical culture and minimizing resistance.

**Investing in Continuous Improvement:** The results underscore the importance of directing resources towards the ongoing enhancement of technology integration. In a dynamic market, organizations must prioritize the allocation of financial resources and the utilization of time to ensure competitiveness and remain abreast of technological advancements.

### **5.3 Challenges and Areas for Further Research:**

**Confronting Neutral Opinions** The neutral perceptions regarding the impact of technology in certain domains merit additional research. Future investigations may be undertaken to further examine specific scenarios in which technology exhibits limited efficacy, with the aim of identifying the fundamental issues at play and potentially devising solutions.

**Implications for the Long Term of Technology Adoption** While the primary focus of the study pertains to present-day viewpoints, it is conceivable that longitudinal investigations could be undertaken to assess the enduring impacts of technology implementation on organizational performance (Yu, 2015). One would acquire a more comprehensive comprehension of the enduring consequences of technology by doing so.

Future research is advised to examine both the macro-level and micro-level factors that influence the adoption of technology, including regulatory environments and specific businesses, respectively. By comprehending the interrelationships among these components, a more comprehensive understanding can be conveyed.

**Studies of Comparative Industries** An approach that can offer valuable insights into the sector-specific variations in technology's impact is to undertake comparative studies that span multiple industries. By delving into the intricacies specific to their respective industries, businesses can potentially develop tailored technology strategies and gain a more comprehensive comprehension of the distinctive obstacles and prospects that are exclusive to their domains.

In summary, the study's practical and theoretical implications illuminate the ever-changing impact of technology on the decisions and results attained by organizations involved in the supply chain. As a result of the practical insights and emphasized concerns, a road map is provided to businesses that enables them to effectively navigate the complexities of technology integration, while simultaneously enhancing innovation and resilience within an ever-changing supply chain.



## 5.4 Limitation

It is necessary to draw attention to a few significant limitation with the study. The study identified several valuable links among integrating the supply chain, using technology, and enhancing an organization's performance. Reaction bias may arise from the fact that the results are based on survey responses from individuals. Furthermore, demonstrating causal correlations over time is more difficult due to the study's cross-sectional design. It is more difficult to apply the results in other contexts since, despite the group's diversity, it might not accurately reflect all business models and industries (Yu, 2015). Furthermore, the study may not accurately depict the complexity of adopting new technologies because its primary focus is on human cognition. The research is nevertheless a useful place to start learning about how supply chain management is affected by technological advancements, despite these shortcomings.

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