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ABSTRACT

As global industries embrace digital technology, understanding its effects on supply chain processes becomes crucial for boosting competitiveness and operational efficiency. Digital advancements have significantly influenced business innovation and performance, particularly in supply chain management, where digitization has become integral for optimizing procurement functions and aligning with evolving market demands. This study therefore aimed to examine the effect of digital technology on the performance of supply chain systems in manufacturing firms in Kenya. The study specifically examined the effect of digital supply chain transformation, supply chain agility, lean supply chain and supply chain collaboration on performance of supply chain systems at Giant Millers Limited. The study was anchored on resource-based view, lean production theory, and technology-organization-environment framework. The study adopted a descriptive design and targeted 229 employees of Giant Millers Limited in Nairobi, Kenya. The study used a simple random sampling technique to select the respondents for the study in conjunction with purposive sampling technique. The study used structured questionnaires that were issued to the respondents through a drop and pick later method. Data analysis involved quantitative analysis to establish trends in the responses. Similarly, regression analysis was performed to establish the relationship between digital technology metrics and performance of supply chain systems at Giant Millers Limited. Results revealed a strong positive relationship between digital supply chain transformation, supply chain agility, lean practices, and supply chain collaboration and the performance of supply chain systems at Giant Millers Limited in Kenya. These variables were found to significantly influence the company's operational efficiency, collectively explaining approximately 63.9% of the variation on performance. ANOVA results also supported the model's significance, showing that each variable contributed positively and meaningfully, with digital supply chain transformation emerging as a key factor driving enhanced performance. The study therefore, recommended that Giant Millers should adopt emerging technologies like IoT, AI, and block-chain to improve supply chain transparency and efficiency, alongside ongoing employee training for effective implementation. To enhance agility, GML should develop flexible workflows and engage in regular scenario planning while fostering cross-functional teams for better communication. Additionally, conducting audits to eliminate inefficiencies and standardizing operations to boost productivity. The study further recommended for strengthening partnerships with suppliers and investing in advanced communication tools to enhance collaboration, and improve supply chain effectiveness and resilience. The researcher suggested for more studies to focus on how companies can leverage big data to optimize inventory management, demand forecasting and supplier selection.

***Keywords**: Digital Technology; Supply Chain Transformation, Supply Chain Agility, Lean Supply, Supply Chain Collaboration and Supply Chain Performance.*

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INTRODUCTION

The influence of digital technology on the performance of supply chain systems in manufacturing firms is a critical area of research, especially in the context of Kenya and the broader African region. As digital transformation reshapes industries globally, understanding its implications on supply chain dynamics becomes essential for enhancing competitiveness and operational efficiency (Ghobakhloo & Ching, 2019; Nasiri, Ukko & Saunila 2020). Over the past ten years, manufacturing companies have been investigating the potential applications of cutting-edge digital technologies, such as artificial intelligence (AI), big data analytics (BDA), and the Internet of Things (IoT), in their supply chain management (SCM) and production processes (Addo-Tenkorang & Helo, 2016; Caputo et al., 2016).

Scholars contend that the development of digital technology has a significant impact on supply chain management. However, using and implementing digital supply chains is difficult and complex (Wang et al.,2022). Moreover, digital manufacturing has the potential to shift supply chains' organizational structure from a distributed to a centralized production model (Holmström and Partanen, 2014). This typically causes the supply chain to shorten significantly, which puts other stakeholders at risk because they too must swiftly adjust to this disruptive change.

According to Chase (2019), digital supply chain (DSC) has emerged as a necessary option for businesses looking to increase their capacity to forecast demand and risk through the use of digital technology. This enhances not only the speed at which the market responds to changes and the operational effectiveness of businesses, but also the quality of services provided and their financial gains. Preindl et al. (2020) assert that the digital technology augments the information-sharing capacity, a crucial function in this collaboration that aims to digest copious volumes of information to synchronize associated operations for increased efficacy.

Furthermore, Banerjee and Mishra (2017) contend that digital technologies enhance supply chain collaboration, which necessitates coordination and unity between suppliers, manufacturers, retailers, and customers on both an internal and external level. However, the implementation and use of the digital technology in supply chain presents complex challenges, requiring collaboration across sectors, industries, and fields. 80% of digital transformation practices fail, according to the statistics. Reyes et al. (2020) contend that instead of heedlessly adopting technology for its own sake, companies should determine whether new innovations can help them reach their strategic and operational goals. Tjahjono et al. (2017), note that effective configuration and coordination of technical activities ensure successful applications. This can only be achieved through improving organizational capacity.

A higher level of production technology changes in particular might lead to the more effective and efficient extension of process and product standardization among SC members, as well as the use of lean supply chain tools and practices like value stream mapping (VSM) to identify and eliminate waste (Seth et al., 2017). Furthermore, Degroote and Marx (2013) acknowledge that DT enhances the supply chain's agility and enables the company to detect changes in the market by enhancing the flow of information among chain participants in terms of sufficiency, correctness, accessibility, and timeliness. Additionally, DT improves the quality and timeliness of creating and implementing coordinated plans to respond to changes in the market across the supply chain, which lowers costs and boosts the chain's ability to adapt to changes in the market.

A joint survey by SYSPRO and Strathmore Business School (SBS) in 2020, revealed that majority of manufacturing firms in Kenya still operate using outdated technology. Only 11% of firms are fully automated, compared to 83% who are semi-automated while 6% use only manual processes. Moreover, Nganga (2020) allude that

manufacturing firms in Kenya rely heavily on labor-intensive manual labor and simple hand tools for production and points that globalization and the successful adoption of Industry 4.0 by companies can lead to fierce rivalry, posing extremely detrimental concerns to upcoming companies.

Studies show that global landscape of manufacturing is rapidly evolving due to the integration of digital technologies in their supply chain systems. For instance, in Europe, the adoption of digital technologies in manufacturing is often framed within the context of Industry 4.0, which emphasizes smart manufacturing through the use of IoT, artificial intelligence (AI), and big data analytics. A study by Kagermann et al. (2013) outlines how these technologies can enhance production processes by enabling real-time data exchange and decision-making. The research indicates that European manufacturers who embrace these technologies see significant improvements in operational efficiency and product quality.

Moreover, Brettel et al. (2014) conducted a comprehensive analysis of the impact of digital technologies on manufacturing performance in Germany. Their findings reveal that firms utilizing advanced manufacturing technologies reported a 20% increase in productivity and a substantial reduction in time-to-market for new products. The study emphasizes the importance of a supportive organizational culture to facilitate the successful adoption of these technologies.

In South Korea, the integration of IoT and smart factories has transformed supply chain systems significantly. Kim et al. (2018) found that manufacturers using IoT technology could track products throughout the supply chain, enhancing visibility and reducing delays. This real-time tracking allows firms to respond quickly to supply chain disruptions, improving overall efficiency. Choi et al. (2019) also emphasize the role of digital twins in optimizing supply chain performance. By simulating supply chain processes, manufacturers can identify bottlenecks and test different scenarios to improve logistics and distribution strategies. This proactive approach leads to enhanced supply chain agility and reduced operational costs.

In the Americas, particularly in the United States, the impact of digital technology on manufacturing has been extensively studied. McKinsey and Company (2016) published a report highlighting that U.S. manufacturers adopting digital technologies could achieve productivity gains of up to 30%. The report outlines various case studies where companies like General Electric and Boeing have leveraged digital tools to optimize their supply chains and enhance operational efficiencies.

Statement of the Problem

In the current fast-paced business environment, manufacturing firms must adopt contemporary digital solutions in their supply chain operations to succeed (Wang et al., 2022). Supply chain digitalization offers economical solutions and adds value for all stakeholders in the ecosystem, including companies and their suppliers, employees, and clients (Korpela et al., 2017). Agrawal and Narain (2018) further attributed the benefits of digital supply chains to increased transparency, lower inventory levels, clear visibility of inventory, more decentralized warehousing, shorter lead times, improved customer understanding, improved supply chain flexibility, improved decision-making processes, and maintaining competitive advantages.

The use of digital technology in supply chain management (SCM) has been acknowledged in a number of academic papers as having significantly increased SCM's efficacy. Backhaus & Nadarajah (2019) asserted that digitalization makes it easier for businesses to collaborate by enabling resource pooling, lifecycle integration, and collaborative production. To properly optimize their operations, manufacturing companies must integrate intelligent technologies like location-based services and barcode scanning into their supply chain (Nasir et al.,2020; Bacgkhaus & Nadarajah, 2019).

However, significant inefficiencies in Kenya's supply chain management and procurement environment have led to higher costs, longer delivery times, and a lack of transparency in the process (Kuria, Muhoro, & Ngari, 2021). The lack of automation, the use of paper-based and manual processes, and inadequate information management systems are the causes of these inefficiencies. The inadequate optimization of supply chain operations in Kenya has been attributed to the absence of technological solutions in the procurement and supply chain management processes (Murumba & Ngari, 2020). Although technology solutions, like supply chain management software and e-procurement systems, have been developed to simplify supply chain and procurement procedures in other nations, their adoption in Kenya has been slow, with many businesses continuing to rely on manual and paper-based processes (Kuria, Muhoro, & Ngari, 2021). The lack of understanding, the poor infrastructure, and the restricted ability to deploy and maintain these technologies are the causes of this sluggish acceptance.

This study therefore, aimed to examine the effect of digital technology on the performance of supply chain systems at Giant Millers Limited in Kenya.

Objective of the study

The main objective of this study was to examine the effect of digital technology on the performance of supply chain systems at Giant Millers Limited in Kenya. Specifically, the study assessed the effect of digital supply chain transformation on the performance of supply chain systems at Giant Millers Limited in Kenya.

LITERAURE REVIEW

Theoretical Review

Technology-Organization Environment Framework

The Technology-Organization-Environment (TOE) framework, was developed by Tornatzky and Fleischer in 1990. The TOE framework identifies three critical dimensions i.e. technology, organization, and environment, that influence the adoption of technological innovations within organizations (Tornatzky & Fleischer, 1990). From a technological perspective, the framework emphasizes the adoption of advanced tools such as IoT, AI, and big data analytics, which are instrumental in enhancing supply chain visibility, optimizing inventory management, and enabling data-driven decision-making (Büyüközkan & Göçer, 2018; Zheng et al., 2020). These technologies help firms streamline operations and respond proactively to supply chain disruptions, improving efficiency and resilience.

The organizational dimension of the TOE framework highlights the importance of internal factors, such as leadership commitment, employee expertise, and organizational readiness, in enabling successful digital transformations (Li et al., 2018; Oliveira et al., 2020). This includes fostering a culture that supports innovation and providing adequate resources for training and system integration. Meanwhile, the environmental context focuses on external pressures such as market competition, customer expectations, and regulatory requirements, which compel firms to adopt digital technologies to remain competitive (Dubey et al., 2021).

For Giant Millers Limited, applying the TOE framework provides a structured approach to understanding how these three dimensions collectively drive digital supply chain transformation. By leveraging the framework, the company can align its technological advancements, organizational strategies, and environmental adaptations to enhance performance and maintain a competitive edge in the rapidly evolving manufacturing sector. TOE framework therefore, provides a robust foundation for examining the effect of digital supply chain transformation on supply chain performance at Giant Millers Limited in Kenya.

Empirical Review

Digital supply chain transformation (DSCT) refers to the process of integrating advanced digital technologies into supply chain operations to

enhance efficiency, agility, and decision-making across the value chain. This transformation involves leveraging tools such as artificial intelligence (AI), the Internet of Things (IoT), blockchain, big data analytics, and cloud computing to automate processes, improve visibility, and enable real-time collaboration between stakeholders (Ivanov & Dolgui, 2020; Büyüközkan & Göçer, 2018). DSCT encompasses changes in both technological infrastructure and organizational processes to create smarter, more connected supply chains that can adapt dynamically to market demands and disruptions (Hugos, 2018).

Digital transformation enhances the efficiency of supply chain management by improving data accessibility and reducing transaction costs between partners (Nayal et al., 2022; Oubrahim et al., 2023). Additionally, research highlights that the adoption of information technology contributes significantly to enhancing supply chain performance by streamlining processes and fostering better collaboration (Cui et al., 2023; Han et al., 2017).

Manufacturing firms leverage digital supply chain transformation to optimize production, inventory management, and logistics through data-driven decision-making and predictive analytics (Hugos, 2018; Waller & Fawcett, 2013). For example, DSCT enhances the ability to anticipate demand fluctuations, reduce waste, and minimize lead times while improving customer satisfaction value (McKinsey & Company, 2020). DSCT also emphasizes the strategic alignment of technological investments with organizational goals to ensure that the transformation delivers measurable performance improvements, such as cost reduction, increased resilience, and enhanced sustainability (Dubey et al., 2021; Queiroz et al., 2019).

Mwangi (2023) explored the adoption of technologies like IoT and AI in Nairobi-based firms. The study adopted a cross-sectional survey design, targeting manufacturing firms in Nairobi. The population included supply chain managers from 50 companies, with data collected through structured questionnaires. The findings revealed significant improvements in operational efficiency, cost reduction, and decision-making, driven by real-time data and automation. However, challenges such as high implementation costs and skill gaps were noted as barriers to fully digital integration.

Kamau et al. (2022) examined the role of cloud computing in supply chain management among Kenyan manufacturers. The study used a mixed-methods approach involving interviews and surveys with 30 manufacturing firms using cloud computing. Participants were IT and supply chain managers. Findings showed that cloud computing enhanced data sharing, collaboration, and process automation. Nonetheless, cybersecurity threats and lack of trust in data storage services hindered its adoption.

Ochieng and Mutua (2021) explored the use of big data analytics in supply chain systems among manufacturing firms in Kenya. The researchers adopted a case study design focusing on two leading manufacturing firms in Kenya. Data was collected through semi-structured interviews with supply chain managers and analyzed qualitatively. The study found that big data analytics improved demand forecasting and inventory management. However, limited IT infrastructure and the cost of analytics tools restricted broader adoption.

Muthoni (2023) performed a longitudinal study examining blockchain integration in agricultural export supply chains. The study population included exporters and supply chain managers from 20 firms in Kenya. Findings revealed that blockchain improved transparency, reduced fraud, and ensured compliance with export standards. However, the study highlighted issues with scalability and interoperability across systems. showing reduced fraud and better compliance with export standards.

Moreover, Waweru and Gikonyo (2022) conducted a survey on the challenges faced by Kenyan manufacturers in adopting digital technologies. Their findings indicate that while there is a growing awareness of the benefits of digitalization, issues

such as limited access to financing and insufficient technical expertise remain significant barriers. The study advocates for public-private partnerships to promote technology adoption and skills training in the manufacturing sector.

Mbatha and Otieno (2023) study focused on AI-powered demand planning in East African firms. The study employed a qualitative approach using focus group discussions with supply chain managers in East Africa and analysed data using thematic analysis method. The findings from the study revealed that AI-powered demand planning enhanced responsiveness to market changes. However, firms struggled with harmonizing cross-border policies and aligning digital tools with business objectives.

Research by Nkosi et al. (2022) on South African manufacturing firms, surveyed 100 South African manufacturing firms. Data were analyzed using structural equation modeling to examine relationships between blockchain use and supply chain agility and found that blockchain and predictive analytics improved transparency and agility in supply chains. However, regional infrastructure and regulatory constraints limit the scalability of these innovations. The need for public-private partnerships to foster digital literacy and infrastructure investment is also highlighted.

Amponsah et al. (2021) study examined Ghanaian firms' use of IoT in logistics. The study used a descriptive survey design targeting logistics manager in 50 manufacturing firms in Ghana. Data were collected via questionnaires and analyzed quantitatively. Findings showed improvements in tracking and fleet management but highlighted challenges in device integration.

Osei et al. (2020) conducted a survey on the barriers to digital adoption in Ghanaian manufacturing firms. Their findings reveal that challenges such as limited access to finance, inadequate infrastructure, and a lack of skilled workforce hinder the widespread adoption of digital technologies. The study calls for targeted government interventions to promote digital literacy and support technology adoption in the manufacturing sector.

Banda and Musonda (2022) Studied Zambia's adoption of e-commerce platforms in manufacturing supply chains. The study used a survey approach, targeting 40 Zambian manufacturing firms using e-commerce platforms. Data were analyzed using regression analysis to evaluate the impact on supply chain performance. Findings showed that e-commerce improved customer engagement, delivery efficiency, and inventory management but faced challenges with rural connectivity and customer trust in online platforms.

Ning and Yao (2023) conducted a large-scale study examining the integration of technologies such as big data, cloud computing, and AI. Their findings underscore that digital tools enhance supply chain agility, collaboration, and competitive performance. Moreover, supply chain capabilities mediate the relationship between digital transformation and organizational competitiveness, particularly under conditions of market uncertainty. This underscores the importance of aligning digital strategies with broader supply chain objectives

Queiroz et al. (2021) focused on the role of blockchain in global supply chains. The researchers conducted a meta-analysis of 30 studies on blockchain in global supply chains and relied on secondary data to identify common themes and challenges. Results showed blockchain improved transparency, traceability, and trust across supply chains but was hindered by high implementation costs and scalability.

Conceptual Framework

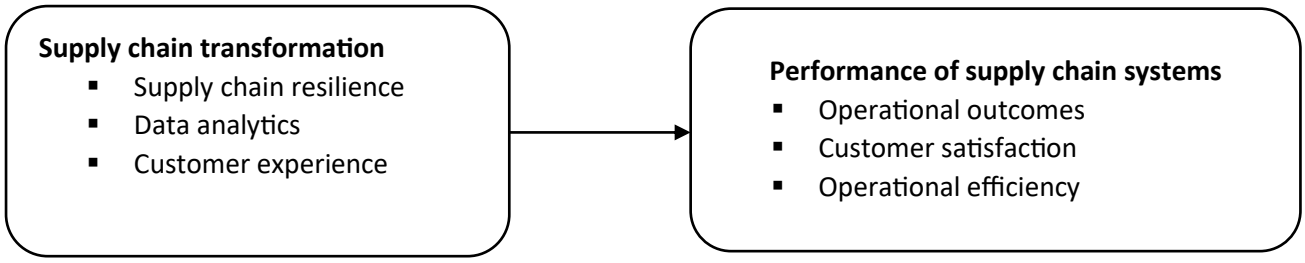

Figure 1: Conceptual Framework

METHODOLOGY

This study adopted a descriptive survey design. Neuman (2017) describes a descriptive design as an explanatory and a fact-finding tool with the ability of establishing the truth.

In addition, the study targeted 229 employees drawn from procurement, production and marketing departments of Giant Grain Millers Limited in Nairobi, Kenya (GML, 2023). Out of this, the researcher selected a sample of 70 respondents who were randomly selected through simple random sampling to take part in the main study and adopted a structured questionnaire collect data. The data collected from the field was analyzed using qualitative and quantitative analyses. Quantitative data were taken through a preliminary data analysis process to ensure that they were comprehensive, accurate, free of errors, omissions, and other irregularities. These were thereafter subjected to quantitative analysis through descriptive statistics with the aid of Statistical Packages for Social Sciences (SPSS) software, which sought to determine the frequencies, percentages, means and standard deviation scores on the data sets. Multiple regression analysis was used to determine whether there exists a relationship between the dependent and independent variables (Faraway, 2002; Cohen, West, and Aiken 2003).

FINDINGS

Descriptive Analysis

Effect of Digital Supply Chain Transformation on Performance of Supply Chain Systems of GML

The first objective of the study sought to assess the effect of digital supply chain transformation on the performance of supply systems at Giant Millers Limited in Kenya. This objective sought to answer the question “What is the effect of digital supply chain transformation on the performance of supply chain systems at Giant Millers Limited in Kenya?

The first question under this objective sought to establish whether digital technology transformation contributes to the success of Giant Miller’s supply chain performance systems. The summarized findings obtained was presented in Figure 1 below;

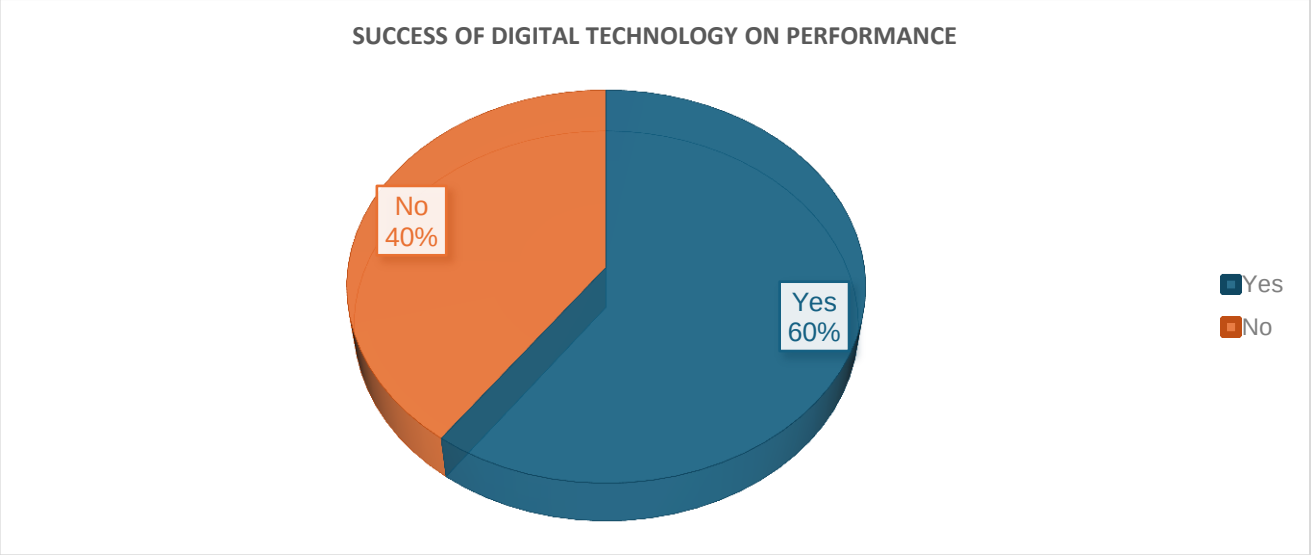

Figure 2: Success of digital transformation on performance of supply chain systems

The findings on the above Figure 1, indicate that majority of the respondents agreed that digital technology transformation contributes to the success of Giant Miller's supply chain performance systems as shown by 60% of the respondents, whereas 40% disagreed. In conclusion, the findings suggest that digital technology greatly influences the performance of supply chain systems at Giant Millers limited. The findings conform with a report of Australian Manufacturing Forum (2019) which found that digital technologies' such as robotics and AI, were transforming supply chain operations, hence leveraging these technologies to streamline logistics and distribution, resulting in improved delivery times and reduced operational costs

The second question sought to establish whether Giant Millers Limited had a policy that guides the integration of digital technology systems in their manufacturing value chain. The summarized results were presented in Figure 3 as shown below;

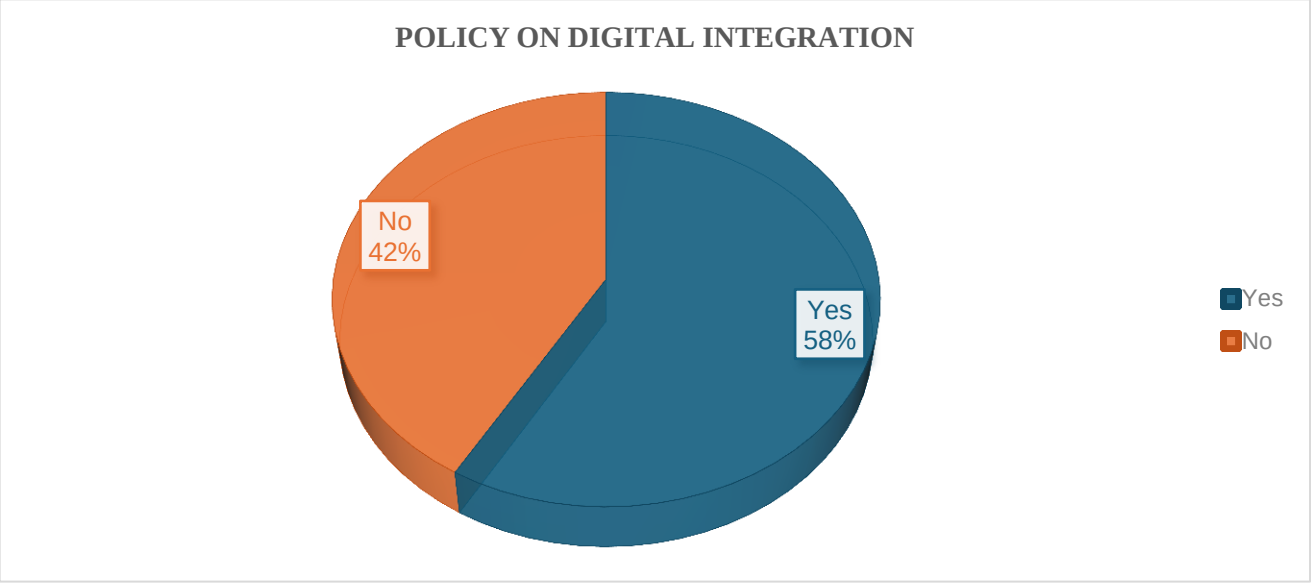

Figure 3: Policy framework on digital technology integration in manufacturing value chain

The results showed that moderate majority (58%) agreed that the company had policy in place that guided the integration of digital technology on their manufacturing value chain systems. This implied that Giant Millers limited embraced policies that provided a foundation for digital integration in their manufacturing operations.

The third question sought to establish the main reasons for slow digital technology systems integration in manufacturing operations at Giant Millers Limited. The respondents were required to outline reasons why the company's manufacturing operations had not fully embraced digital technology. The summarized results are indicated in Figure 4 below'

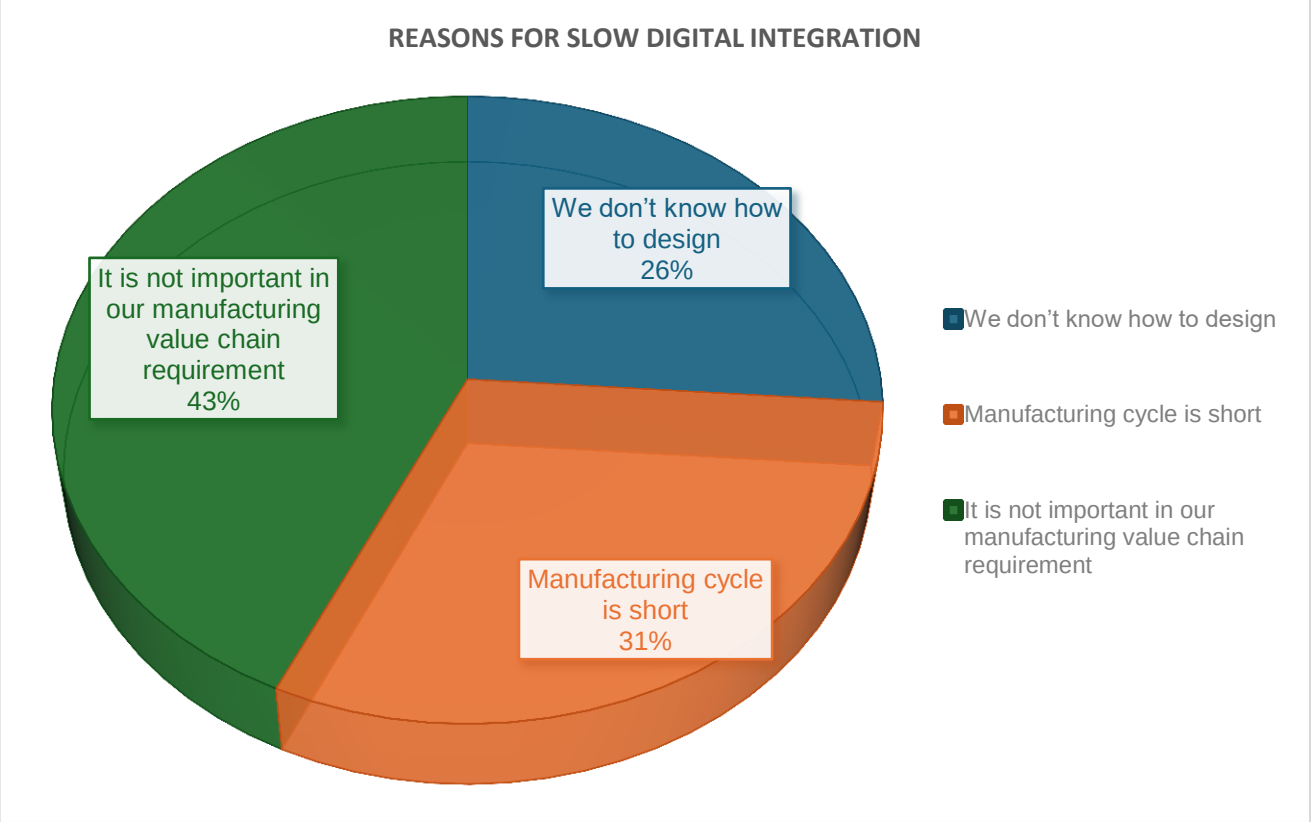

Figure 4: Reasons for slow digital integration in manufacturing operations

Findings from the above Figure 4, show that among the many reasons indicated by the respondents, majority cited that digital technology integration was not important in the company's manufacturing value chain requirement (43%), compared to 31%, who cited that manufacturing cycle at the company was short hence there was no need. Whereas, 26% of the respondents indicated that the company did not know how to design it. The findings implied that Giant Millers Limited lacked the technical capacity to integrate fully digital technology in their manufacturing operations. Waweru and Gikonyo (2022) also noted in their study that while there was a growing awareness of the benefits of digitalization, issues such as limited access to financing and insufficient technical expertise remained as significant barriers. Moreover, Mwangi (2023) argued that challenges such as high implementation costs and skill gaps were barriers to digital integration.

The last question under this objective required respondents to rate their opinions on the level of agreement based on the statements provided regarding digital supply chain transformation at the company. The summarized findings were presented in Table 1 below;

Table 1: Descriptive Statistics on Digital Technology Transformation

Statements	N	Mean	Std. Deviation
Our supply chain is capable of quickly recovering from disruptions e.g. market changes	65	3.4000	1.05771
We have contingency plans in place to address potential supply chain disruptions effectively.	65	3.5615	1.40175
The resilience of our supply chain has improved as a result of adopting new technologies and practices	65	4.0769	.73544
Our organization effectively uses data analytics to inform supply chain decision-making.	65	3.8923	.85006
The insights gained from data analytics have led to significant improvements in our supply chain performance	65	2.7231	1.09698
Employees are trained to utilize data analytics tools to enhance their work within the supply chain.	65	3.9538	.69441
Our supply chain practices contribute positively to the overall customer experience.	65	3.6615	.75575
We actively gather customer feedback to improve our supply chain processes.	65	4.2000	.44017
The use of digital technologies has enhanced our ability to meet customer expectations and demands	65	3.9538	.79904
Valid N (listwise)	65		

Scale: 1.0 -2.49= Disagree; 2.50-3.49 =Neutral/Moderate; 3.50-5.0 =Agree.

Source: Field Data (2025)

The means obtained from the study ranged between 2.7231 to 4.2000, reflecting varying levels of perceived effect of digital technology transformation on performance of supply chain systems at Giant Millers Limited. A higher score indicated stronger agreement or greater effect, with the highest score of 4.2000 signifying the most significant factor identified by respondents. Conversely, lower scores suggest areas of lesser importance or effect.

Findings revealed that respondents held a neutral view on the statement that the company's supply chain was capable of quickly recovering from disruptions like market changes as indicated by a mean of 3.4000 with a standard deviation of 1.05771. The study also noted that respondents agreed moderately that the company had contingency plans in place to address potential supply chain disruptions effectively as suggested by a mean of 3.5615 with a standard deviation of 1.40175, an indication of closeness to the mean.

Additionally, findings from the study showed that respondents agreed that the resilience of the company supply chain has improved as a result of adopting new technologies and practices as indicated by a mean score value of 4.0769 with a standard deviation of 0.73544. The finding aligned with those of Ning and Yao (2023) who observed that supply chain capabilities mediate the relationship between digital transformation and organizational competitiveness, particularly under conditions of market uncertainty. The findings underscored the importance of aligning digital strategies with broader supply chain objectives

The results further revealed that respondents agreed that their company effectively uses data analytics to inform supply chain decision-making as indicated by a mean score of 3.8923 with a standard deviation of 0.85006. The findings concurred with those of Banda and Musonda (2022) who found that digital tools in supply chain improved customer engagement, delivery efficiency, and inventory management. Moreover, manufacturing firms that leveraged digital supply chain transformation optimized their production, inventory management, and logistics through data-driven decision-making and predictive analytics (Hugos, 2018).

Moreover, the study noted that insights gained from data analytics have led to significant improvements in our supply chain performance as shown by the level of agreement of the respondents with a mean value of 2.7231and a standard deviation of 1.09698. Other studies also found similar results noting that the adoption of information technology contributed significantly to enhancing supply chain performance by streamlining processes and fostering better collaboration (Cui et al., 2023; Han et al., 2017).

Findings further revealed that employees receive trainings to utilize data analytics tools in order to enhance their work within the supply chain as indicated by a mean of 3.9538, and a standard deviation of 0.69441. Similarly, Mbatha and Otieno (2023) found that AI-powered demand planning enhanced responsiveness to market changes. Whereas Quieroz et al. (2021) results showed that digital supply chain improved transparency, traceability, and trust across supply chains.

Respondents also opined that their company's supply chain practices contributed positively to the overall customer experience at Giant Millers Limited as reflected by a mean score value of 3.6615 and a standard deviation of 0.75575. Nonetheless, respondents agreed that the company actively gathers customer feedback to improve on its supply chain processes (Mean = 4.2000, standard deviation = 0.44017). Similar sentiments were also held by Ochieng and Mutua (2021) who noted that big data analytics improved demand forecasting and inventory management through elaborate customer feedback mechanisms initiated by digital transformation.

The study consequently found that respondents agreed that the use of digital technologies enhanced their company's ability to meet customer expectations and demands as indicated by a mean value of 3.9538 with a standard deviation of 0.79904. nonetheless, he findings correlated with those of Dubey et al. (2022) whose study explored the impact of digital twin technologies in improving supply chain resilience during disruptions and found that digital twins improved resilience, scenario planning, and risk mitigation during disruptions.

Performance of Supply Chain Systems at GML

The purpose of this study was to examine the effect of digital technology on the performance of supply chain systems at Giant Millers Limited in Kenya. To achieve this objective, the researcher asked the respondents to rate their opinions on their level of agreement based on the statements provided relating to performance of supply chain systems of Giant Millers Limited on a likert of 1 to 5. The summarized findings obtained were presented as under in Table 2 below;

Table 2: Descriptive Statistics on Performance of Supply Chain Systems of GML

Statement	N	Mean	Std. Deviation
Our supply chain operates efficiently and effectively due to digital transformation	65	3.9231	1.05041
We have seen improvements in customer satisfaction as a result of adopting digital technologies	65	3.8615	.86380
The time-to-market for our products has decreased due to enhanced supply chain processes	65	4.4000	.55340
Our firm experiences reduced operational costs because of digital supply chain practices.	65	4.4340	.65340
Overall, digital technologies have positively impacted our supply chain performance	65	4.2308	.86185
The adoption of digital technology in our supply chain system supports continuous improvement and innovation in operations.	65	3.9231	1.05041
Our supply chain ensures accurate and timely communication with customers regarding order status and issues.	65	3.6769	1.10549
The supply chain demonstrates resilience in responding to disruptions or unexpected challenges.	65	4.3385	.47687
The supply chain system effectively minimizes inventory shortages and stock-outs.	65	3.8462	.98791
Valid N (listwise)	65		

Scale: 1.0 -2.49= Disagree; 2.50-3.49 =Neutral/Moderate; 3.50-5.0 =Agree.

Source: Field Data (2025)

Table 2 above show that the means obtained from the study ranged between 3.6769 to 4.4340, reflecting varying levels of perceived impact. A higher score indicated stronger agreement or greater impact, with the highest score of 4.4340 signifying the most significant factor identified by respondents. Conversely, lower scores suggest areas of lesser importance or impact.

Findings show that GML's supply chain operates efficiently and effectively as a result of digital transformation (Mean =3.9231, Standard deviation = 1.05041). Additionally, the study found that respondents agreed that the company has seen improvements in customer satisfaction levels as a result of adopting digital technologies (Mean = 3.8615, Standard deviation = 0.86380). These conform with findings of Zhang et al. (2018) who found that companies that adopted smart manufacturing technologies experienced a 15% increase in production efficiency and a 10% reduction in operational costs. The study further observed that firms leveraging on digital tools for supply chain management reported improved collaboration with suppliers and logistics providers, resulting in optimized production schedules and reduced lead times.

Findings also revealed that time-to-market for company products has decreased due to enhanced supply chain processes reducing cases of prolonged lead-times as indicated by a mean of 4.4000 with a standard deviation of 0.55340, indicating closeness of the responses to the mean. Furthermore, the study found that respondents agreed that their company experienced reduced operational costs as a result of implementation of digital supply chain practices (Mean = 4.4340, Standard deviation = 0.65340). The findings align with those of Ochieng et al. (2023) who noted that technology facilitates real-time information sharing, enabling partners to respond swiftly to changes in demand and supply conditions. And that digital integration not only streamlines processes but also strengthens relationships among supply chain participants.

Findings further showed that digital technologies implemented by GML have positively impacted their supply chain performance as indicated by a mean score value of 4.2308 with a standard deviation of 0.86185. In addition, the study found that the adoption of digital technology in the supply chain supported continuous improvement and innovation in GML operations (Mean =3.9231, standard deviation = 1.05041). Moreover, Chase (2019) also held similar views noting that digital supply chain enhanced not only the speed at which the market responds to changes and the operational effectiveness of businesses, but also the quality of services provided and their financial gains.

The study also found that GML's supply chain ensured accurate and timely communication with customers regarding order status and issues (Mean =3.6769, standard deviation = 1.10549). Consequently, findings revealed that the company supply chain demonstrated resilience in responding to supply disruptions or unexpected challenges along the supply value chain as reflected by a mean of 4.3385 and standard deviation 0.47687. And that the supply chain system effectively minimizes inventory shortages and stock-outs (Mean = 3.8462, Standard deviation = 0.98791). These findings corroborate with CBI (2019) report that found that manufacturers' embracing digital tools experienced enhanced supply chain visibility and coordination. This allowed firms to anticipate demand fluctuations and adjust their supply chain strategies accordingly, leading to increased efficiency and customer satisfaction.

Inferential Statistics

The study employed inferential statistics to determine the nature of the relationship between the data sets of the variables under investigation and how those relationships would affect the study's dependent variable. Multiple linear regressions were used in the study to establish the relationship between the independent and dependent variables. Regression analysis aims to demonstrate how and to what extent each variable influences the dependent variable. It is used to estimate the weight of the influence of independent variables on the dependent variable. The findings of the analysis were then presented as follows:

Regression Model

The study used multiple linear regressions analysis to determine the relationship between the independent variables (digital supply chain transformation, supply chain agility, lean supply chain and supply chain collaboration) and the dependent variable (performance of supply chain systems). As can observed from the model summary in Table 1.3, the coefficient of determination (R2) was used to determine the regression model's ability to explain the variation of the independent variables. R is the correlation coefficient which shows the relationship between the independent variables and dependent variable.

Table 3: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.798[a]	.639	.625	.76532	1.646

a. Predictors: (Constant), SCC, LSC, DSC, SCA
b. Dependent Variable: P

It is important to note that there exists a strong positive relationship between the independent and dependent variables, as indicated by an R value of 0.798. The coefficient of determination ranges from zero to one (Robinson, 2010). The data revealed a high R-squared value of 0.639, suggesting that the independent variables in this study account for 63.9% of the variation in performance of supply chain systems of GML,Kenya, while the remaining 36.1% is attributed to factors outside the model. The standard error is low, at 0.76532, indicating that the model has minimal error effects related to performance of supply chain systems of GML,Kenya. This suggests a good model fit, with a

value of 62.5%. This aligns with Graham (2012), who states that R-squared values range from 0% to 100%: 0% means the model explains none of the variability in the response data around its mean, while 100% means it explains all variability. Generally, a higher R-squared indicates a better fit for the model. This highlights the need to adequately address issues related to digital supply chain transformation, supply chain agility, lean supply chain and supply chain collaboration to enhance the performance of supply chain systems of GML, Kenya.

Analysis of Variance (ANOVA)

To determine whether the model was significant, the ANOVA was used. The study used a p-value of less than 0.05 as a standard for testing the significance level, thus a p-value of 0.05 indicated statistical significance in this study, which examined the model's significance at a 95% confidence interval. Table 4 below displays the test results.

Table 4: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.780	4	4.695	98.614	.000[b]
	Residual	458.820	60	7.647		
	Total	477.600	64			

a. Dependent Variable: P

b. Predictors: (Constant), SCC, LSC, DSC, SCA

Findings of the analysis of variance shown in Table 4 above, indicates that the regression model was significant ($F=98.614$ $p<0.05$). This suggests that a considerable portion of the variation in the performance of supply chain systems of GML, may be explained by the combined independent variables; digital supply chain transformation, supply chain agility, lean supply chain and supply chain collaboration. The substantial F-value shows that the independent factors in the model have an effect on the variation in performance of supply chain systems of GML and is not due to chance. The p-value of 0.000, which is below the significance level of 0.05, confirms that the statistical significance of the results. These findings supported those of Zhang et al. (2020) who established that digital transformation efforts and agile supply chain practices substantially boost organizational performance by enhancing both responsiveness and operational efficiency. The study further revealed that collaborative supply chain approaches lead to improved performance, highlighting the value of integrating these key factors for optimal results in supply chain management. In conclusion, the researcher noted that all the independent variables of digital supply chain transformation, supply chain agility, lean supply chain and supply chain collaboration jointly have a significant effect on the performance of Giant Millers Limited in Kenya.

Regressions Beta Coefficients

Beta coefficient is defined as the size of the coefficient for each independent variable that indicates the magnitude of the effect of that variable on the dependent variable (Kothari, 2014). The direction of the influence is indicated by the sign of the coefficient (positive or negative). In a regression model with a single independent variable, the coefficient shows how much the dependent variable is anticipated to change when the independent variable increases by one, depending on whether it is positive or negative. Table 5 below shows the summarized regression beta coefficient results.

Table 5: Regression Beta Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	31.650	6.907		4.582	.000
	DSC	.533	.112	-.039	3.299	.001
	SCA	.483	.151	-.080	2.548	.000
	LSC	.782	.155	.157	3.174	.002
	SCC	.696	.103	.135	2.939	.002

a. Dependent Variable: Performance

Findings from the regression analysis provide the basis of how the regression model can be fitted as under;

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_3 X_4 + e$

Where Y= Performance of supply chain systems

X_1 = digital supply chain transformation, X_2 = supply chain agility, X_3 = lean supply chain and X_4 =supply chain collaboration. From the equation, holding digital supply chain transformation, supply chain agility, lean supply chain and supply chain collaboration constant, the expected value of the dependent variable (performance of supply chain systems) is 31.650 The regression analysis shows that all the independent variables i.e. digital supply chain transformation, supply chain agility, lean supply chain and supply chain collaboration have a significant positive relationship with the performance of supply chain systems of GML, Kenya.

The finding further showed that digital technology transformation had a positive significant effect on the performance of supply chain systems of GML, Kenya (B=0.533, at a p-value of 0.001). This implies that for every one-unit increase in digital technology transformation, performance of supply chain systems of GML, Kenya, will significantly increase by 0.533 units. The standardized coefficient value (B) is 0.389, implying that digital technology transformation have a moderate positive significant influence on performance of supply chain systems of GML, Kenya. Furthermore, the t-value is 3.299 at a p-value =0.001 which is less than p<0.05, is significant. This implies that the relationship between digital technology transformation and performance of supply chain systems is robust and is unlikely due to chance. In conclusion, the results show that digital technology transformation plays a significant effect in determining the performance of supply chain systems of GML. Hence, higher levels of digital technology transformation are likely to contribute to improved performance of supply chain systems of GML. This finding aligns with the previous research that highlighted that adoption of information technology contributes significantly to enhancing supply chain performance by streamlining processes and fostering better collaboration (Cui et al., 2023; Han et al., 2017).

Secondly, supply chain agility was found to have a significant positive effect on the performance of supply chain systems of GML, Kenya (B=0.483, at a p-value of 0.000). This implies that for every one-unit increase in supply chain agility, performance of supply chain systems of GML, Kenya, will significantly increase by 0.483 units. The standardized coefficient value (B) is 0.280, indicating that supply chain agility has a moderate positive and significant impact on the performance of supply chain systems at GML, Kenya. Additionally, the t-value is 2.548 with a p-value of 0.000, which is less than $p < 0.05$, confirming significance. This suggests that the relationship between supply chain agility and the performance of supply chain systems is strong and unlikely due to random chance. In summary, the findings demonstrate that supply chain agility significantly influences the performance of GML's supply chain

systems. Therefore, higher levels of supply chain agility are expected to enhance the performance of these systems. The findings conform with those of Dubey et al. (2020) who observed that agile supply chains significantly enhance organizational performance by improving customer satisfaction and reducing lead times. The findings suggest that agility not only supports operational efficiency but also fosters stronger customer relationships. Similar views were also held by Ivanov et al. (2022) who alluded that agile supply chains were inherently more resilient, as their flexible structures enabled them to absorb shocks and recover swiftly from supply disruptions.

The third objective of this study focused on determining the effect of lean supply chain on the performance of supply chain systems of GML. Findings showed that lean supply chain had a positive significant effect on the performance of supply chain systems of GML, Kenya (B=0.782, at a p-value of 0.002), implying that a-unit increase in lean supply chain will lead to a significant increase in performance of supply chain systems of GML by 0.782 units. Moreover, a study by Omondi and Ngugi (2022) highlighted similar views that the combination of lean practices with digital technologies, results in significant performance improvements The standardized coefficient value (B) is 0.457, indicating that lean supply chain has a positive and significant effect on the performance of supply chain systems at GML, Kenya. Additionally, the t-value is 3.174 with a p-value of 0.002, which is less than $p < 0.05$, is significant. This suggests that the relationship between lean supply chain and the performance of supply chain systems is robust and unlikely to be due to chance. In summary, the findings demonstrate that lean supply chain significantly influences the performance of GML's supply chain systems. Therefore, higher levels of lean supply chain are expected to enhance the performance of these systems. These results resonate well with the views of Shah and Ward (2020) who observed that organizations implementing lean practices alongside digital tools, experience enhanced operational performance, including reduced lead times, improved quality, and higher customer satisfaction.

Lastly, findings showed that the last objective which aimed at assessing the effect of supply chain collaboration on performance of supply chain systems of GML, had a positive significant effect on the performance of supply chain systems of GML, Kenya (B=0.696, with a p-value of 0.002). This implied that increasing supply chain collaboration by one unit will significantly and positively result in improvement on performance of supply chain of systems of GML by 0.696 units. The standardized coefficient value (B) is 0.435, implying that supply chain collaboration has a positive and significant effect on the performance of supply chain systems at GML, Kenya. Furthermore, the t-value is 2.939 with a p-value of 0.002, which is less than $p < 0.05$, confirming significance. This suggests that the relationship between supply chain collaboration and performance of supply chain systems of GML is strong and unlikely due to chance. This also aligns well with the findings of Muriuki and Karanja (2023) who highlighted that collaborative efforts led to improved supply chain performance by fostering trust, sharing best practices, and facilitating joint ventures. The researchers argued that such initiatives help firms navigate challenges and enhance competitiveness in the market. In conclusion, the findings demonstrate that supply chain collaboration significantly affects performance of supply chain systems of GML. Therefore, management of GML should embrace supply chain collaboration to foster supply value chain confidence as well as enhance supplier trust on their performance. Other researches also indicate that collaborative supply chains are generally more resilient and better equipped to adapt to market changes (Hingley et al., 2021). This resilience is attributed to the ability of collaborative networks to share risks, resources, and information, allowing for quicker responses to disruptions and uncertainties in the market.

CONCLUSION AND RECOMMENDATIONS

The study reveals a strong positive correlation between the independent variables i.e. digital supply chain transformation, supply chain agility, lean supply chain practices, and supply chain collaboration and performance of supply chain systems at Giant Millers Limited in Kenya. These factors significantly enhance GML's operational effectiveness, with approximately 63.9% of the variation in performance attributed to them. Statistical analysis through ANOVA confirms that each variable contributes positively and significantly, particularly highlighting digital supply chain transformation as a key driver of improved performance.

These findings align with existing research that underscored the benefits of these practices in promoting efficiency and responsiveness. Therefore, it is recommended that GML's management intensify efforts to adopt digital technologies, embrace agile methodologies, implement lean strategies, and foster strong collaborative partnerships. Such initiatives will not only boost operational performance but also enhance resilience and adaptability in an increasingly dynamic market landscape.

The study notes that GML should embrace emerging technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and blockchain to enhance transparency and operational efficiency within its supply chain. Providing employees with relevant digital skills through ongoing training programs will be essential for maximizing the benefits of these technologies. Furthermore, establishing a system for continuous evaluation and refinement of digital processes will enable the company to remain adaptive and responsive to evolving market dynamics.

Suggestions for Further Research

The integration of technology in supply chain still faces tremendous bottlenecks in the manufacturing sector as noted by the study, therefore, there is need for a more tailored study to investigate the barriers of digital technology adoption among manufacturing companies in Kenya. In addition, more studies can be done on the role of data analytics in improving supply chain decision making. Further research can also focus on how companies can leverage big data to optimize inventory management, demand forecasting and supplier selection.

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