

Article

The Role of Implementing Lean Supply Chain in Enhancing Customer Satisfaction: A Survey Study of A Sample of Managers at The General Company for Pharmaceutical Industries and Medical Supplies in Samarra

Wessam Hussein Abd Ali

Department of Forensic Evidence, College of Applied Medical Sciences, Al-Shatrah University, Al-Shatrah city, Iraq

wessamhussein@shu.edu.iq

Mahmoud Majid Na'meh

Ministry of Environment

xaalonso74@gmail.com

Abstract: This paper seeks to perceive the function of Lean Supply Chain implementation, with its four dimensions (just-in-time delivery, incessant enhancement, waste elimination, and lean storage), in enhancing customer satisfaction through its three dimensions (understanding customer needs, customer feedback, and measuring customer satisfaction). Lean Supply Chain raises an important question about the mechanism used to eliminate waste and wasted time. It is essential to identify and understand the challenges and obstacles hindering the company's progress and growth. The research employed a descriptive-analytical approach. Accordingly, a composition of questionnaire was utilized as the primary research tool to measure the degree of implementation of the research variables. The research was conducted at the designated General Company in connection with Pharmaceutical Industries as well as Medical Supplies in the city Samarra, with a sample of 120 individuals. To address the research problem, several statistical methods were employed, including SPSS. The results demonstrated a correlation between Lean Supply Chain and customer satisfaction, indicating that increased execution of Lean Supply Chain enhances customer satisfaction. Among the most important proposals was the requirement for the company to continue conducting workshops, lectures, and training courses to educate and raise awareness among leaders, guiding the company toward achieving the goals that can be accomplished through the implementation of lean supply chain principles. It was also recommended to organize events and host activities to increase employee understanding and motivation in implementing lean supply chain principles across all areas of the business.

Keywords: Lean supply chain, customer satisfaction



This is an open-access article under the [CC-BY 4.0](https://creativecommons.org/licenses/by/4.0/) license

1. Introduction

In today's progressively viable ecosystem, with growing customer needs and expectations in terms of quality, speed, cost, and availability, companies are now required to adopt advanced management and operational methods that enable them to achieve a sustainable competitive advantage at the local and global levels [1], [2], [3]. The Lean Supply Chain is one of the most prominent of these methods, as it is based on eliminating waste, improving the flow of materials and information, and enhancing integration and coordination among all parties in the chain, which contributes to raising performance efficiency and responding quickly to constantly changing market demands [4], [5].

Customer satisfaction is considered as one of the main signs of success, survival, and continuity of companies, as it plays a strong role in attaining the loyalty customer, which increases market share, customer loyalty, achieving superior performance, and increasing profits. Customers no longer evaluate a product or service in isolation from the speed of delivery, responsiveness, flexibility, reliability, level of value provided, and knowing their needs and desires before they express them. All of these elements are closely related to the efficiency of supply chain managing [6], [7], [8].

The foregoing highlights the role of implementing lean supply chain principles in enhancing customer satisfaction by reducing waiting times, minimizing unnecessary costs, improving product and service quality, and achieving the ability to accurately and effectively meet evolving customer needs. Therefore, this study seeks to shed light on the role of implementing lean supply chain values in enhancing customer satisfaction by analyzing its dimensions [9], [10].

2. Materials and Methods

First: The Research Problem

Today's global business environment faces significant challenges in a competitive landscape driven by intense competition and the rapid pace of change in meeting customer needs and requirements. Many companies struggle to achieve high levels of customer satisfaction due to high production costs, long delivery times, weak collaboration and communication across the supply chain, and resource and process losses resulting from production and transportation. Despite the importance of implementing lean supply chain management as a modern approach to improving production efficiency and enhancing customer value, numerous challenges still hinder companies from effectively meeting customer expectations and ensuring optimal value delivery [11], [12].

Therefore, the research problem is defined by the following questions:

1. What role does implementing lean supply chain management play in enhancing customer satisfaction?
2. Is there a numerically essential connection between the implementation of lean supply chain managing and customer satisfaction?
3. Which proportions of lean supply chain managing contain the highest impact of improving customer satisfaction?

Second: Importance of the Research

1. It provides a theoretical framework that clarifies the concepts and dimensions of lean supply chain and its implications for customer satisfaction.
2. It helps company management understand the importance of applying lean supply chain principles to improve customer satisfaction.
3. It presents practical results and recommendations that can be used to reduce waste and improve response time and service quality.

Third: Research Objectives

This research seeks to attain several objectives, the most important of which are:

1. Measuring the level of implementation of lean supply chain principles in the companies under study.

2. Analyzing the nature of the relationship between the implementation of lean supply chain principles and customer satisfaction.
3. Measurement of the effect of lean supply chain dimensions on the enhancement of customer satisfaction.

Fourth: The hypothetical plan of the research

Based on the problem presented and in order to reach the goals that the current research seeks to achieve; the hypothetical plan was designed which clarifies the relationship between its variables as in Figure (1).

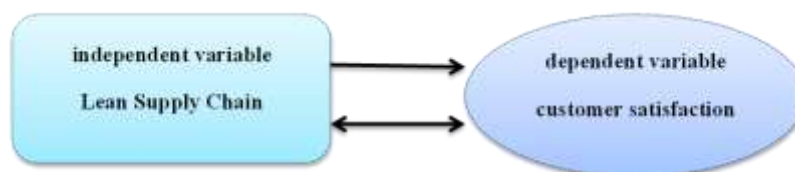


Figure (1) Hypothetical research plan

Based on the research theoretical model, the hypotheses can be presented in the following manner:

Hypothesis 1: There is a correlation between lean supply chain and customer satisfaction.

Hypothesis 2: Lean supply chain has a statistically significant effect on customer satisfaction.

Fifth: The research community and its sample

The research sample included the managers, assistants, and department heads of the designated General Company responsible for the production of Medical Supplies in Samarra. This sample was chosen because of the high level of awareness among the company's leadership in implementing the lean supply chain to enhance customer satisfaction and the extent of its impact on the research sample. This facilitated the researchers in obtaining accurate data and real results that could be generalized to the community. Accordingly, the researchers relied on a purposive sample of (125) individuals, of whom (123) were actual respondents out of the total sample (98%). (3) questionnaires were excluded because they did not meet the conditions.

Sixth: Research Scale

The research adopted the scale used in a previous study with high credibility. The first variable is attributed to (Jawad and Kadhim, 2023, p:9) and the second variable is attributed to (Kadhim et al., 2025, p: 229) [13], [14].

Seventh: Statistical Methods Used

The SPSS vr. 28 program was used to conduct the tests. The research relied on the extracted results and their interpretation according to the results of descriptive statistics in an attempt to show the associations that connect the variables and dimensions included in the study, represented by the descriptive statistics that relied on arithmetic means, standard deviations and coefficients of variation [15].

3. Results and Discussion

Section Two: Theoretical Aspect

First Variable: Lean Supply Chain

First: The Concept of Lean Supply Chain

A few decades ago, supply chain plans have shifted from cost-inclined to agile and effective systems, especially in sectors that need resource usage. This change shows that it goes beyond just cost reduction to comprises rapid adaptation to volatility in supply and demand. Therefore, "supply chain management encompasses the procurement, operations, logistics, and marketing channels through which raw materials are transformed into finished products and delivered to end consumers" [10]. Agile supply chain managing focus on the practices that prevents non-value activities. These sorts of practices may need strategic partnerships, human resource managing and

waste elimination. It is used in separate which include electronics, automotive and home appliances [12]. It can be viewed as a collection of companies that directly connected by flows of various products, finance, and data, working closely together to reduce costs and waste by drawing what is needed to efficiently and effectively meet each customer's needs [5] The lean supply chain strategy aims to create a group of organizations that cooperate to reduce costs, inventory, and delivery time by implementing a more efficient drawing system. This strategy focuses on creating a cost-efficient supply chain through the elimination of non-value-added resources, to integrate materials to design well-organized procedures among the supply chain partners to embed progressive enhancement at all stages [16].

The construct of a lean supply chain can be defined as an agglomeration of companies working together to decrease waste via effective withdrawal, reduce costs, improve quality, enhance the quality of supply chain activities and increase flexibility. Accordingly, a lean supply chain should be based on tight associations, information must be noticeable at all times and stages, and performance must be monitored. A key requirement is increased organization and administration of physical, financial and informational flow among different stakeholders [16]. It is a series of procedures in the material preparation and the delivery of goods and services to the potential customers [2]. It can also be viewed as a group of firms that are related to the flows of services, products, information and finance to the supply chain which cooperate to decrease waste and costs by defined efficiently meeting customer needs [17]. Agile supply chain management involves managing multiple organizations that integrate production and distribution flows from different entities, which enhances value and reduces costs and waste by responding quickly to consumer demands. The agile supply chain management system aims to ensure the creation and efficient transfer of value to the production and distribution stages [4].

Second: Lean Supply Chain Management Practices

The key objective of lean administration is to remove all types of waste within a company to enhance its competitiveness. This is achieved by generating positive outcomes in the areas of innovation, flexibility, cost, quality, and service. However, these practices will be discussed in the subsections below [12].

Just-in-Time Production: The construct of Just-in-Time production can be referred to the inventory managing philosophy that aims to decrease spoilage through the delivery of products, materials or components at the time the organization needs them [12]

Total Quality Management (TQM): TQM is can be viewed as the series of improvement in the quality of the product, it is an approach where employees work in group to enhance the product, work environment and process [12].

Strategic Partnership: This is a contract between two firms or establishments to collaborate or work together to facilitate the achievement of their goals. Furthermore, strategic partnerships with suppliers are essential for building and maintaining a network of qualified suppliers [12].

Eliminating Waste: Waste is viewed as anything that cannot add value to the product from the customers perspective. This comprises some activities that can add time or cost without the consumption of supplementary resources to produce the required goods or services needed by the potential customer [12]

Human Resources: The concept of "agility" in human resource management is defined as eliminating waste in human resource management processes within organizations. The concept of "agility" implemented through human resources means how human resource develops and functions contribute to achieving agile success throughout the organization [12].

Third: Dimensions of the Lean Supply Chain

The lean supply chain comprises the identification of all types of waste in the process of supply chain to eliminate them whereas minimizing delivery period. This chain should enable processes and flows from the supplier, through the manufacturer, then the distributor, and finally to the end customer, without any waste. Participants in the lean supply chain must make continuous efforts to implement various improvements, focusing on eliminating wasteful or unproductive activities along

the chain while meeting the actual needs of customers. Successful implementation of the lean supply chain approach requires the direct participation and cooperation of the company, its main suppliers, and its main customers [18]. Researchers and authors have differed regarding the dimensions of the lean supply chain. Below are the dimensions adopted by [19]:

1. Just-in-Time Delivery

Efficient logistic of materials can be seen as just-in-time (JIT) procurement, which is essential aspect of reducing waste in lean production transportation. From an JIT perspective, inventory is not considered valuable but rather waste. Through this system, contractors aim to receive smaller batches of materials on-site as needed, thus minimizing storage and duplication of material handling [20]. Just-in-Time (JIT) production is can be viewed as the integration of supply chain plans that comprises specific items: Just-in-Time Production, Just-in-Time Purchasing, Just-in-Time Selling, and a new and important element: Just-in-Time Data. It is a basic item in the growth of lean production in numerous countries. Additionally, lean production procedure needs small volume deliveries from authorized suppliers that can distribute to reduce the levels and maintain costs [21].

2. Continuous Improvement

Adopting a long-term approach on progressive enhancement is critical in lean production to reduce waste and increase efficacy over time. Thus, the main focus in order to reduce cost and promote sustainable enhancements should be in long-term contracts. Working in group to facilitate the transfer of knowledge and basic experience among the stakeholders in the very supply chain and from one project to another [21]. Kaizen (continuous development) is another concept thoroughly related to lean production. If eliminating waste is the fundamental principle of lean production, then continuous improvement comes second. Kaizen is a methodology that focuses on the continuous improvement of the process, emphasizing small, incremental improvements. The focus of continuous improvement is to identify the root causes of non-value-adding activities and eliminate them by improving the production process [22].

3. Eliminating Waste

Waste is defined as "any human activity that consumes resources without adding value." It is also defined as "anything exceeding the absolute minimum resources of materials, machinery, and manpower required to add value to the product." This comprises any tasks conducted by the organizations to add value to the final product aimed at the customers. This will eliminate waste and lead to enhanced procedures throughout the whole supply chain [21]. In production, three types of value-added activities are typically applied: Value-added activities, which involve changing or processing raw materials to attain to the customers needs; that are required for non-value-added actions which are considered wasteful so they should be avoided under current operating procedures; and Non-value-added activities, which are clear waste that must be completely eliminated [8].

4. Lean Warehousing

The concept of lean warehousing focuses on fulfilling purchase orders efficiently and effectively. This construct involves the reduction of non-value-adding activities in the whole warehouse operations to receive, store, fulfil order, package and shipping. So, if any firm wants to attain lean warehousing, it is important to reduce these aspects and identify the major source of spoilage. As in production, there are seven different types of spoilage recognized in warehousing seven types of spoilage [23]. Warehousing is one of the essential parts of attaining lean warehousing goals. Lean warehousing is a construct that needs systematic continuity, stability and necessary improvement including all employees. Lean warehousing can also be defined as the concept of minimizing spoilage at all stages of the supply chain, whether in the initial or final stages, to guide customers to the right place at the right time [6].

The second variable: Customer satisfaction

First: The concept of customer satisfaction

Customer fulfilment is the customer's assessment of a product or service after consuming it. Decades of research have been dedicated to understanding the factors influencing customer

satisfaction ratings. These factors include: expectations regarding real product performance, performance comparative to expectations and tested during the previous intake experiences and the function of competing which offers expectations with regard to perceived quality of service and later connected to customer expectations. Generally, service quality can be equated to service performance and it can be considered as an input to meet the satisfaction of the customer [9]. Customer fulfilment is defined as "the evaluation of the perceived discrepancy between prior expectations and actual product performance." Customer satisfaction with a firm's products and services is an essential factor for achieving competitiveness and success. At its core, customer satisfaction represents how the customer assesses the state of satisfaction. This is necessary in today's business world as it provides the ability to create a high-level satisfaction to customer fulfilment. Customer satisfaction is critical for product differentiation that seeks to build strong connections with customers [14].

Customer satisfaction is an indicator of fulfilment with the potential service or product, and thus, it is viewed as the customer's general attitude toward the service provider [11]. Customer satisfaction is the degree to which the customer perceives that an individual, company, or organization has provided a product or service that effectively meets their needs, within the context of their knowledge of and use of the product or service. Satisfaction is not an intrinsic characteristic of the individual or product, but rather a social response to the relationship between the customer, the product, and the product's supplier or manufacturer. To the degree that they can influence the customer fulfilment extent [24]. Generally, customer satisfaction can be seen as a positive element on their parts towards the firm [25]. Customer satisfaction means the ability to meet to their expected demands with regards to the provision of goods and services. This aspect will measure their level of happiness after an interaction with a specific company. A customer that is satisfied will have value for the products and services received [26].

Customers are all individuals who use goods or services progressively for personal use with regards to the products served by the firm. This construct is in connection with the customer satisfaction that arise after the comparison of how the product is accepted. If the product is not up to expectations the customer may become disappointed and avoid the company. However, customer satisfaction can be managed if the firm can attain to the required expectations and convince them to repurchase their products which will serve as a competition [7] generally, the customer's satisfaction can be obtained by the evaluation of the chasm between the real performance and the customer's real expectations and if eventually it exceeds the expectations of the customer, then it will be happy [27]. Customer gratification is a post-purchase assessment where the selected alternative achieves at least the same result or exceeds the consumer's expectations, while dissatisfaction arises if the results are not in line with the consumer's expectations or are below them. From these two views, it can be concluded that consumer satisfaction is the result of consumers' evaluation after using a product or service, and that the variables used in this evaluation are the consumers' own expectations [15]. Customer fulfilment is a key indicator reflecting their overall satisfaction with a product, service, or business entity. Customer satisfaction is primarily based on their cognitive assessment of whether their expectations are met or exceeded. When customers find that the product or service perfectly matches their needs and desires, they feel satisfied and fulfilled. Conversely, when a clear gap appears between customers' expectations and their actual experiences, dissatisfaction begins [1].

Second: The Importance of Customer Satisfaction

attaining customer satisfaction is the main goal of any successful institutional. Financially, it positively impacts the company's financial standing. A satisfied customer with a positive impression of a particular brand may prioritize how they are treated over the price of the product or service. Generally, given multiple options, many consumers will choose the company that has pleased them with its good service and high-quality products, even if its prices are higher than lower-cost alternatives of lower quality. This explains why most high-end brands are able to attract customers despite their higher prices; customers understand that the price offered is commensurate with the services provided [25]. The significance of customer satisfaction lies in the following points:

1- Satisfaction is one of the criteria used for benchmarking against the performance of competitors.

2- Satisfied customers have a more positive attitude towards the firm's products and they should be more loyal to the firm.

3- Satisfied customers enhance the company's reputation, which leads to attracting new customers.

4- Customer satisfaction may lead to the retention of existing and potential customers increased positive word-of-mouth, which is effective in attracting new customers and reducing marketing expenses. Customer satisfaction is considered one of the fundamental marketing assets that leads to increased customer loyalty towards the company, in addition to increased profits and reduced costs. Through customer satisfaction, companies can be more effective than their competitors in delivering benefits to customers in their market. It is also an important measure of the performance of business organizations in light of intense competition and constantly changing customer tastes [28]. The importance of customer satisfaction has been defined as follows:

- a) To foster customer loyalty to the company.
- b) To increase customer repeat business.
- c) To develop the company's business plan and strategies.
- d) To improve product quality and achieve a competitive advantage in the market.
- e) To ensure the company's profitability by meeting customer needs and requirements.

Third: Steps to Achieving Customer Satisfaction

There are several steps involved in achieving customer satisfaction before reaching the final result. These stages can be summarized as follows: [29]

1. Understanding Customer Needs: Maintaining continuous communication between marketers and customers, whether current or potential, is crucial for the company to identify customer purchasing behavior. Understanding the customer and their needs and desires is essential for the company [29]. Understanding customer needs is a primary concern for the company, and the marketing department must prioritize it. By understanding customer needs, the company identifies the specific needs and desires that the customer requires and that can be fulfilled. Market research, customer contact, and listening to customer feedback can all be used to determine customer needs and desires. A correct understanding of needs leads to achieving the desired level of satisfaction [30].

2. Customer Feedback or Review: After obtaining information that allows understanding the customer's needs, the company takes the second step, which is customer feedback. This is done through the exchange of data between the firm and its customers (the company's external environment). This is done through a set of methods and techniques that determine customer reactions to the goods and services offered. Some of the methods used in feedback are "hidden marketing, customer satisfaction surveys, and customer loss analysis." The latter is one of the most commonly used methods, as customer loss leads to a decrease in the level of customer satisfaction with the product provided [29].

3. Measuring customer satisfaction: This is the last step in achieving customer satisfaction, and it involves defining a set of methods, policies, and approaches through which A comparison will be made between the strategy and the real results of the customer fulfilment which serve as the ultimate goal that the firm hopes to attain [29].

Section Three: The Applied Aspect

First: Measuring the Reliability Coefficient and Normality of the Data

To simplify data processing using SPSS version 28, and to ensure accurate results that better represent the population, a statistical method appropriate to the nature of the data distribution was selected. The normality of the research variables was tested by calculating the skewness and kurtosis coefficients. According to most research, and based on Hair et al. [31], values between +1.96 and -1.96 are considered acceptable and indicate a normal distribution. Reliability was further confirmed using Cronbach's alpha coefficient, where values of 0.70 or higher are considered acceptable, based on Nonnaly and Bernstein (1994). The data shown in Table 1 confirms the requirements for the

reliability coefficient and normality, as shown in the following table:

Table 1. Reliability coefficient and normality distribution of data.

Dimensions	Number of questions	Kurtosis	Skewness	Cronbach's Alpha
Just-in-Time Delivery	6	0.988	-1.075	89.4%
Continuous improvement	6	1.433	-1.542	90.7%
Elimination of spoilage	6	0.933	-0.893	84.3%
Lean warehousing	6	1.168	-1.201	90.3%
Lean supply chain	24	1.131	-1.177	88.7%
Understanding customer needs	4	0.543	-0.650	82.5%
Customer feedback	4	1.018	-1.108	94.2%
Measuring customer satisfaction	4	0.762	-0.819	88.1%
Customer satisfaction	12	0.774	-0.859	88.3%

Source: Researchers using the SPSS statistical software. 28

The table above reveals:

- Reliability coefficient (Cronbach's alpha): The overall values for the alpha coefficient are high (ranging between 82.5% and 94.2%), indicating very good internal reliability across the various dimensions of the scale. This suggests that the questionnaire questions were consistent within each dimension.

- Table (1) shows the skewness and kurtosis values, which demonstrate the close normality of the data distribution across all dimensions. The skewness values, ranging from 0.543 to 1.168, and the skewness values, ranging from -1.542 to -0.650, generally indicate a normal distribution. The absence of significant skewness or kurtosis explains the large deviations from normality.

Second: Construct validity of the sample size adequacy test:

According to the results shown in Table (2), the sample size adequacy was measured by the Sample Size Adequacy Index (KMO), exceeding the threshold of 0.70. This is achieved for the main research variables and their dimensions, namely lean supply chain and customer satisfaction. Furthermore, the significance level for the analysis is (error rate less than 5%). The results presented in Table (2) indicate that the requirements for sample size adequacy (KMO) were met, allowing for the continuation of the analysis.

Table 2. Sample Adequacy Size

variable	Dimensions	Number of paragraphs	KMO test	Bartlett's test based on Chi-Square	degrees of freedom	Statistical significance
Lean supply chain	Just-in-Time Delivery	6	0.944	1357.755	120	0.000
	Continuous improvement	6				
	Elimination of spoilage	6				
	Lean warehousing	6				
Customer satisfaction	Understanding customer needs	4	0.933	1760.168	105	0.000
	Customer feedback	4				
	Measuring customer satisfaction	4				

Source: Researchers using the SPSS statistical software. 28

Third: Descriptive Statistics of the Research Data

1) The Lean Supply Chain Variable

The results indicated in table 3 that the arithmetic mean for the proposed lean supply chain variable was (4.00), as the standard was (0.701), where the coefficient of the differences was (15%), and the related importance was at (81%). This shows that the specimen implemented the lean supply chain procedure and eliminated unused time.

There is also a progressive arithmetic mean of (4.115), at a standard deviation of around (0.696), a coefficient of difference of (15%), and a relative significance of (85%). Whereas the lean storage dimension may appear fourth with an arithmetic mean of (3.831), a standard deviation of (0.712), a coefficient of difference of (19%), and a relative rank of (77%), which indicates that the company being researched has a high ability to improve processing operations, possesses a timely delivery mechanism, works to eliminate waste, and has a lean storage process.

Table 3. Descriptive statistics for the dimensions of the lean supply chain

Paragraph code	arithmetic mean	standard deviation	Coefficient of variation %	Relative importance %	Order of importance
Just-in-Time Delivery	4.092	0.701	15%	83%	2
Continuous improvement	4.115	0.696	14%	85%	1
Elimination of spoilage	3.963	0.706	17%	79%	3
Lean warehousing	3.831	0.712	19%	77%	4
Lean supply chain	4.00	0.704	16.5%	81%	***

Source: SPSS V.28 output

2)Customer Satisfaction Variable

The findings of table (4) clearly indicate that the general mean for the said customer was around (3.951), with a standard deviation of (0.706), a coefficient of variation of (16.5%), and a comparative importance of (79.5%).

The findings in table (4) show that the customer fulfillment has a rank of in Table (4) also indicate that (4.104), a standard deviation of (0.698), a coefficient of difference of (14.5%), and a comparative significance of about (83.5%). The response dimension ranked third, with a mean of (3.821), a standard deviation of (0.712), a coefficient of difference of (18.5%), and a comparative importance of (76.5%). This demonstrates that the company under study places great importance on measuring customer satisfaction, is committed to understanding customer needs, and implements a customer feedback process.

Table 4. Descriptive Statistics of Customer Satisfaction Dimensions

Paragraph code	arithmetic mean	standard deviation	Coefficient of variation %	Relative importance %	Order of importance
Understanding customer needs	3.930	0.707	17.5%	78.5%	2
Customer feedback	3.821	0.712	18.5%	76.5%	3
Measuring customer satisfaction	4.104	0.698	14.5%	83.5%	1
Customer satisfaction	3.951	0706	16.83%	79.5%	***

Source: SPSS V.28 output

Fourth: Testing the Research Hypotheses:

1- Correlation Hypothesis

Testing the Correlation Hypothesis: ((There is a correlation between lean supply chain and customer satisfaction)).

Table (5) shows the results obtained by using Pearson's correlation coefficient to interpret the relationship between the research variables: lean supply chain and customer satisfaction. The correlation coefficient was (0.930) at a significance level of (0.000), which is less than (0.05) for the significance level. This shows that any addition in the lean supply chain of variable can be seen positively in an increment, in the same position, in the customer satisfaction variable. These outcomes influence the correlation hypothesis.

Table 5. Correlation coefficient between lean supply chain and customer satisfaction.

variable	Index	Customer satisfaction
Lean supply chain	Correlation coefficient	0.930**
	Statistical level	.000
	Sample number	120

Source: Prepared by the researcher based on the outputs of the SPSS statistical program analysis.

2- Effect Hypothesis

Testing the second hypothesis: ((There is a numerically significant impact of lean supply chain on customer fulfilment)).

Table 6. Regression Analysis Test for the Effect Hypothesis

Model Summary			Analysis of Variance (ANOVA)			Regression coefficients				
independent variable	R	R ²	Calculate d F value	Significance level Sigg. F	DF	dependent variable	β	standar d error	Calculate d t value	Level of Significance Sigg. T
Lean supply chain	0.730	0.628	98.11	0.000	120	Customer satisfaction	0.553	0.020	23.97	0.000

Source: Prepared by the researcher based on the outputs of the SPSS statistical program analysis.

From the table above, we can demonstrate the following:

a) The Lean Supply Chain contain a coefficient of 0.730 for customer satisfaction, indicating a strong positive impact.

b) The coefficient of determination (CSD) was 0.628, which means that 62.8% of variations in the Lean Supply Chain explain the change in customer satisfaction.

c) The calculated F-value was 98.11, with a significance level of less than 0.05, further explaining the positive impact of the Lean Supply Chain on customer satisfaction.

d) The regression coefficient was 0.553, indicating that a change of one unit in the Lean Supply Chain results in a 55.3% modification in customer satisfaction. c) The intended value of t was 23.97, at a significance level of less than 0.05. This value specifies a numerically significant impact of lean supply chain on customer fulfilment.

d) From the above, we conclude that the hypothesis of a significant impact, which states that lean supply chain has a numerically significant effect on customer satisfaction, is acknowledged.

4. Conclusion

First: Conclusions

1. There is a relationship between lean supply chain and customer satisfaction. Therefore, increased implementation of lean supply chain enhances customer satisfaction.
2. The company under study is interested in adopting lean supply chain due to its effective contribution to saving employees time and effort in completing their tasks, and its ability to provide in-depth solutions for fulfilling their assigned duties. Lean supply chains aim to transform companies through continuous improvement and the creation of an ideal work environment.
3. The company adopts lean supply chains to promote initiatives focused on practices that eliminate non-value-adding activities. These practices include Just-in-Time (JIT) production, Total Quality Management (TQM), strategic partnerships, waste elimination, and human resource management.

Second: Recommendations

1. The company should continue conducting workshops, lectures, and training courses to educate and raise awareness among leaders, guiding the company towards achieving the goals that can be realized through the implementation of the lean supply chain. It is also recommended to organize events and host activities to increase employee understanding and motivation in implementing the lean supply chain across all areas of the business.
2. It is essential to develop and cultivate an employee culture of lean supply chain implementation to achieve workplace effectiveness and facilitate better communication between leaders and employees. When employees possess a lean supply chain culture and awareness, they will be better equipped to improve work performance without expressing negative feedback or complaints.

3. The company should dedicate its efforts to assessing the impact of lean supply chain activities on employee performance, as well as their behavior, attitudes, and values. It is important for the company to enhance its ability to recognize and understand the diverse aspects of these behaviors that contribute to generating diverse and innovative approaches.

REFERENCES

- [1] K. Yum and J. Kim, "The influence of perceived value, customer satisfaction, and trust on loyalty in entertainment platforms," *Applied Sciences*, vol. 14, no. 13, p. 5763, 2024.
- [2] T. F. Muhammad and H. A. Abdullah, "The application of the holonic manufacturing system by adopting the lean Six Sigma methodology," *Tikrit Journal of Administrative and Economic Sciences*, vol. 19, no. 64, 2023.
- [3] V. Singh, M. P. Sharma, K. Jayapriya, B. K. Kumar, M. A. R. N. Chander, and B. R. Kumar, "Service quality, customer satisfaction and customer loyalty: A comprehensive literature review," *J. Surv. Fish. Sci.*, vol. 10, no. 4S, pp. 3457–3464, 2023.
- [4] H. A. Setyawati and I. Helmy, "An analysis of the literature on lean supply chain management in relation to I4.0," *Current Perspective on Business Operations*, vol. 1, no. 2, pp. 130–152, 2025.
- [5] J. Reyes, J. Mula, and M. Díaz-Madroñero, "Development of a conceptual model for lean supply chain planning in Industry 4.0," *Production Planning & Control*, vol. 34, no. 12, 2023.
- [6] Y. Prasetyawan and N. G. Ibrahim, "Warehouse improvement evaluation using lean warehousing approach and linear programming," in *IOP Conference Series: Materials Science and Engineering*, 2020, p. 12033.
- [7] N. F. Naini, S. Santoso, T. S. Andriani, U. G. Claudia, and N. Nurfadillah, "The effect of product quality, service quality, customer satisfaction on customer loyalty," *Journal of Consumer Sciences*, vol. 7, no. 1, pp. 34–50, 2022.
- [8] S. Mostafa and J. Dumrak, "Waste elimination for manufacturing sustainability," *Procedia Manuf.*, vol. 2, pp. 11–16, 2015.
- [9] V. Mittal and C. Frennea, "Customer Satisfaction: A Strategic Review and Guidelines for Managers," 2010.
- [10] N. Maharana *et al.*, "Configuring lean supply chain performance in Indian millet distribution," *Journal of Transport and Supply Chain Management*, 2025.
- [11] V. Leninkumar, "The relationship between customer satisfaction and customer trust on customer loyalty," *International Journal of Academic Research in Business and Social Sciences*, vol. 7, no. 4, pp. 450–465, 2017.
- [12] S. Khoza, C. Mafini, and W. V. L. Okoumba, "Lean practices and supply-chain competitiveness in the steel industry in Gauteng, South Africa," *South African Journal of Economic and Management Sciences*, 2022.
- [13] K. Hidayat and M. I. Idrus, "The effect of relationship marketing towards switching barrier, customer satisfaction, and customer trust on bank customers," *J. Innov. Entrep.*, vol. 12, no. 1, p. 29, 2023.
- [14] M. Hanif, S. Hafeez, and A. Riaz, "Factors affecting customer satisfaction," *International Research Journal of Finance and Economics*, vol. 60, pp. 44–52, 2010.
- [15] I. Gunawan, "Customer loyalty: The effect customer satisfaction, experiential marketing and product quality," *KINERJA: Jurnal Manajemen Organisasi dan Industri*, vol. 1, no. 1, pp. 35–42, 2022.
- [16] D. de Oliveira-Dias, J. M. M. Marin, and J. Moyano-Fuentes, "Lean and agile supply chain strategies: the role of mature and emerging information technologies," *The International Journal of Logistics Management*, vol. 33, no. 5, 2022.
- [17] D. Guo and S. Mantravadi, "The role of digital twins in lean supply chain management: review and research directions," *Int. J. Prod. Res.*, vol. 63, no. 5, 2025.
- [18] B. Cvetic, D. Vasiljević, J. Novaković, and A. Đorđević, "Lean supply chain: take an opportunity to

- do more with less," *Tehnički Glasnik*, vol. 15, no. 2, pp. 275–281, 2021.
- [19] A. K. Jawad and I. F. Kadhim, "The Impact of Lean Supply Chains on Achieving Business Sustainability: An Analytical Study at the General Company for Grain Manufacturing - Baghdad, Iraq," *Journal of Economic Sciences*, vol. 6, no. 17, 2023.
- [20] P. Erik Eriksson, "Improving construction supply chain collaboration and performance," *Supply Chain Management: An International Journal*, vol. 15, no. 5, pp. 394–403, 2010.
- [21] H. Abu Nimeh, A. B. Abdallah, and R. Sweis, "Lean supply chain management practices and performance: empirical evidence from manufacturing companies," *International Journal of Supply Chain Management*, vol. 7, no. 1, pp. 1–15, 2018.
- [22] A. Agus and M. Shukri Hajinoor, "Lean production supply chain management as driver towards enhancing product quality and business performance," *International Journal of Quality & Reliability Management*, vol. 29, no. 1, pp. 92–121, 2012.
- [23] A. Anđelković, M. Radosavljević, and D. Stošić, "Effects of lean tools in achieving lean warehousing," *Economic Themes*, vol. 54, no. 4, pp. 517–534, 2016.
- [24] E. Cengiz, "Measuring customer satisfaction: must or not," *Journal of Naval Science and Engineering*, vol. 6, no. 2, pp. 76–88, 2010.
- [25] M. A. M. D. Basari and M. F. Shamsudin, "Does customer satisfaction matters," *Journal of Undergraduate Social Science and Technology*, vol. 2, no. 1, pp. 1–15, 2020.
- [26] M. Singh and S. Singh, "Friccohesity of Dispersion or Flocculation of Colloidal Suspensions through the Surface Area of NPs' Zeta Potential," in *Survismeter*, Jenny Stanford Publishing, 2019, pp. 229–232. doi: 10.1201/9780429027611-35.
- [27] M. S. Hidayat, "Pendekatan kontekstual dalam pembelajaran," *INSANIA: Jurnal Pemikiran Alternatif Kependidikan*, vol. 17, no. 2, 2012.
- [28] M. L. Abdul-Hadi and M. S. Abdul-Razzaq, "The Impact of Marketing Flexibility on Achieving Customer Satisfaction," *Journal of Economic and Administrative Studies*, no. 29, 2023.
- [29] M. Kazemi, E. Hadavi, and J. Hekmati, "The effect of malic acid on the bacteria populations of cut flowers of carnations vase solution," *World Applied Sci. J.*, vol. 10, pp. 737–740, 2010.
- [30] M. R. Saleh, "The Role of Marketing Control in Enhancing the Dimensions of Customer Satisfaction," *Tikrit Journal of Administrative and Economic Sciences*, vol. 16, no. 5, 2020.
- [31] Y. Jiang, M. Fauziah, M. Hairiyah, and Y. Li, "Effects of organic acids on postharvest life and quality of Chinese water chestnut," *Food Chem.*, vol. 32, pp. 16–21, 2004.