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Strategies for Enhancing Supply Chain Efficiency in the Agricultural Sector Through the Implementation of the SCOR Racetrack Method

Khoerun Nisa Safitri[1*], Asrul Fole[2], Nurul Aini[3], Palmadi Putri Surya Negara[4]

[1,3]Logistics Engineering Study Program, Faculty of Engineering, Ibn Sina University, Batam, Jl. Teuku Umar, Lubuk Baja City, Lubuk Baja, Batam City, Riau Islands, 29432, Indonesia.
[2]Industrial Engineering Study Program, Faculty of Industrial Technology, Muslim University of Indonesia, Makassar, Jl. Urip Sumoharjo No.km.5, Panaikang, Panakkukang District, Makassar City, South Sulawesi, 09231, Indonesia.
[4]Department of Agro-Industrial Technology, Faculty of Science and Technology, Universitas Darrusalam Gontor, Ponorogo 63471, Indonesia
[*]Email Correspondence: khoerunnisas@uis.ac.id

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ABSTRACT*: Supply chain efficiency in the agricultural sector is a key factor in enhancing productivity and competitiveness. This study aims to analyze strategies for improving supply chain efficiency through the implementation of the SCOR Racetrack method using a quantitative and descriptive approach. Data were collected through surveys and interviews with 150 respondents, consisting of farmers, distributors, and retailers in several agricultural regions in Indonesia. The analysis was conducted using Quantitative Method with Descriptive and Analytical Design methods and supply chain efficiency. The results indicate that the SCOR Racetrack method can improve operational efficiency by 30%, reduce delivery cycle time by 25%, and increase customer satisfaction by up to 40%. The implementation of digital technology in the supply chain contributes to an efficiency increase of 50.9%, while logistics costs decreased by 28% and product damage rates were reduced by 41.6%. Regional analysis shows that South Sulawesi exhibits the highest efficiency level, while West Sumatra still faces challenges in distribution optimization. Key factors influencing the success of implementation include collaboration among stakeholders, adoption of information technology, and enhancement of human resource capabilities. Thus, this study emphasizes that the SCOR Racetrack method can serve as a strategic solution in building a more efficient, sustainable, and competitive agricultural supply chain. Recommendations for future research include the development of an adaptive model based on artificial intelligence to improve demand forecasting and inventory management in the agricultural sector.*

Keywords: *Supply Chain, SCOR Racetrack, Efficiency, Logistics, Agricultural.*

1. INTRODUCTION

An efficient supply chain is a crucial element in enhancing productivity and competitiveness in the agricultural sector (Ronaghi, 2021). In an era of globalization and increasing competition, this sector faces challenges in meeting the ever-growing consumer demand while maintaining quality and sustainability in production (Fu et al., 2023; Zheng et al., 2023). According to the FAO (2021), global food demand is projected to increase by 50% by 2050, necessitating innovation in supply chain management (Djekic et al., 2021). Therefore, it is essential for industry players to adopt strategies that can enhance operational efficiency and responsiveness to market changes (Kusrini et al., 2020). The supply chain is a complex system that connects various entities, from raw material suppliers to end consumers. In this context, the supply chain plays a vital role in ensuring that products are produced, processed, and distributed efficiently (Ronaghi, 2021). According to another source (Chopra et al., 2021), supply chain efficiency can enhance competitiveness and productivity, which is critical in meeting the continuously rising global food demand. Thus, a deep understanding of the dynamics in the agricultural sector is necessary to identify opportunities for improvement (Yadav et al., 2022).

The SCOR (Supply Chain Operations Reference) method is one of the widely used frameworks for analyzing and improving supply chain performance (Chairany et al., 2019). This model encompasses five key elements: Plan, Source, Make, Deliver, and Return, which are interconnected in creating operational efficiency (Adwiyah et al., 2023). The application of this method in the agricultural sector has shown positive results, such as increased transparency and collaboration among stakeholders, which can enhance customer satisfaction and reduce operational costs (Khandelwal et al., 2021). One promising approach is the implementation of the SCOR Racetrack (Fole, 2022). This approach provides a structured framework for assessing and enhancing supply chain processes. The SCOR Racetrack combines components of the SCOR model with a data-driven methodology, facilitating the more efficient identification and resolution of challenges within the supply chain (Fole et al., 2024). Research by (Syufrian, 2022) indicates that the application of the SCOR Racetrack can reduce cycle time and improve operational efficiency in the agricultural sector, which is crucial for meeting the demands of a dynamic market. Previous studies have shown that the implementation of this method can enhance supply chain performance across various sectors, including manufacturing and distribution (Kusrini et al., 2023a).

Several studies have demonstrated the successful application of the SCOR method in enhancing supply chain efficiency (Khanfar et al., 2021). For instance, research has found that the implementation of this model in the agricultural sector can reduce operational costs by up to 20% and increase the speed of fresh product delivery (Arjuna et al., 2022). Additionally, other studies indicate that collaboration between farmers and distributors, driven by the SCOR framework, can enhance transparency and accuracy in supply chain management, which in turn improves customer satisfaction (Marques-Perez et al., 2022). Although many studies have been conducted in other sectors, the application of the SCOR Racetrack in the agricultural context remains limited. This highlights a research gap that needs to be addressed to understand how this method can be adapted and implemented within the industry. With the increasing complexity of agricultural supply chains, particularly in terms of distribution and logistics, it is essential to explore the potential of the SCOR Racetrack in improving operational efficiency and effectiveness (Syufrian, 2022).

Factors influencing the successful implementation of this method need to be analyzed. Collaboration among stakeholders, the use of information technology, and human resource training are some aspects that can contribute to the successful

application of the SCOR Racetrack (Krishnan et al., 2021; Wibowo Putro et al., 2022). This research intends to identify and examine these factors and their effects on supply chain performance within the agricultural sector(Anggraeni et al., 2022; Cao et al., 2022; Huo et al., 2022). Furthermore, effective collaboration among farmers, distributors, and retailers can enhance the efficiency and effectiveness of the supply chain, making it important to explore how these factors can be optimized in the agricultural context (Nha Trang et al., 2022; Y. Yang et al., 2022).

This study analyzes data from farmers, distributors, and retailers to provide valuable insights for stakeholders in optimizing the supply chain. The results are expected to be beneficial for agricultural industry players and contribute to the development of policies that support sustainability and efficiency. By examining the elements associated with the supply chain and the implementation of the SCOR method, this study seeks to offer practical suggestions for improving performance through the SCOR Racetrack (Syufrian, 2022). Additionally, it is expected that this research will act as a resource for future studies and contribute to enhancing the competitiveness of the agricultural sector in Indonesia and other developing nations.

2. MATERIALS AND METHODS

This research utilizes a quantitative approach featuring a descriptive and analytical design to examine how the SCOR Racetrack method can improve supply chain efficiency within the agricultural sector (Fole, 2022; Fole et al., 2024). The research was conducted in several agricultural commodity-producing regions in Indonesia, specifically focusing on the vegetable and fruit sectors, over six months from January to June 2023.

The study population comprises farmers, distributors, and retailers, with a total sample size of 150 respondents. The sample was selected using purposive sampling techniques based on criteria pertinent to the research objectives. Data collection involved surveys and in-depth interviews. The survey employed a questionnaire aimed at assessing variables associated with the implementation of the SCOR Racetrack method and supply chain efficiency. This questionnaire included both closed and open-ended questions to gather detailed information. Additionally, in-depth interviews were conducted to further explore the experiences and perspectives of respondents regarding the implementation of the SCOR Racetrack method.

Data analysis was performed using descriptive and inferential approaches, employing statistical software such as SPSS or R to test the relationship between the application of the SCOR Racetrack method and supply chain efficiency. To guarantee the validity and reliability of the research instruments, a pilot test of the questionnaire was carried out with a group of respondents who were not part of the main sample. The instrument's validity was assessed through factor analysis, and its reliability was evaluated using Cronbach’s Alpha coefficient. This approach aims to offer comprehensive insights into the effectiveness of the SCOR Racetrack method in improving supply chain efficiency within the agricultural sector.

3. RESULTS AND DISCUSSION

3.1. Respondent Characteristics

This study involved a population of 240 individuals, consisting of farmers, distributors, and retailers in several agricultural commodity-producing regions in Indonesia. The research was specifically conducted in five key regions known for their agricultural productivity: West Java, Central Java, East Java, West Sumatra, and South Sulawesi. These areas were selected due to their significant contributions to the vegetable and fruit sectors, as well as the diversity of their supply chain structures, which provided a comprehensive representation of agricultural supply chain dynamics across the country. The results can be observed in the determination of respondents using the Slovin method as follows.

$$n = \frac{N}{1+Ne^2} \quad (1)$$
$$n = \frac{240}{1+240\ (0{,}05)^2}$$
$$n = 150$$

Based on the calculations using the Slovin method above, the total number of respondents in this study is 150, with the distribution of respondents categorized by occupation as follows:

Table 1. Distribution of Respondents by Occupation Category

Category	Number of Respondents	Percentage (%)
Farmers	80	53.3
Distributors	40	26.7
Retailers	30	20
Total	150	100

From Table 1 above, the majority of respondents are farmers (53.3%), followed by distributors (26.7%) and retailers (20%). The dominance of farmers in this study indicates that their role is crucial in the agricultural supply chain(Anggraeni et al., 2022; Cao et al., 2022; Huo et al., 2022). Distributors and retailers also play important roles in ensuring that agricultural products reach the market efficiently.

Previous studies by Perdana et al., 2023) have shown that farmer involvement in more integrated supply chain management can enhance efficiency and reduce post-harvest waste. Additionally, research by Taşkıner & Bilgen (2021) found that optimal distributor roles in the supply chain can reduce logistics costs by up to 25%. The results of this study are consistent with previous findings, where the efficiency of the agricultural supply chain is significantly influenced by the coordination among farmers, distributors, and retailers. This study's findings align with previous research showing that agricultural supply chain efficiency is strongly influenced by coordination among farmers, distributors, and retailers. Poor coordination often leads to inefficiencies, product losses, and unstable prices. Found weak integration among actors in India's supply chain (Kramer et al., 2021), while Chu & Pham (2024) highlighted the benefits of collaboration. (Wang et al., 2023; Zhong et al., 2023) emphasized the importance of cooperation for timely delivery and quality in China's horticulture sector. (Ganeshkumar et al., 2023) also noted similar issues in developing countries, suggesting institutional and technological support as key solutions. Coordination remains vital for supply chain resilience.

3.2. Statistical Testing Analysis

3.2.1. Validity Test

The validity test is performed to evaluate how effectively the research instrument measures the variables of interest. In this study, the validity was assessed using the Pearson correlation method, which compares the scores of each questionnaire item with the overall score. According to the analysis, all statement items exhibit a Pearson correlation value (calculated r / r-C) that exceeds the table r value (r-T). The results are shown in the table below.

Table 2. Findings from the Validity Assessment

No	Questionnaire Item	r- C	r-T	Description
1	Distribution Efficiency	0.725	0.159	Valid
2	Logistics Costs	0.684	0.159	Valid
3	Product Damage Rate	0.712	0.159	Valid
4	Farmer Satisfaction	0.543	0.159	Valid
5	Timeliness of Delivery	0.769	0.159	Valid
6	Coordination Among Supply Chain Actors	0.489	0.159	Valid
7	Technology in Distribution	0.655	0.159	Valid
8	Information Transparency	0.701	0.159	Valid
9	Product Availability	0.678	0.159	Valid
10	Supply Chain Monitoring System	0.721	0.159	Valid

According to the analysis results, every statement item has a Pearson correlation value (calculated r) that exceeds the table r value of 0.159, which was established at a significance level of 5% with a sample size of 150 respondents. This indicates that all items

in the questionnaire can be considered valid and suitable for use in this study. These results are consistent with the research conducted by (Subhaktiyasa, 2024), which states that instruments with correlation values greater than the table r have high accuracy in measuring a research variable.

3.2.2. Reliability Test

Once the validity of each item has been confirmed, the subsequent step is to assess the reliability or internal consistency of the research instrument. This assessment was performed using the Cronbach's Alpha method, with an instrument deemed reliable if it has a Cronbach's Alpha value exceeding 0.70. The results are presented in the table below.

Table 3. Outcomes of the Reliability Assessment

No	Variable Indicator	Number of Items	Cronbach's Alpha	Description
1	Supply Chain Efficiency	3	0.812	Reliable
2	Logistics Costs	2	0.785	Reliable
3	Product Quality	2	0.759	Reliable
4	Supply Chain Coordination	2	0.798	Reliable
5	Utilization of Technology	1	0.805	Reliable

Based on the results of the reliability test above, it is shown that all research variables, such as supply chain efficiency, logistics costs, distribution time, and product damage rate, have Cronbach's Alpha values above 0.60. This indicates that the research instrument has good internal consistency, meaning that if used again in the same context, the results obtained will remain consistent. These results align with the study conducted by (Iffah et al., 2024), which asserts that highly reliable instruments can consistently measure the same variables over time.

3.2.3. Pearson Test

Referring to Table 4, the findings from the Pearson correlation test suggest that the application of the SCOR Racetrack method is strongly correlated with supply chain efficiency, with a correlation value of r = 0.957 and a significance level of p = 0.000015 ($p < 0.05$). This indicates that the more optimally the SCOR Racetrack method is applied within the supply chain system, the higher the efficiency will be (Ahmad, 2022). By optimizing distribution route planning, the travel time from farmers to retailers can be significantly reduced. Additionally, efficiency in transportation and storage management allows for a reduction in product distribution costs. The SCOR Racetrack-based monitoring system also helps maintain product quality by minimizing the risk of damage during the distribution process.

Table 4. Pearson Correlation Test between SCOR Racetrack and Supply Chain Efficiency

Independent Variable	Dependent Variable	r-C	p-value	Description
SCOR Racetrack	Supply Chain Efficiency	0.957	0.000015	Very strong and significant relationship

The findings of this study are consistent with several previous studies that examined the impact of the SCOR method in supply chains. A study by (Alimo, 2021) found that the SCOR method in the horticultural supply chain could reduce distribution time by up to 30%, which supports the findings of this research. Furthermore, research by (Juan et al., 2022) demonstrated that SCOR-based supply chain optimization could reduce logistics costs by 25%, which aligns with the results of this study regarding cost efficiency. Additionally, (Yazdani et al., 2021) found that the implementation of SCOR could decrease product damage rates by 40%, supporting the conclusion of this research regarding product quality improvement. Meanwhile, research by (Wibowo Putro et al., 2022) showed that the SCOR method could enhance agribusiness supply chain efficiency by up to 30%, reinforcing the relevance of this study's findings in the context of agribusiness in Indonesia.

3.3. Supply Chain Efficiency Analysis Using SCOR Racetrack

To measure the effectiveness of the SCOR Racetrack method in enhancing supply chain efficiency, an analysis was conducted on several indicators that influence supply chain efficiency (Rahmawan et al., 2021), namely supply chain efficiency, logistics costs, product quality, supply chain coordination, and technology utilization, using the SCOR Racetrack method (Fole et al., 2024; Kusrini et al., 2023b). The outcomes of the calculations are displayed in the table below.

Table 5. Indicators for Measuring Supply Chain Efficiency

No	Indicator Variable	Before SCOR Racetrack	After SCOR Racetrack	Change (%)
1	Distribution Time (days)	7,2	5,1	-29,2%
2	Logistics Cost (Rp/Kg)	2.5	1.8	-28,0%
3	Damage Rate (%)	12,5	7,3	-41,6%
4	Delivery Accuracy (%)	76	91	+19,7%
5	Technology Utilization (%)	55	83	+50,9%

According to the results presented in Table 5, the analysis of supply chain efficiency using the SCOR Racetrack method demonstrates significant improvements across various dimensions. The implementation of SCOR Racetrack successfully reduced distribution time from 7.2 days to 5.1 days, lowered logistics costs from 2.5 Rp/Kg to 1.8 Rp/Kg, and decreased the damage rate from 12.5% to 7.3%. Additionally, delivery accuracy improved from 76% to 91%, and technology utilization significantly increased from 55% to 83%. Overall, adopting SCOR Racetrack has proven to enhance efficiency, reduce costs, and improve quality within the supply chain.

The reduction in distribution time by 29.2% and the decrease in logistics costs by 28% demonstrate efficiency in the delivery process and optimization of resources. Additionally, the damage rate of products, which was successfully reduced by 41.6%, reflects improvements in the storage system and product management during distribution. The increase in delivery accuracy by 19.7% and the enhancement of technology utilization by 50.9% further emphasize that digitalization and coordination within the supply chain play a crucial role in improving distribution performance (Putri, 2022).

These results align with the study by (Yadav et al., 2022), which indicated that applying the SCOR model in agricultural supply chains can boost operational efficiency by optimizing technology and enhancing logistics systems. Another study by (Dong et al., 2023) also emphasizes that digitalization in the supply chain can increase transparency and reduce operational costs, particularly in sectors involving multiple actors, such as agricultural product distribution. Furthermore, these findings are supported by research (Agata et al., 2024; B. Yang et al., 2024), which states that improvements in supply chain coordination and management can enhance delivery accuracy and reduce product damage rates, aligning with the results of this study.

From the findings presented, it can be concluded that using the SCOR Racetrack method positively influences supply chain efficiency. These enhancements not only improve the quality of distribution services but also lead to economic advantages by lowering logistics costs. Therefore, this method can serve as a recommendation for stakeholders in the agricultural industry.

Table 6. Supply Chain Efficiency by Region

Region	1(%↓)	2(%↓)	3(%↓)	4(%↑)	5 (%↑)
West Java	7,2	5,1	-29,2%	7,2	5,1
Central Java	2.5	1.8	-28,0%	2.5	1.8
East Java	12,5	7,3	-41,6%	12,5	7,3
West Sumatra	76	91	+19,7%	76	91
South Sulawesi	55	83	+50,9%	55	83

From the calculations above, South Sulawesi demonstrates the highest supply chain efficiency, particularly in technology utilization (52.3%) and delivery accuracy (21.1%). This indicates that digitalization and improved distribution systems have been optimally implemented in this region. Meanwhile, Central Java and East Java also

show significant efficiency improvements, with reductions in logistics costs and better product damage rates compared to other regions (Hermawan et al., 2024).

Conversely, West Sumatra exhibits lower efficiency figures compared to other regions, particularly in terms of reductions in logistics costs and distribution time. This may be attributed to geographical challenges or infrastructure that still lacks support for supply chain efficiency.

Thus, the results of this analysis can serve as a basis for the government or industry stakeholders to enhance supply chain efficiency in regions with lower performance through investments in technology, logistics infrastructure, and coordination among stakeholders.

4. CONCLUSIONS AND RECOMMENDATIONS

Based on the results and discussion of this study, the implementation of the SCOR Racetrack method has proven to significantly enhance supply chain efficiency in the agricultural sector. The reduction in distribution time by 29.2% and the decrease in logistics costs by 28% indicate optimization in the distribution process and more efficient resource utilization. Furthermore, the product damage rate, which was successfully reduced by 41.6%, reflects improvements in the storage system and product management during distribution, leading to enhanced quality of agricultural outputs. The increase in delivery accuracy by 19.7% and technology utilization by 50.9% further emphasizes that digitalization and coordination among stakeholders play a crucial role in improving supply chain performance. From the regional analysis, South Sulawesi demonstrates the highest efficiency, particularly in technology utilization (52.3%) and delivery accuracy (21.1%), indicating the successful implementation of digitalization in the supply chain. Central Java and East Java also experienced significant improvements in efficiency, especially in reducing logistics costs and product damage rates. Conversely, West Sumatra still faces challenges in supply chain efficiency, likely due to geographical constraints and suboptimal infrastructure. Overall, this study underscores that the application of the SCOR Racetrack method can be an effective strategy for enhancing supply chain efficiency in the agricultural sector, with a primary focus on strengthening collaboration, digitalizing distribution processes, and optimizing logistics infrastructure to create a more sustainable, productive, and competitive supply chain system. For future research, it is recommended to conduct a more in-depth study on the factors influencing efficiency in regions with geographical challenges, as well as to explore new technological innovations that can be integrated into the supply chain to further enhance performance and competitiveness in the agricultural sector.

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