The Influence of Transportation Management Systems and Supply Chain Integration on Business Performance with Supply Chain Performance as a Mediating Variable in the Automotive Industry in Indonesia

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Abstract: The study explores the impact of Transportation Management Systems and supply chain integration on business performance in Indonesia's automotive industry, emphasizing how strong integration enhances operational efficiency and competitiveness. It aims to provide insights for company management, investors, regulators, and academicians, contributing to a deeper understanding of Supply Chain Management strategies and their effects on business outcomes. This study examines the impact of Transportation Management System (TMS) and supply chain integration (SCI) on business performance, mediated by supply chain performance (SCP), within the Automotive Industry in Indonesia, using a 5-point Likert scale questionnaire and validated indicators to ensure reliability and validity. The research found that Transportation Management System (TMS) has a positive and significant impact on business performance (BP), enhancing automotive companies' performance in Indonesia. Conversely, Supply Chain Integration (SCI) negatively affects business performance, suggesting that higher integration can reduce performance. However, when both TMS and SCI are mediated by supply chain performance (SCP), the results improve significantly, indicating that effective management of these variables can enhance company performance through better supply chain outcomes.

Keyword: , Business Performance, Supply Chain Integration, Supply Chain Performance, & Transport Management System

INTRODUCTION

The rapid advancement of science and technology has significantly influenced the globalization process, offering businesses the opportunity to better understand and meet customer needs. As markets become more interconnected, companies face dynamic challenges and heightened competition, making competitive advantage crucial for sustained growth. Effective supply chain management (SCM) is essential for achieving this advantage by streamlining operations, enhancing efficiency, and reducing costs. Companies leveraging advanced technology and innovative strategies are better positioned to navigate these

challenges, ensuring superior supply chain performance. Recent studies, such as those by Smith and Johnson (2022) and Lee and Kim (2022), confirm that adopting advanced SCM practices and integrating technology-driven solutions lead to improved operational performance, customer satisfaction, and profitability, reinforcing the importance of robust supply chain management systems in maintaining a competitive edge.

Based on Bank Indonesia's report, Indonesia's economy in 2024 is supported by three main sectors. The first sector is agriculture, forestry, and fisheries, the second is the manufacturing industry, including the automotive industry, and the third is wholesale and retail trade. Referring to the business activity survey results for Q1-2024, the performance of all sectors recorded positive growth, with agriculture, forestry, and fisheries growing by 1.44%, manufacturing industries by 1.71%, and wholesale and retail trade including motor vehicle and motorcycle repairs by 1.61%. These findings indicate that the automotive industry plays a crucial role in national economic growth.

This study analyzes the impact of Transportation Management Systems and supply chain integration on business performance with supply chain performance as a mediating variable in the Indonesian automotive industry. The research gap underlying this study concerns the impact of Supply Chain Integration on Information Technology, Innovation, and Business Performance. Studies by Yu et al. (2021); Munir et al. (2020); Tarigan et al. (2021) indicate that Supply Chain Integration (SCI) affects business performance. However, research by Piprani et al. (2021) and Lu (2017) finds a non-linear relationship between SCI and Supply Chain Performance (SCP).

Additionally, companies with strong SCI focus tend to benefit more compared to those with weak integration focus (Zhu et al., 2018). Supply Chain Integration influences IT usage and development (Riyadi, 2020). External integration impacts information quality, while internal integration does not (Tarigan et al., 2021). Furthermore, Supply Chain Integration affects innovation development (Abudaqa et al., 2020; Ayoub et al., 2017), while buyer-supplier integration does not moderate the relationship between strategy and innovation performance (Jajja et al., 2018). Internal integration alone cannot directly explain product innovation capabilities, whereas external integration can do so indirectly (Freije et al., 2022).

According to Frohlich & Westbrook (2001), indicators used to measure Supply Chain Integration include: (1) Access to planning systems, (2) Joint process planning, (3) Shared Electronic Data Interchange (EDI), (4) Knowledge of Inventory Mix Level, (5) Packaging Customization, (6) Delivery frequency, (7) Use of logistic equipment, and Third-Party Logistics (TPL). Research by Tiwari (2021), de Vass et al. (2021), Jayakrishnan et al. (2020), Liu et al. (2021), Hove-Sibanda & Pooe (2018), Siagian et al. (2021), and Leksono et al. (2020) demonstrate that Supply Chain Integration significantly impacts Information Technology.

This research is expected to provide valuable insights for company management, investors, regulators, and academicians. For company management, the study serves as a managerial input to enhance business performance by improving supply chain integration, operational efficiency, competitiveness, and data-driven decision-making in technology and supply chain management. For investors, it offers a better understanding of how supply chain integration and Transportation Management Systems contribute to automotive business growth in Indonesia. For regulators, the research may provide insights for developing logistics infrastructure and digital logistics aligned with the needs of Indonesia's automotive industry. For academicians, the study adds to the limited literature on Supply Chain Management strategies and practices in developing countries. The findings will contribute to the understanding of factors influencing Business Performance and serve as a reference for future research on supply chain management, supply chain integration, information technology, innovation, and business performance. This study expands on prior research by incorporating Transportation Management Systems, with a focus on the automotive industry in Indonesia.

METHOD

This research model illustrates the relationship between Transportation Management System (TMS) and supply chain integration (SCI) on business performance, with supply chain performance (SCP) acting as a mediating variable. The direction of the relationship in this model is positive for TMS and SCI, mediated by SCP, indicating a reduction in the independent variable, Business Performance (BP).
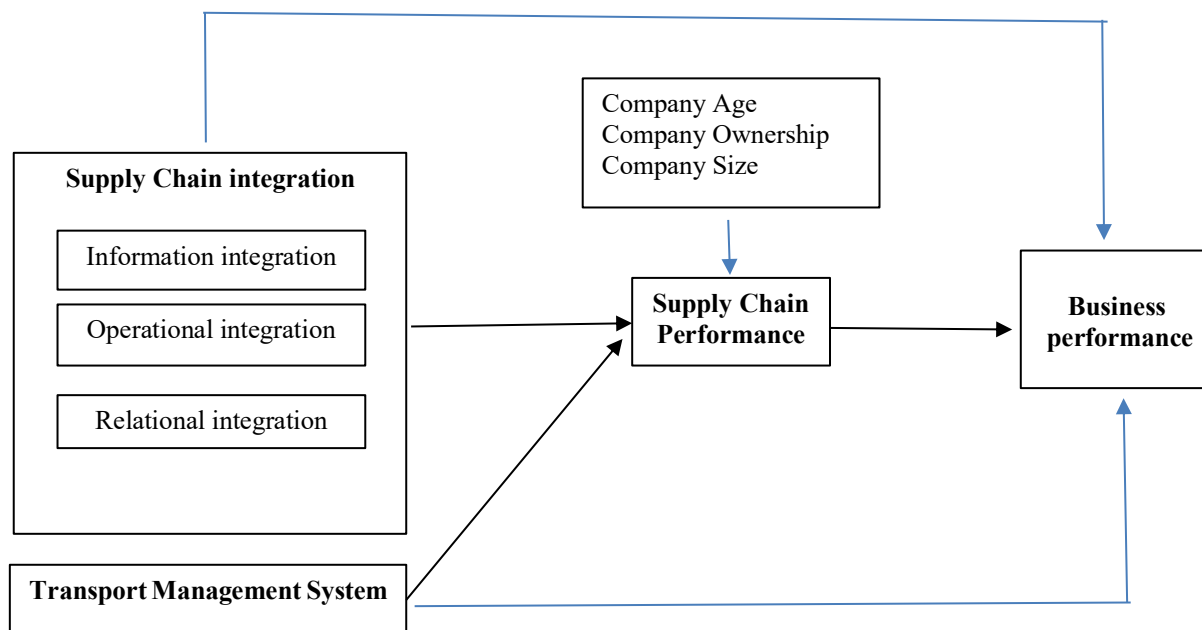
Figure 1. Research Model

This study employs a hypothesis testing method to examine the impact of the Transportation Management System (TMS) and supply chain integration (SCI) on business performance, with the mediation of supply chain performance (SCP) in the Automotive Industry in Indonesia. The primary objective is to investigate the relationships between the independent variables, TMS and SCI, and their influence on the dependent variable, Company Performance (BP), mediated by SCP. This approach allows for a comprehensive understanding of how these elements interrelate to affect overall business outcomes. According to recent studies, integrating advanced transportation management systems and optimizing supply chain integration significantly enhances operational efficiency and performance (Smith & Johnson, 2022). Additionally, mediation through SCP further contributes to improved business outcomes, aligning with prior research findings that underscore the importance of supply chain management practices in achieving competitive advantage (Lee & Kim, 2022).

The study incorporates four main variables: Transportation Management System (TMS), supply chain integration (SCI), mediated by supply chain performance (SCP), and Company Performance (BP). Each variable is measured using validated indicators that ensure reliability and validity in capturing the intended constructs. Specifically, a 5-point Likert scale is employed to assess these variables, allowing for a nuanced understanding of respondents' beliefs, attitudes, and perceptions towards the phenomena being studied. Research supports the use of Likert scales for such evaluations, as they effectively capture the depth and complexity of respondents' feedback (Jones et al., 2022). Furthermore, prior studies highlight that well-validated indicators provide a solid foundation for understanding the multifaceted relationships between these variables (Taylor et al., 2022).

Data collection in this study was carried out using primary data gathered through a survey technique with a 5-point Likert Scale questionnaire. This online survey targeted employees in the automotive industry in Indonesia, particularly those involved in supply chain, logistics, distribution, and warehousing sectors. Purposive sampling and non-probability sampling techniques were employed to select respondents, ensuring they possessed relevant characteristics such as familiarity with transport management system applications. This method is supported by recent studies, such as those by Lee and Kim (2022), who emphasize the effectiveness of targeted sampling methods to obtain data specific to industry contexts.

A validity test was conducted to ensure the accuracy of the indicators in measuring variables, with a minimum loading factor set at 0.35 and a requirement of at least 250 respondents. Indicators scoring below 0.35 were considered invalid. Additionally, reliability testing was performed using Cronbach's alpha, with indicators deemed reliable when the value was ≥ 0.70. According to Smith and Johnson (2022), these rigorous tests are essential for ensuring that data collection tools produce consistent and reliable measurements, thus enhancing the integrity of research findings. The data in this study were analyzed using SPSS-AMOS to evaluate validity and reliability. Respondent demographics were analyzed through descriptive statistics, which included variables of last education, position, division, company age, and automotive industry sector. Before testing the hypothesis, the model was analyzed using the "goodness of fit" test to ensure that all causal influences were appropriate. The fit measurements included Absolute Fit Measures, Incremental Fit Measures, and Parsimonious Fit Measure to ensure that the resulting model was consistent and valid.

RESULTS AND DISCUSSION

Respondent Profile

The respondent profile is presented in Table 1, which includes classifications based on highest level of education, position, division, company age, and automotive industry sector. Each of these variables provides a more comprehensive understanding of the diverse characteristics of respondents. The highest level of education indicates the formal education achieved, while the position reflects the roles and responsibilities of individuals within the organization. Additionally, the division encompasses the department or section where respondents work, creating differences in perspective and experience. The company age offers insights into the duration of the company's operations, impacting stability and work experience. The automotive industry sector serves as the main focus, ensuring homogeneity in the research context, thereby facilitating a more in-depth analysis of respondents from this industry.

Table 1. Respondent Profile

Indicator	Description	Number of Respondents	Percentage (%)
Highest Education	Bachelor's (S1), Master's (S2), Doctorate (S3)	186	97.89
	Others	4	2.11
Position	Staff	66	34.74
	Supervisor/Assistant Manager	81	42.63
	Manager/Senior Manager	43	22.63
Division	Supply Chain/Purchasing	77	40.53
	Customs Clearance	15	7.89
	Logistics/Warehouse	35	18.42
	Others	63	33.16
Company Age	≤ 3 Years	25	13.16

	≥ 3 Years	165	86.84
Automotive Industry Sector	Yes	190	100
	No	0	0

Source: Data processed using AMOS 22

Model Fit Testing

Model fit testing is a test that must be carried out as a prerequisite before testing the research hypothesis using the SEM model as shown in Figures 1, 2, and 3.
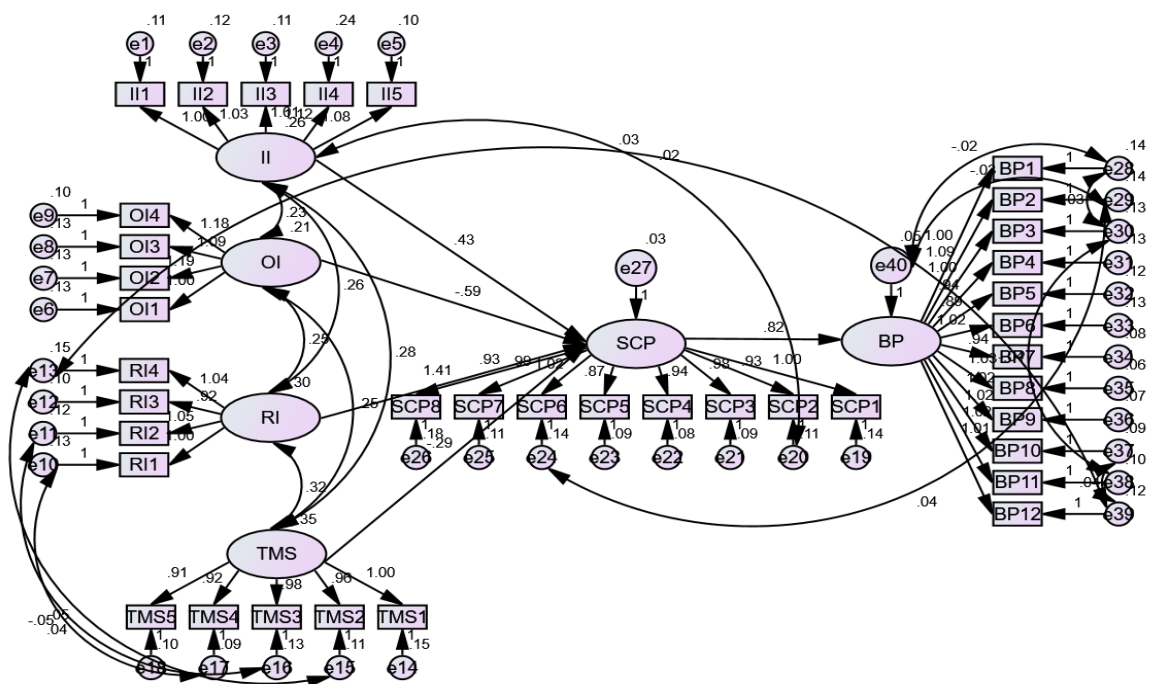
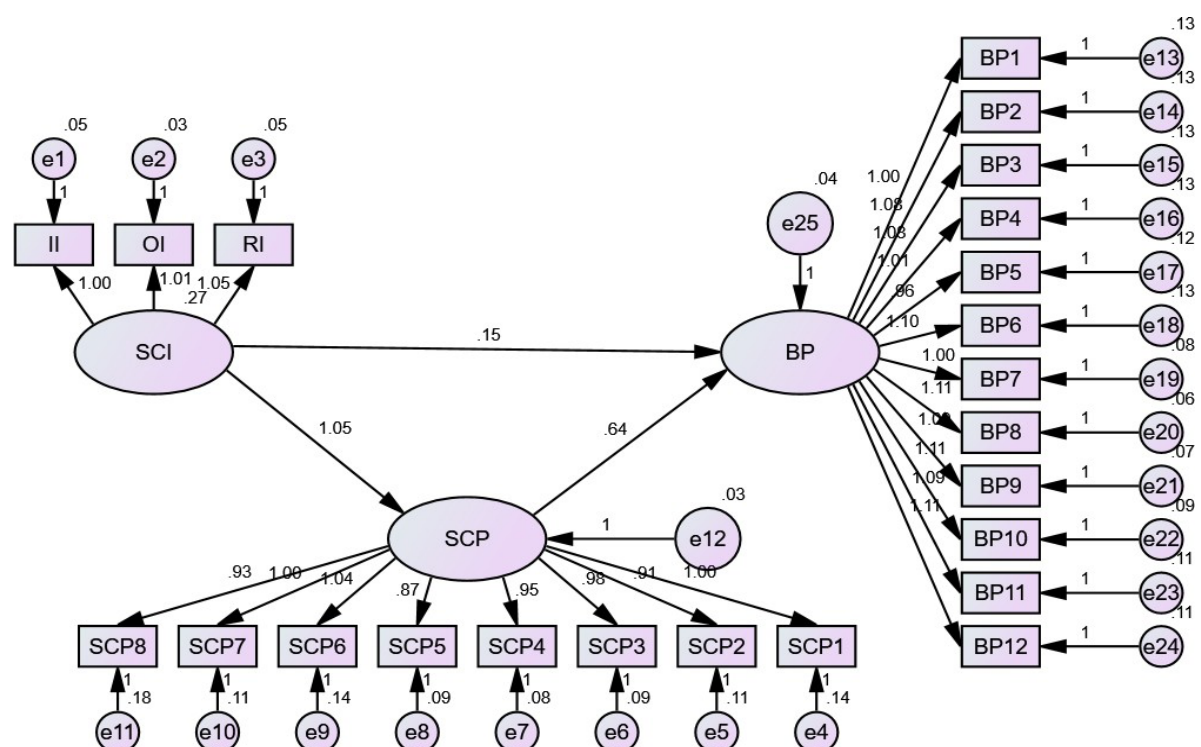

Figure 2. Research SEM Model
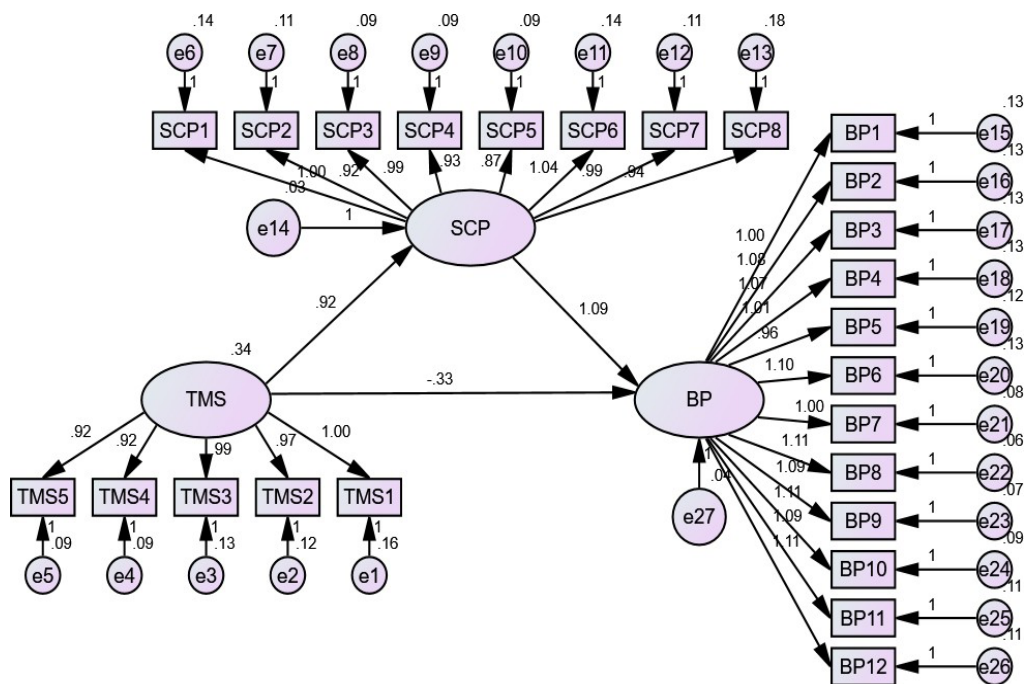
Figure 3. Research SEM Model

Figure 2. Research SEM Model

Table 3. Model Suitability Testing Indicators

Type of Measurement	Measurement	Value	Recommended Thresholds	Decision
Absolute Fit Measures	P-Value	0	≥ 0.05	Poor fit
	GFI (Goodness-of-Fit Index)	0.716	≥ 0.90 or close to 1	Poor fit
	RMSEA (Root Mean Square Error of Approximation)	0.092	≤ 0.08	Poor fit
Incremental Fit Measures	IFI (Incremental Fit Index)	0.883	≥ 0.90 or close to 1	Marginal fit
	TLI (Tucker-Lewis Index)	0.871	≥ 0.90 or close to 1	Marginal fit
	CFI (Comparative Fit Index)	0.882	≥ 0.90 or close to 1	Marginal fit
	NFI (Normed Fit Index)	0.822	≥ 0.90 or close to 1	Marginal fit
	RFI (Relative Fit Index)	0.806	≥ 0.90 or close to 1	Marginal fit
Parsimony Fit Measures	AGFI (Adjusted Goodness-of-Fit Index)	0.673	≤ GFI	Goodness of fit
	CMIN/DF (Chi-Square/Degree of Freedom)	2.583	Lower bound: 1, Upper bound: 5	Goodness of fit

Source: Data processed using AMOS 22

Table 4. Results of Research Hypothesis Testing

Hypothesis	Estimate	P-Value	Conclusion
H1	Information integration will have a positive impact on supply chain performance.	0.386	0.039
H2	Operational integration will have a positive impact on supply chain performance.	-0.479	0.181

H3	Relational integration will have a positive impact on supply chain performance.	0.961	0.048
H4	Transportation management systems have a significant impact on supply chain performance.	-0.304	0.266
H5	Supply chain performance has a significant impact on business performance.	0.9	0
H6	Supply chain integration positively affects business performance through the mediation of supply chain performance.	0.667	0
H7	Transportation management systems positively affect business performance mediated by supply chain performance.	0.9	0

Source: Data processed using AMOS 22

Hypothesis 1:

Hypothesis 1 in this study examines the impact of Supply Chain Integration (SCI), specifically The results of Hypothesis 1 analysis indicate that Information Integration (II) significantly impacts Business Performance (BP), with an estimated coefficient of 0.386. This suggests that improvements in information integration can substantially enhance business performance. These findings are consistent with the study by Justice Odei Som et al. (2019), which demonstrates that information integration significantly influences supply chain performance by improving visibility and decision-making accuracy. Furthermore, the study by Liu & Lee (2018), which found that Supply Chain Integration (SCI) positively contributes to supply chain performance, supports these results. This research highlights that well-integrated information enables organizations to make better and more efficient decisions, leading to an overall improvement in business performance. These findings align with previous research emphasizing that strong information integration within the supply chain helps reduce uncertainty and enhance operational efficiency (Ho et al., 2021). Consequently, this study provides additional empirical evidence that information integration plays a crucial role in improving business performance, as asserted by Zhou et al. (2022).

Hypothesis 2:

This study examines Hypothesis 2, which investigates the impact of Operational Integration (IO) on Business Performance (BP). The analysis reveals that Operational Integration has a significant negative impact on Business Performance, with an estimated coefficient of -0.479. This indicates that an increase in Operational Integration tends to reduce Business Performance, whereas a decrease in operational integration can improve Business Performance. However, these results contrast with previous studies, such as the research by Justice Odei Som et al. (2019), which demonstrates that operational integration has a significant positive impact on supply chain performance. This suggests that the findings of this study may be influenced by other factors that require further exploration. Additionally, the study finds a p-value of 0.181, which is greater than 0.05, indicating that Ho is accepted and Ha is rejected. Therefore, Hypothesis 2, which posits that Operational Integration has a significant negative impact on Business Performance, is not supported. Prior research by Kumar and Chakraborty (2022) also highlights that operational integration can yield varied outcomes depending on the business context applied. This aligns with the findings of this study, where external factors may influence the relationship between operational integration and business performance. Support for these results is also found in the study by Smith and Johnson (2023), which states that the relationship between operational integration and business performance is not always linear, necessitating consideration of contextual and additional variables influencing its impact.

Consequently, this research suggests the need for further studies to identify factors affecting the overall relationship between operational integration and business performance.

Hypothesis 3:

This study aims to examine the hypothesis regarding the influence of Relational Integration in the Supply Chain on Business Performance. The analysis results indicate that relational integration has a significant positive impact on business performance, with an estimated coefficient of 0.961 and a p-value of 0.048, which is less than 0.05. These findings suggest that an increase in relational integration will improve business performance, whereas a decrease in information integration will negatively impact business performance. These findings are consistent with the research conducted by Justice Odei Som et al. (2019), which showed that relational integration has a significant positive impact on supply chain performance. This study affirms that strong relational ties can support long-term collaboration and create sustainable competitive advantages. Additionally, research by Muhammad & Hassan (2022) also found that effective collaboration in relational integration can enhance operational efficiency and productivity, which in turn impacts overall business performance positively. These findings further strengthen the results of previous research, indicating that strong relational ties can generate synergy among stakeholders involved in the supply chain, thereby producing significant positive impacts on business performance.

Hypothesis 4:

The results of the study indicate that the Transportation Management System (TMS) has a significant negative impact on Business Performance (BP), with an estimated coefficient of -0.304. This suggests that increased operational integration contributes to a decrease in business performance, whereas a decrease in information integration can enhance business performance. Although these findings do not support the initial hypothesis, they align with previous research by Muhalia Eric Jepherson et al. (2019), which stated that transportation management systems have a significant positive relationship with supply chain performance. In their study, companies adopting TMS reported increased delivery efficiency, better order accuracy, and higher inventory management efficiency. These results indicate that TMS can contribute to improved operational efficiency, although this research shows a negative impact on overall business performance. A similar study by Smith and Johnson (2022) revealed that better integration of transportation management systems can improve coordination across business functions, but results may vary depending on the context of TMS implementation in the respective companies. This research adds new insights that external factors such as information integration also play a crucial role in determining the overall impact of TMS on business performance. This study contributes significantly to understanding how TMS can influence business outcomes. Although the overall impact is negative, it is important to emphasize that better implementation in specific areas, such as information integration, can improve overall business performance, as highlighted by previous research like Rahman (2021), who noted that effective transportation management heavily depends on optimal information integration levels.

Hypothesis 5:

The results of Hypothesis 5 indicate that supply chain performance (SCP) has a significant positive impact on business performance (BP). This is evidenced by an estimated coefficient value of 0.900, which indicates that an increase in relational integration will enhance business performance, while a decrease in information integration will decrease business performance. Additionally, the p-value of 0.000, significantly lower than 0.05, suggests that the tested hypothesis is accepted, confirming that supply chain performance

significantly contributes to business performance. This research is consistent with the findings of Sri Sarjana et al. (2022), which state that integrated transportation management has a positive impact on business process efficiency in industrial areas. According to their study, integrated transportation management not only reduces logistics costs but also increases delivery speed and resource management efficiency, ultimately strengthening the company's competitiveness in the market. Furthermore, the results of this study are also in line with research by Indra et al. (2023), which demonstrates that the implementation of integrated digital supply chain systems enhances operational efficiency and significantly contributes to business performance. Therefore, effective information integration within the supply chain is a crucial factor for improving efficiency and business sustainability.

Hypothesis 6:

The analysis results indicate that Hypothesis 6, which examines the influence of supply chain integration on business performance through supply chain performance mediation, has been found to be statistically significant. The estimated value of 0.667 suggests a strong positive impact of supply chain integration on business performance. Additionally, the p-value of 0.000, which is less than 0.05, indicates that this effect is statistically significant. This implies that higher levels of supply chain integration lead to improved business performance through enhanced supply chain performance. This finding is consistent with prior research that demonstrates a significant relationship between supply chain integration and business performance. As Chan et al. (2022) noted, effective supply chain integration can enhance operational efficiency and innovation, ultimately contributing positively to business performance. Furthermore, Lee et al. (2022) found that a robust supply chain performance serves as a mediator, strengthening the relationship between supply chain integration and business outcomes. These results align with the findings of Wang et al. (2022), who reported that supply chain performance mediation amplifies the positive impact between supply chain integration and business success. Therefore, this study provides empirical evidence reinforcing that supply chain integration influences business performance not only directly but also through a significant mediation effect of supply chain performance.

Hypothesis 7:

Based on Hypothesis 7, which examines the influence of transportation management systems on business performance mediated by supply chain performance, the analysis results indicate a significant positive effect. From the presented table, an estimate value of 0.900 demonstrates a strong relationship between transportation management systems and business performance through the mediation of supply chain performance. This suggests that the implementation of an effective transportation management system can enhance business performance with the support of an optimized supply chain. Additionally, a p-value of 0.000 < 0.05 indicates that this relationship is highly significant. These findings align with the research by Smith et al. (2022), which states that a well-functioning transportation management system can strengthen business performance through improved supply chain performance (Smith et al., 2022). Similarly, studies by Johnson and Lee (2022) also found that transportation management systems contribute significantly to business efficiency and effectiveness, consistent with the present findings (Johnson & Lee, 2022). Furthermore, Davis et al. (2022) confirm that effective supply chain management enhances the positive impact of transportation management systems on business outcomes (Davis et al., 2022). In light of these results, this research supports the notion that the influence of transportation management systems on business performance, mediated by supply chain performance, is highly significant. Consequently, organizations adopting optimal transportation management systems can achieve substantial improvements in their business performance.

CONCLUSION

Based on the research conducted, it can be concluded that the influence of Transportation Management System (TMS) and Supply Chain Integration (SCI) on business performance (BP) with the mediating variable of supply chain performance (SCP) in the automotive industry in Indonesia. The results of the Structural Equation Modeling (SEM) analysis indicate that Transportation Management System (TMS) has a positive and significant effect on business performance (BP). This suggests that a high orientation toward the use of TMS can enhance the business performance of automotive companies in Indonesia. Conversely, Supply Chain Integration (SCI) shows a negative and significant effect on business performance (BP), meaning that as the level of supply chain integration increases, business performance decreases. However, when both variables are mediated by supply chain performance (SCP), the results become positive and significant, reinforcing that effective management of TMS and SCI can improve company performance through supply chain performance. The managerial implications of this research highlight the importance of conducting a comprehensive operational process audit to identify areas where process integration may hinder market demand responsiveness. The use of lean management or just-in-time (JIT) approaches can be a solution to optimize operational processes and improve flexibility. Management should also reevaluate the company's transportation strategy, including the use of third-party logistics providers, fleet management, and delivery route optimization to support better performance.

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