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The Moderating Role of Information Quality in The Relationship Between Operational Performance and Supply Chain Integration: Evidence from The Manufacturing Sector

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ABSTRACT

In this study examined the moderating effect of information quality (InfoQ) in the relationship between supply chain integration (SCI) and operational effectiveness within the manufacturing sector. Respondents from selected manufacturing companies provided the study data, which were then analyzed using structural equation modeling, to ascertain the proposed relationships. Results affirmed a correlation between SCI (both supplier and customer integration) and operational effectiveness, denoting the ability of streamlined supply chains in increasing operational outcomes. This correlation is also influenced by InfoQ, which means that integrated supply chains require accurate information. Supply chain management can be understood better through the study findings. Also, the findings could facilitate managers in improving their operational performance through the use of SCI-based initiatives.

1. Introduction

In keeping abreast with the fast and competitive business world today, companies often have to find methods to be more efficient in their business operations [32]. In order to achieve efficient business operations, many companies would integrate the suppliers and customers into their operations, and this strategy has been effective in increasing performance [43]. In this regard, supplier integration (SI) includes collaboration of company with suppliers, and this collaboration streamlines the processes while also improving the effectiveness [12]. Furthermore, SI has been shown to contribute to shorter lead times, aside from improving supply chain performance and product quality [33]. Meanwhile, customer integration (CI) encompasses involving customers in the process of value creation so that they (the customers) will gain better understanding of their preferences and requirements [27]. CI has been known to increase customer satisfaction and sales figures, while strengthening the company's market presence. Somehow, it is possible that the effect

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of these integrations on efficiency is affected by the quality of information exchanged between the involved parties [23].

The quality of information affects the information exchanged, particularly in terms of its accurateness, reliability, and importance, and therefore, during the integration process, this aspect is crucial [41]. Decision-making could be improved through the use of high-quality information Nenavani and Jain [34], while confusions, delays, and inefficiencies could result when the information used is of poor quality, especially during the integration processes, leading to impaired performance [7]. The effects of SI, CI and information quality (InfoQ) on operational performance (OP) have been explored in various studies. Nonetheless, the joint effects of these factors have not been examined much, especially the moderating role of InfoQ in the relationship between supplier CI and OP [45]. Therefore, there has been a research gap which this study attempted to fill. Accordingly, the potential collective impacts of suppliers and customers on efficiency, with the factor of information accuracy, were addressed in this study [38]. With the results, this study attempted to provide a perspective on how businesses can improve their OP through effective collaboration with suppliers and customers, taking into account the value of having reliable information exchange.

To address the research gap, this study examined the moderating effect of information quality (InfoQ) in the relationship between supply chain integration (SCI) and operational effectiveness within the manufacturing sector. Respondents from selected manufacturing companies provided the study data, which were then analyzed using structural equation modeling, to ascertain the proposed relationships. Results affirmed a correlation between SCI (both supplier and customer integration) and operational effectiveness, denoting the ability of streamlined supply chains in increasing operational outcomes. This correlation is also influenced by InfoQ, which means that integrated supply chains require accurate information. Supply chain management can be understood better through the study findings. Also, the findings could facilitate managers in improving their operational performance through the use of SCI-based initiatives. The rest of the study is divided into review of literature, methodology, findings, discussion, conclusion, implications and future directions.

2. Literature Review

2.1 Operational Performance

Performance can be regarded as a complex concept because it comprises many different aspects, for instance, response time, capacity planning, and workload prediction, among others [23]. This concept, when described in software systems, can be understood as how well the system can fulfill the needs of user, and at the same time, the system needs to be adequately accurate, fast, and effective in resource usage. Appositely, for a company, OP is vital in the improvement of its progression and value-cost balance [33]. The concept of performance was examined by Chavez et al. [8] by measuring two aspects namely operations per unit of time and the time spent to accomplish certain tasks. Meanwhile, competitive performance demonstrates organizations doing their best to beat their rivals, particularly in terms of efficiency and cost-effectiveness, to gain a competitive edge [5].

2.2 Supply Chain Management

Supply chain management is a logistics system that handles the process of procurement, the conversion of materials, and the circulation of products to consumers [38], and it involves a number of aspects such as planning, inventory management, procurement, production, transportation, in addition to customer relations. At present, the terms “Supply chain” and “supply chain management” are commonly seen in various media like newspapers, books, magazines, newsletters, and in

discussions as well. The concept of supply chain management was coined by consultants in the early 1990s, and this fairly new research domain, as highlighted by [37], has been a subject of interest among academic and industry professionals. The supply chain comprises a series of processes of converting materials from nature into finished products, which are then delivered to end consumers. Notably, supply chains are used by various parties, not just manufacturing companies.

2.3 Supply Chain Integration

Supply chain integration (SCI) is a concerted approach between a business and its supply chain partners, as well as effective management within and between organizations, primarily to maximize customer value [45]. The main goal of this collaboration is to achieve effectiveness in terms of goods and services, data, banking or finance, and process decisions. Integrated supply chains can be classed into the following: CI, SI, and internal integration (II) [31], and internal integration can be achieved through information sharing and strategies coordination across departments. Concurrent engineering and lean manufacturing can be categorized as internal integration, whereas CI and SI can be categorized as external integration.

2.4 Customer Integration

Customer integration or CI requires the collaboration and engagement of organizations with their customers with the goal of making the process of supply chain more effective. According to Sharma and Joshi [41], companies could improve their CI by fulfilling the requirements of their customers promptly, through understanding the organizations of their customers, and comprehending their products, culture, and markets. CI involves the sharing of strategic information and collaboration with key manufacturers and customers, and as indicated by Cui et al. [9], CI becomes the basis for improving forecasts of customer demand. More customer information would generally lead to more information sharing, which would allow manufacturers to have a better understanding of customer demands, and consequently more accurate forecasts of the market. This facilitates senior management in their long-term operational decisions.

2.5 Supplier Integration

Supplier integration encompasses the inculcation of a close partnership between manufacturers and suppliers, in order that the business processes could be effectively managed. This manufacturer-supplier partnership involves information sharing, strategic alliance establishments, project collaboration, and joint product developments [7]. Furthermore, decision making from active supplier-manufacturer participation could result in a competitive advantage Abdelilah et al. [1], because involvement of key stakeholders in decision-making will increase the quality of the decisions made, in addition to facilitating the diversification of assets and market risks, aside from reinforcing the response capabilities of the enterprise, leading to more efficient decisions. Consequently, the quality of service or product and customer satisfaction could be increased, and all these foster a positive reputation for the company in the market.

2.6 Information Quality

Information quality (InfoQ) concerns how effectively a dataset is applicable in the accomplishment of certain objective with the use of practical examination [24]. This complex concept, which is influenced by data quality and analysis quality, can be measured using eight dimensions, as proposed by [34]. These dimensions are data precision, organization, integration, timeliness, applicability, coherence, operationalization of concepts, and communication. Skills to comprehend, leverage, and innovate information were the three additional dimensions proposed by [9] to the

concept, and this has added a human touch to InfoQ. In a related study by Khan et al. [27] involving official statistics, the importance of InfoQ in data analysis and its role in informing policy decisions, were highlighted.

2.7 Relationship between Supplier Integration, Customer Integration, Information Quality and Operational Performance

According to Kumar et al. [28], the integration with suppliers is necessary for any business to improve its collective performance. Integration and partnership with suppliers is helpful in managing business in a better way. The study Tan et al. [42] discussed that when a company is working significantly with the suppliers, OP is improved. Lee et al. [29] discussed that the businesses which are not in a good position to partnership with the suppliers, it becomes a challenge for them to improve their performance. Furthermore, Fernando et al. [14] found that suppliers should be motivated to develop positive relationship with the business. Similarly, the integration with customers is also significant for the development and management of the business [11]. When there is significant work by the business management, reliable information and feedback from the customers is used.

According to He et al. [20], the integration of suppliers and customers helps create a better networking of supply chain which is effective for business performance. SI refers to the collaboration between a firm and its suppliers, characterized by joint decision-making [30], information sharing, and synchronized activities to optimize production and distribution processes [25]. According to Abdulkareem and Mohd Ramli [2], through SI, firms can reduce lead times, manage inventory more effectively, and respond faster to changes in demand or supply disruptions. The study Wang and Feng [44] discussed that when firms and suppliers share real-time data on inventory levels and forecasts, suppliers can adjust their production schedules to meet the firm's needs. In addition, Oubrahim et al. [36] discussed that partnership in product design and development enables firms to improve quality and reduce costs, both of which contribute positively to OP. Additionally, SI allows firms to leverage their suppliers' expertise and resources, fostering innovation and improving process efficiency [10].

According to Gopal et al. [17], CI focuses on the alignment of a firm's operations with customer needs and expectations. By collaborating with customers, firms gain valuable insights into customer preferences, market trends, and demand patterns. Harif et al. [19] highlighted that this information is crucial for tailoring production schedules, improving product quality, and enhancing delivery performance. CI enables firms to be more responsive to changes in demand and market conditions, leading to higher levels of customer satisfaction and loyalty. The study Rana et al. [39] discussed that firms that engage in close collaboration with their customers are better positioned to anticipate shifts in demand, thereby improving the accuracy of demand forecasting. According to Junaid et al. [24], accurate forecasts allow for better inventory management and production planning, reducing the risk of overproduction or underproduction, which in turn enhances operational efficiency. On the other hand, Freije et al. [16] discussed that CI provides firms with the opportunity to co-create products and services with their customers, fostering innovation and ensuring that the final products meet customer expectations.

According to Huda [22], InfoQ serves as a critical link between SI, CI, and OP. Furthermore, InfoQ defined by its accuracy, timeliness, relevance, and accessibility, enables firms to make informed decisions that optimize supply chain operations. According to Rashid et al. [40], in the context of SI, accurate and timely information helps firms improve demand forecasting, reduce lead times, and manage inventory more effectively. The study Abdelilah et al. [1] discussed that when suppliers provide accurate data on lead times, production schedules, and order statuses, firms can plan their operations more efficiently, minimizing the risk of delays and disruptions. Likewise, Kedi et al. [26]

discussed that in CI, high-quality information on customer demand and market trends enables firms to adjust their production and distribution processes to meet changing customer needs.

2.8 Hypotheses Development

Positive impacts of SI on OP have been reported in various studies. For instance, Al-Rawashdeh et al. [3] and Wajdi et al. [43] reported positive impacts of SI on operations performance (OP). Additionally, He et al. [20] reported a relationship between SI and the speed of introducing new products. They also reported a relationship between lean practices and other OP indicators. Past relevant findings demonstrated a positive role of SI in the improvement of OP, particularly when dealing with product complexity and competitive pressures. Hence, this study proposed the following.

H1: Supplier integration is a significant positive predictor of operational performance.

Al-Rawashdeh et al. [3] and Amoako et al. [5] were among those who reported positive impact of customer integration on OP. In a related study, Ataseven and Nair [6] proposed the alignment of CI with operations. In another study by Wajdi et al. [43], CI and operational success were found to have strong connections. Based on these findings, clearly, customer integration can lead to enhanced OP, especially when paired with valuable information. Hence, the following hypothesis was proposed:

H2: Customer integration is a significant positive predictor of operational performance.

Information quality (InfoQ) can be understood as the value of the output of the system as perceived by the user of the system, and InfoQ can be evaluated through accuracy, timeliness, completeness, relevance, and consistency. The overall success of information systems is majorly influenced by InfoQ, and this often can be observed in web-based systems domains [31]. Positive linkage between InfoQ and organizational performance has been reported in numerous studies. In this regard, Feki [13] is among those who'd reported positive impact of information quality on organizational performance. In another related study, Kumar et al. [28] found that InfoQ affected supply chain performance positively. Overall, these findings were all demonstrating favorable impacts of total quality management on OP in manufacturing firms, in agreement with the extant literature [36]. In addition, InfoQ was found to play a moderating role in a study by [8]. As such, this study proposed the following hypotheses:

H3: Information quality is a significant positive predictor of organizational performance.

H4: Information quality positively moderates the relationship between supplier integration and operational performance.

H5: Information quality positively moderates the relationship between customer integration and operational performance

3. Research Methodology

A research design is regarded as a blueprint that outlines the methods that are to be used in data collection and analyses. In this regard, SPSS and Smart PLS have been commonly used instruments for generating statistical analysis and model estimation. Primary data were data collected in this study, and the questionnaire was the instrument used on collecting the data. The questionnaire used in this study comprised four sections, and items in sections 2 through 4, which were covering the constructs of performance, SI, CI, and InfoQ, respectively, were equipped with seven-point Likert scale, to allow evaluation of the constructs. In order to facilitate interpretation, descriptive analysis was carried out on the data. The data were also ranked according to frequency. Next, correlation among items were evaluated for consistency. Cronbach's alpha was used for this purpose. Alpha value of 0.7–0.9 would denote consistency. Cronbach's alpha evaluates reliability, to ensure that the items effectively measure a shared concept [18]. However, Cronbach's alpha should not be considered as a test [18].

Employing a deductive approach underpinned by Resource-Based View theory, this study used structured questionnaire survey to obtain data from the manufacturing sector in Saudi Arabia. The items in the questionnaire were based on Al-Rawashdeh et al. [3], the items were accordingly adapted to fit the study objectives. The participants of the study were from the manufacturing sector in Saudi Arabia, and there were 300 of them selected for this study. A theoretical framework was constructed in this study, to test the study assumptions. The framework is as illustrated in the following Figure 1.

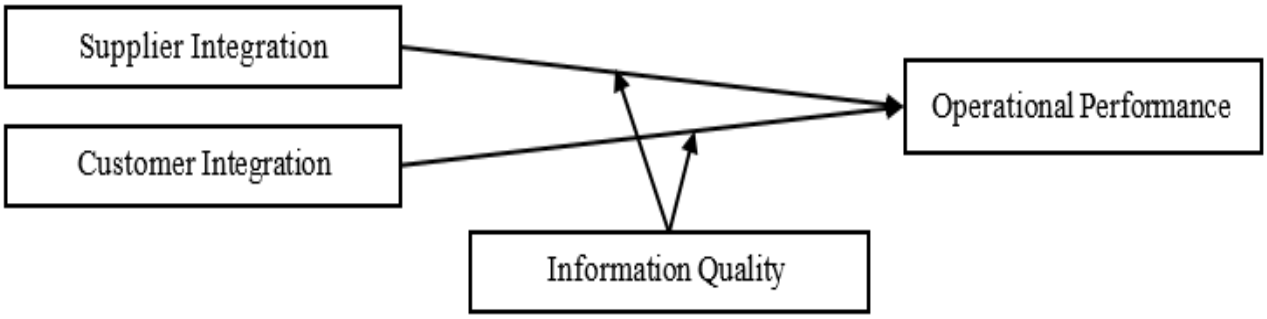

Fig.1. Theoretical Framework

3.1 Instrument Variable Research

As mentioned earlier, the questionnaire items on the study constructs were equipped with 5-point Likert scales. A series of statements were provided in the questionnaire, and the respondents were to provide their agreement level through the Likert scale with the following details: scale of 1 to show "Strongly Disagree," the scale of 2 to show "Disagree," the scale of 3 to denote "Neutral," the scale of 4 to show "Agree," and finally, the scale of 5 to show "Strongly Agree." The data collection instrument used can be referred to in Table 1, where the instrument items were detailed. As shown, the items were to ascertain the impact of SCP on OP, and the moderating role of InfoQ.

Table 1
Study Items

Variables of the study	Indicator	Sources
Operational Performance	1. To what extent has supply chain integration resulted in more efficient operation in your organization (better operational efficiency)? 2. How satisfied are you with the current operational performance of your organization? 3. To what extent has the operational efficiency of your organization fulfilled or superseded the expectations of the industry? 4. In general, what is your evaluation of the operational performance of your organization? 5. How thoroughly is your company monitoring the operational performance indicators (e.g., manufacturing effectiveness, quality, and lead time)?	Al-Rawashdeh et al. [3]; Ali et al. [4]
Customer Integration	1. In improving product or service and design processes in your company, how expansively is the involvement of consumers? 2. In improving the operational processes, to what extent does your company seek out customer feedback? 3. How has customer integration affected the capability of your company in fulfilling the expectations of customers? 4. How do you evaluate the integration level between your business and the customers? 5. To what level has customer integration made your business more competitive?	Al-Rawashdeh et al. [3]

Variables of the study	Indicator	Sources
Supplier Integration	1. In optimizing its supply chain operations, to what extent has your company collaborated with its suppliers? 2. In order to make the supply chain more efficient, to what extent is the information sharing between your company and its suppliers? 3. How has supplier integration improved your company's business supply chain performance? 4. How do you evaluate the level of integration that your company and its suppliers have achieved? 5. To what extent has your company saved its costs from supplier integration?	Al-Rawashdeh et al. [3]
Information Quality	1. Our organization provides information that is accurate and dependable. 2. The information processing in our organization increases user trust. 3. The information provided by our organization is accurate. 4. The information provided by our organization is recent. 5. The information provided by our organization is reliable. 6. The information provided by our organization is inclusive. 7. The information conveyed by our organization is concise.	Ali et al. [4]

4. Analysis and Results

4.1 Measurement Model Assessment

As the first step in PLS, the measurement or outer model, was evaluated. There were four criteria employed in this study for the purpose, based on [18]. The indicators are perceived as reliable with achieved loadings of 0.70, while internal consistency are affirmed with composite reliability (CR) of at least 0.70. Convergent validity is affirmed with an average variance extracted (AVE) of 0.50 or higher, whereas discriminant validity is affirmed when the AVE of each latent component is larger than the highest squared correlation of that factor with any other latent factor, as explained by Fornell and Larcker [15]. Also, the square root of AVE of each construct must be larger than the correlations with other latent constructs, as suggested by [18]. Discriminant validity can be assessed using the Heterotrait-Monotrait (HTMT) ratio, the cross-loading approach, and the Fornell-Larcker correlation matrix method, but, as mentioned by [21], the HTMT ratio has been the most popular among scholars because it is specific and sensitive in the identification of issues with discriminant validity. Tables 2, Table 3 and Table 4 and Figure 2 show that all results are within the acceptable values, and therefore, the structural model could be evaluated without risk.

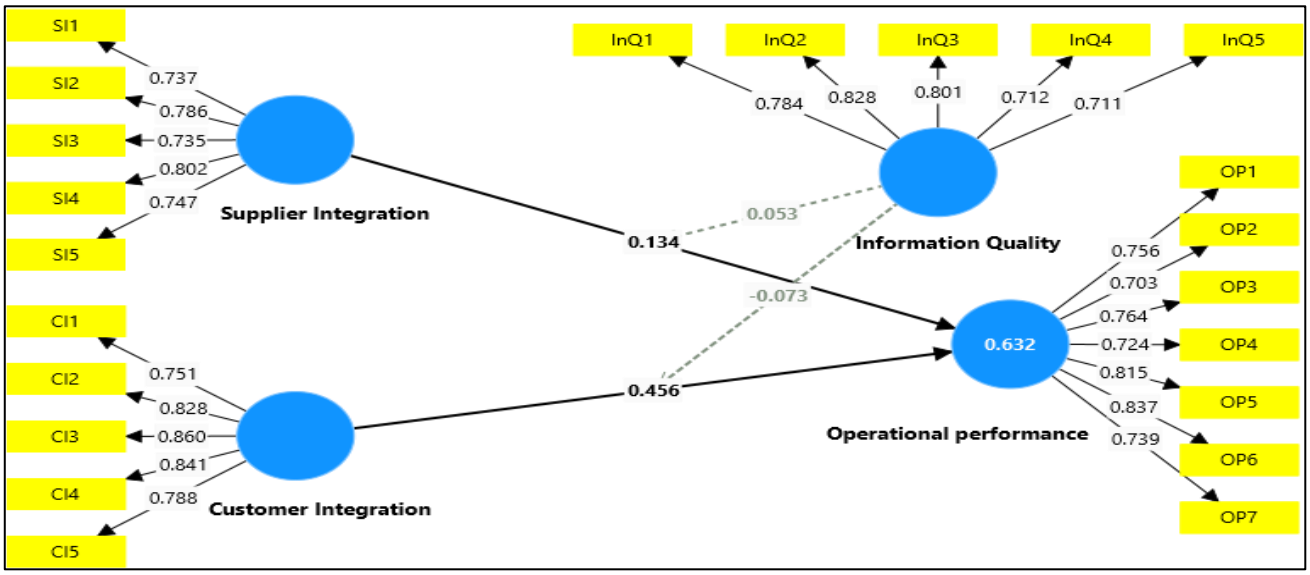

Fig.2. Measurement Model

Table 2
Result summary from the reflected measurement model

	Cronbach's alpha	Composite reliability	Composite reliability	Average variance extracted
Customer Integration	0.873	0.877	0.908	0.663
Information Quality	0.825	0.826	0.878	0.591
Operational Performance	0.881	0.884	0.907	0.584
Supplier Integration	0.823	0.833	0.874	0.580

Table 3
Matrix of Fornell-Larcker correlation

	Customer Integration	Information Quality	Operational Performance	Supplier Integration
Customer Integration	0.814			
Information Quality	0.692	0.769		
Operational Performance	0.743	0.682	0.764	
Supplier Integration	0.120	0.097	0.205	0.762

Table 4
Outer loadings of items

	Customer Integration	Information Quality	Operational Performance	Supplier Integration
CI1	0.751			
CI2	0.828			
CI3	0.860			
CI4	0.841			
CI5	0.788			
InQ1		0.784		
InQ2		0.828		
InQ3		0.801		
InQ4		0.712		
InQ5		0.711		
OP1			0.756	
OP2			0.703	
OP3			0.764	
OP4			0.724	
OP5			0.815	
OP6			0.837	
OP7			0.739	
SI1				0.737
SI2				0.786
SI3				0.735
SI4				0.802
SI5				0.747

4.2 Structural Model Analysis

In the last stage of PLS SEM model analysis in this study, the proposed relationships were examined through the use of PLS bootstrapping. PLS analysis usually involves path coefficients evaluations, but Hair et al. [18] proposed rejecting the initial hypotheses if the paths appear insignificant or demonstrate contradictory trends. On the other hand, the proposed causal relationship is supported if significant paths are in line with the projected direction. A bootstrap sample size of at least 5,000 should be employed in path coefficients evaluations, with the number of cases corresponding to that of observations in the sample, as indicated in [18]. A total of 5,000 resampling iterations were applied in this study, with a number of bootstrap cases matches that of the initial sample size of 300 to introduce moderate errors and create t-values. Results and values of standardized path coefficients were used in this study, in the structural paths analysis for hypotheses

testing. Table 5 and Figure 3 can be referred. The Smart PLS analysis outcomes revealed the interrelationships involving four variables namely InfoQ, OP, CI, and SI in the sector of manufacturing in the Kingdom of Saudi Arabia.

Firstly, results showed a significant relationship between CI and OP (T = 7.625, p = 0.000), demonstrating that manufacturing firms in Saudi Arabia often would improve their performance when the customers' input and preferences are effectively added into their operations. Furthermore, results showed a significant impact on the quality of information used during decision making on the OP of manufacturing firms (T Value = 5.477, p = 0.000). Here, it shows that an improvement in the quality of the information would likely increase the firm's performance levels. Thirdly, results show connection between supplier integration and improved performance (T = 2.842, p = 0.005), implying improved performance among manufacturing companies after collaborating with their suppliers. Moreover, the results show that the effect of interaction between SI and InfoQ on performance is not significant statistically (T = 1.066, p = 0.286), which means that while each factor has impact on performance on their own, their combined impact does not generate more impact. However, results show correlation between CI and InfoQ, which imparts impact on performance (T = 2.146, p = 0.032), implying that manufacturing companies in Saudi Arabia would increase performance through the combined effect of InfoQ and strong CI.

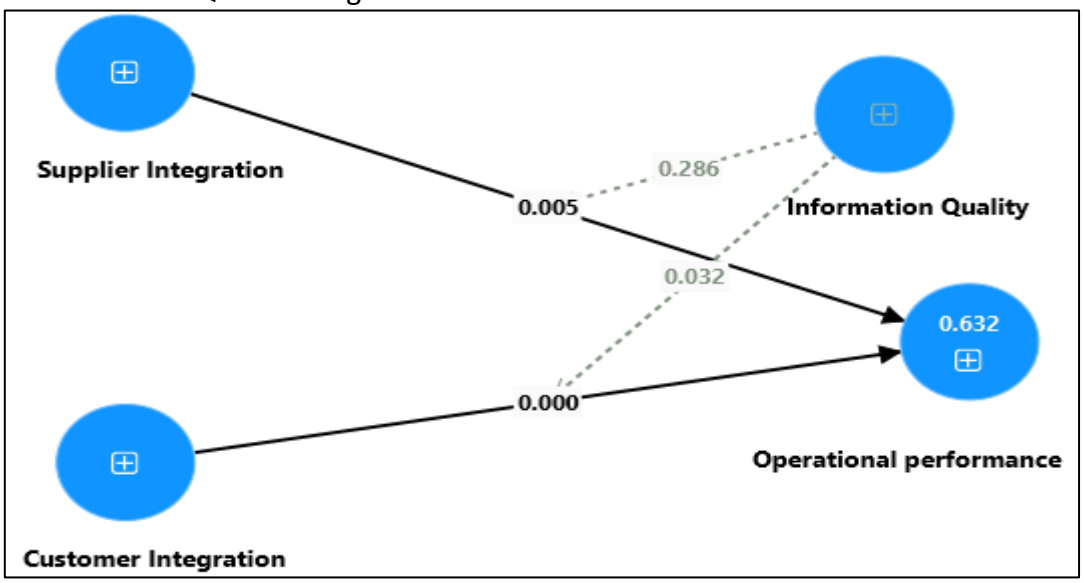

Fig.3. Investigating Structural Models

Table 5
Outcome of hypotheses

	Original sample	Sample mean	Standard deviation	T statistics	P values
Customer Integration -> Operational Performance	0.456	0.455	0.060	7.625	0.000
Information Quality -> Operational Performance	0.312	0.315	0.057	5.477	0.000
Supplier Integration -> Operational Performance	0.134	0.138	0.047	2.842	0.005
Information Quality x Supplier Integration -> Operational Performance	0.053	0.057	0.050	1.066	0.286
Information Quality x Customer Integration -> Operational Performance	-0.073	-0.081	0.034	2.146	0.032

Based on Table 6, the study achieved R-squared value is 0.632, which means that roughly 63.2% of the variation in OP is explainable by the study model variables, which also means that the model is accountable for a substantial fraction of the diversity in performance, in accordance with the factors

scrutinized in this study. Additionally, Table 6 shows that the achieved adjusted R value is 0.623. This value denotes a refined version of the R value which considers the number of predictors included in the model. As shown, the achieved adjusted R value is slightly smaller than the R value. This shows that even though the model captures a certain fraction of OP variability, some of this predictive ability may be random or irrelevant to the new data.

Table 6
R-Squared values

	R-square	R-square adjusted
Operational Performance	0.632	0.623

5. Discussion

Based on empirical analysis, the study found that CI has a significant impact on OP. The findings of this relationship are compared with existing studies results. The findings of Rashid et al. [40] are aligned with this study reporting the relationship between CI and OP. Furthermore, Fernando et al. [14] discussed that if the customers are supportive and providing reliable information, it is necessary to adopt new changes in the supply chain which can effective the performance. Meanwhile, Dong et al. [10] also supported the findings of this research by reporting the significant relationship between CI which is possible by the feedback of the customer. In this way, the significant relationship between CI and OP is established. The study Kedi et al. [26] also supported the aforementioned relationship.

Furthermore, the research reported by InfoQ has a significant impact on OP. The findings of this relationship are compared with existing studies results. The study Erboz et al. [11] also discussed that InfoQ is a significant factor for improving OP. Furthermore, Kamble et al. [25] pointed out that OP of any business is possibly developed by significant working on quality of information. The study Gopal et al. [17] revealed that when there is a significant improvement in OP, the overall performance of the business is improved. In addition, the study Harif et al. [19] found that significant level of OP is developed when the management is taking decisions based on critical information. Therefore, the role of InfoQ is considered appropriate in decision making.

Meanwhile, the research found SI has a significant impact on OP. The findings of this relationship are compared with existing studies results. Wang and Feng [44] also discussed that a significant integration with suppliers is a way forward to improve business performance. Furthermore, Rana et al. [39] discussed that partnership with suppliers helps to deal with things in proactive way which is critical to improve the standard performance. Furthermore, Osei et al. [35] found that partnership with suppliers is necessary to have effectiveness in business management. Aligned with the findings of aforementioned relationship, Wajdi et al. [43] also discussed to improve the partnership programs with suppliers to develop a collective approach for advancing supply and OP.

However, the study revealed InfoQ has no moderate influence on the relationship between SI and OP. The findings of this relationship are compared with existing studies results. However, Freije et al. [16] discussed that InfoQ is critical for decision making for operational factor. Furthermore, Tan et al. [42] discussed that InfoQ is an external factor which can be influenced based on a number of factors. Meanwhile, the rejection of this hypothesis can be discussed in a context where the respondents from the selective sector had no access to quality information. Similarly, Harif et al. [19] discussed that when there is no quality information, it becomes difficult to achieve sustainable development and advancements of overall goals. Although the relationship is rejected, it has contribution to OP literature.

Finally, the study revealed InfoQ has a significant moderate influence on the relationship between CI and OP. The findings of this relationship are compared with existing studies results. The study Li et al. [30] discussed that InfoQ by the customers is helpful to improve the OP of business. Furthermore,

Abdulkareem and Mohd Ramli [2] found that customers are recommended to provide quality information based feedback which has a lasting impact on the OP. Similarly, Lee et al. [29] and Huda [22] also supported the findings of aforementioned relationship. This moderate relationship is new in the body of knowledge and it has significant implications for literature.

6. Implications

6.1 Theoretical Implications

The theoretical implications of this study can be observed in some respects. Firstly, this study affirmed a correlation existing between SCI and OP, and such findings are proof that integrated supply chains can improve operational outcomes. This enriches the current knowledge of supply chain management. Secondly, the affirmation of InfoQ as a moderator in the relationship between SCI and OP denotes the significance of the use of accurate information in integrated supply chains. This finding increases our knowledge pertaining to SCI as it reveals the significance of InfoQ in the attainment of the benefits of integration. For managers and policymakers, this study is of value to them, especially those involved in the manufacturing industry, as this study demonstrates how performance of firm can be increased through supplier and customer integration. Hence, the findings of this study can become a strong factor to support investments in SCI efforts. The results achieved in this study enrich the supply chain management theories as these results demonstrate how SCI impacts performance, with the moderating role of InfoQ. Hence, for managers that seek to improve performance using strategic SCI initiatives, these results could be perused.

6.2 Practical Implications

For managers and professionals, especially those in the sector of manufacturing, the results of this study have practical implications. Firstly, this study affirmed the impact of supply chains integration on performance. This implies the need for managers to increase collaboration with both suppliers and customers, which may involve the use of strategies for information sharing and objectives and procedures alignment, all through the supply chain. Furthermore, the discovery of the moderating impact of InfoQ means that integrated supply chains need timely and relevant data exchange. Hence, in order to assure high-quality information sharing with their supply chain partners, managers need to improve the information systems and processes. In addition, the results show the need to take into account the conditions of the organization prior to the implementation of the SCI initiatives – this would be the concern of the managers. Notably, considering the impacts of industry dynamics, company size, and levels of technological infrastructure on the success of integration efforts, these factors (industry dynamics, company size, and levels of technological infrastructure) should also be taken into account. In essence, the practical implications of this study underpin the value of the use of SCI as a strategy in increasing performance in the sector of manufacturing. For managers, they need to be aware of the factors that affect the outcomes of the integration initiative, so that they can make informed decisions and implement the right actions, to enhance the OP of their organization.

7. Conclusions and Further Directions

To conclude, the results of this study demonstrate a connection existing between supply chains integration and improved OP in the sector of manufacturing. For managers, this outcome implies the need to form a strong bond with both suppliers and customers, to achieve better outcomes. Also, the discovery of the influence of InfoQ denotes the need to maintain timely data exchange in integrated supply chains. Despite the valuable insights offered by this study, the limitations need to be addressed

as well. First of all, considering that the manufacturing industry is the only focus of this study, the results attained may not be relatable in other sectors. Secondly, sectional data were used in this study, which means that the ability of this study in forming causality is limited – further research should be carried out, using longitudinal or experimental approaches, to address this limitation. Lastly, this study did not take into account the external factors (e.g., economic conditions or regulatory changes), even though these factors may affect the relationship between integration and performance – taking into account these factors may alter the results.

For future studies, there are several recommendations; firstly, the impact of SCI on performance should be examined in different industries and settings. This would allow understanding of how integration influences the performance of different industries and settings. Also, the use of a longitudinal approach in examining the effect of SCI on performance would provide understanding of how integration affects performance trends over time. The external factors should be examined as well, to see how they affect the relationship between SCI and performance – this imparts more in-depth understanding of the complex dynamics at play. Also, new technologies such as artificial intelligence could also be investigated, especially in terms of how it can improve SCI processes and the performance in general. In a nutshell, despite the revelation of this research on the connection between SCI and OP, the underlying dynamics need to be examined more to provide better guidance to management strategies in the industry.

References

[1] Abdelilah, B., El Korchi, A., & Amine Balambo, M. (2023). Agility as a combination of lean and supply chain integration: how to achieve a better performance. *International Journal of Logistics Research and Applications*, *26*(6), 633-661. https://doi.org/10.1080/13675567.2021.1972949

[2] Abdulkareem, A. K., & Mohd Ramli, R. (2022). Does trust in e-government influence the performance of e-government? An integration of information system success model and public value theory. *Transforming Government: People, Process and Policy*, *16*(1), 1-17. https://doi.org/10.1108/TG-01-2021-0001

[3] Al-Rawashdeh, O. M., Jawabreh, O., & Ali, B. (2023). Supply chain management and organizational performance: the moderating effect of supply chain complexity. *Information Sciences Letters*, *12*(3), 1673-1684. http://dx.doi.org/10.18576/isl/120351

[4] Ali, B., Ali, Bakar, R., Ahmad, W., & Wan Omar, W. A. (2016). The Critical Success Factors Of Accounting Information System (Ais) And It's Impact On Organisational Performance Of Jordanian Commercial Banks. *International Journal of Economics, Commerce and Management*, *IV*, 658-677. https://www.researchgate.net/publication/303247147

[5] Amoako, T., Huai Sheng, Z., Dogbe, C. S. K., & Pomegbe, W. W. K. (2022). Effect of internal integration on SMEs' performance: the role of external integration and ICT. *International Journal of Productivity and Performance Management*, *71*(2), 643-665. https://doi.org/10.1108/IJPPM-03-2020-0120

[6] Ataseven, C., & Nair, A. (2017). Assessment of supply chain integration and performance relationships: A meta-analytic investigation of the literature. *International journal of production economics*, *185*, 252-265. https://doi.org/10.1016/j.ijpe.2017.01.007

[7] Bäckstrand, J., & Fredriksson, A. (2022). The role of supplier information availability for construction supply chain performance. *Production planning & control*, *33*(9-10), 863-874. https://doi.org/10.1080/09537287.2020.1837933

[8] Chavez, R., Yu, W., Gimenez, C., Fynes, B., & Wiengarten, F. (2015). Customer integration and operational performance: The mediating role of information quality. *Decision Support Systems*, *80*, 83-95. https://doi.org/10.1016/j.dss.2015.10.001

[9] Cui, L., Wu, H., Wu, L., Kumar, A., & Tan, K. H. (2023). Investigating the relationship between digital technologies, supply chain integration and firm resilience in the context of COVID-19. *Annals of Operations Research*, *327*(2), 825-853. https://doi.org/10.1007/s10479-022-04735-y

[10] Dong, T., Yin, S., & Zhang, N. (2023). The interaction mechanism and dynamic evolution of digital green innovation in the integrated green building supply chain. *Systems*, *11*(3), 122. https://doi.org/10.3390/systems11030122

[11] Erboz, G., Yumurtacı Hüseyinoğlu, I. Ö., & Szegedi, Z. (2022). The partial mediating role of supply chain integration between Industry 4.0 and supply chain performance. *Supply Chain Management: An International Journal*, *27*(4), 538-559. https://doi.org/10.1108/SCM-09-2020-0485

[12] Espino-Rodríguez, T. F., & Taha, M. G. (2022). Supplier innovativeness in supply chain integration and sustainable performance in the hotel industry. *International Journal of Hospitality Management*, *100*, 103103. https://doi.org/10.1016/j.ijhm.2021.103103

[13] Feki, M. (2022). Effects of IS Quality on Firm Performance from the Perspective of a Business Executive: The Role of Business Strategy. *International Journal of Technology and Human Interaction (IJTHI)*, *18*(1), 1-17. https://doi.org/10.4018/IJTHI.303591

[14] Fernando, Y., Tseng, M.-L., Wahyuni-Td, I. S., de Sousa Jabbour, A. B. L., Chiappetta Jabbour, C. J., & Foropon, C. (2023). Cyber supply chain risk management and performance in industry 4.0 era: information system security practices in Malaysia. *Journal of Industrial and Production Engineering*, *40*(2), 102-116. https://doi.org/10.1080/21681015.2022.2116495

[15] Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, *18*(1), 39-50. https://doi.org/10.1177/002224378101800104

[16] Freije, I., de la Calle, A., & Ugarte, J. V. (2022). Role of supply chain integration in the product innovation capability of servitized manufacturing companies. *Technovation*, *118*, 102216. https://doi.org/10.1016/j.technovation.2020.102216

[17] Gopal, P., Rana, N. P., Krishna, T. V., & Ramkumar, M. (2024). Impact of big data analytics on supply chain performance: an analysis of influencing factors. *Annals of Operations Research*, *333*(2), 769-797. https://doi.org/10.1007/s10479-022-04749-6

[18] Hair, J., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2021). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage publications. https://doi.org/10.1007/978-3-030-80519-7_1

[19] Harif, M. A. A. M., Nawaz, M., & Hameed, W. U. (2022). The role of open innovation, hotel service quality and marketing strategy in hotel business performance. *Heliyon*, *8*(9). https://doi.org/10.1016/j.heliyon.2022.e10441

[20] He, P., He, Y., Tang, X., Ma, S., & Xu, H. (2022). Channel encroachment and logistics integration strategies in an e-commerce platform service supply chain. *International journal of production economics*, *244*, 108368. https://doi.org/10.1016/j.ijpe.2021.108368

[21] Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115-135. https://doi.org/10.1007/s11747-014-0403-8

[22] Huda, M. (2024). Trust as a key element for quality communication and information management: insights into developing safe cyber-organisational sustainability. *International Journal of Organizational Analysis*, *32*(8), 1539-1558. https://doi.org/10.1108/IJOA-12-2022-3532

[23] Islami, X. (2023). Lean manufacturing and firms' financial performance: The role of strategic supplier partnership and information sharing. *Benchmarking: An International Journal*, *30*(9), 2809-2831. https://doi.org/10.1108/BIJ-02-2022-0084

[24] Junaid, M., Zhang, Q., & Syed, M. W. (2022). Effects of sustainable supply chain integration on

green innovation and firm performance. *Sustainable Production and Consumption*, *30*, 145-157. https://doi.org/10.1016/j.spc.2021.11.031

[25] Kamble, S. S., Gunasekaran, A., Subramanian, N., Ghadge, A., Belhadi, A., & Venkatesh, M. (2023). Blockchain technology's impact on supply chain integration and sustainable supply chain performance: Evidence from the automotive industry. *Annals of Operations Research*, *327*(1), 575-600. https://doi.org/10.1007/s10479-021-04129-6

[26] Kedi, W. E., Ejimuda, C., Idemudia, C., & Ijomah, T. I. (2024). AI Chatbot integration in SME marketing platforms: Improving customer interaction and service efficiency. *International Journal of Management & Entrepreneurship Research*, *6*(7), 2332-2341. https://doi.org/10.51594/ijmer.v6i7.1327

[27] Khan, A., Talukder, M. S., Islam, Q. T., & Islam, A. N. (2024). The impact of business analytics capabilities on innovation, information quality, agility and firm performance: The moderating role of industry dynamism. *VINE Journal of Information and Knowledge Management Systems*, *54*(5), 1124-1152. https://doi.org/10.1108/VJIKMS-01-2022-0027

[28] Kumar, A., Singh, R. K., & Modgil, S. (2023). Influence of data-driven supply chain quality management on organizational performance: evidences from retail industry. *The TQM Journal*, *35*(1), 24-50. https://doi.org/10.1108/TQM-06-2020-0146

[29] Lee, K. L., Wong, S. Y., Alzoubi, H. M., Al Kurdi, B., Alshurideh, M. T., & El Khatib, M. (2023). Adopting smart supply chain and smart technologies to improve operational performance in manufacturing industry. *International Journal of Engineering Business Management*, *15*, 18479790231200614. https://doi.org/10.1177/18479790231200614

[30] Li, Y., Fang, J., Yuan, S., & Cai, Z. (2024). Disentangling the relationship between omnichannel integration and customer trust: a response surface analysis. *Internet Research*, *34*(3), 1077-1103. https://doi.org/10.1108/INTR-03-2022-0222

[31] Lin, H.-F. (2022). IT resources and quality attributes: The impact on electronic green supply chain management implementation and performance. *Technology in Society*, *68*, 101833. https://doi.org/10.1016/j.techsoc.2021.101833

[32] Malpani, R., Baral, M. M., Panigrahi, R. R., & Chittipaka, V. (2024). Unveiling the dynamic nexus between corporate social responsibility, innovations and financial performances in 21st-century Indian start-ups. *International Journal of Organizational Analysis*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/IJOA-01-2024-4239

[33] Molinaro, M., Danese, P., Romano, P., & Swink, M. (2022). Implementing supplier integration practices to improve performance: The contingency effects of supply base concentration. *Journal of Business Logistics*, *43*(4), 540-565. https://doi.org/10.1111/jbl.12316

[34] Nenavani, J., & Jain, R. K. (2022). Examining the impact of strategic supplier partnership, customer relationship and supply chain responsiveness on operational performance: the moderating effect of demand uncertainty. *Journal of Business & Industrial Marketing*, *37*(5), 995-1011. https://doi.org/10.1108/JBIM-10-2020-0461

[35] Osei, M. B., Papadopoulos, T., Acquaye, A., & Stamati, T. (2023). Improving sustainable supply chain performance through organisational culture: A competing values framework approach. *Journal of Purchasing and Supply Management*, *29*(2), 100821. https://doi.org/10.1016/j.pursup.2023.100821

[36] Oubrahim, I., Sefiani, N., & Happonen, A. (2023). The influence of digital transformation and supply chain integration on overall sustainable supply chain performance: An empirical analysis from manufacturing companies in Morocco. *Energies*, *16*(2), 1004. https://doi.org/10.3390/en16021004

[37] Purwanto, A. (2022). The role of transformational leadership and organizational citizenship

behavior on SMEs employee performance. *Journal of Industrial Engineering & Management Research*. https://ssrn.com/abstract=4073157

[38] Qu, K., & Liu, Z. (2022). Green innovations, supply chain integration and green information system: A model of moderation. *Journal of Cleaner Production*, *339*, 130557. https://doi.org/10.1016/j.jclepro.2022.130557

[39] Rana, N. P., Chatterjee, S., Dwivedi, Y. K., & Akter, S. (2022). Understanding dark side of artificial intelligence (AI) integrated business analytics: assessing firm's operational inefficiency and competitiveness. *European Journal of Information Systems*, *31*(3), 364-387. https://doi.org/10.1080/0960085X.2021.1955628

[40] Rashid, A., Rasheed, R., Tanveer, U., Ishaq, S., & Amirah, N. A. (2024). Mediation of integrations in supply chain information management and supply chain performance: an empirical study from a developing economy. *Journal of Science and Technology Policy Management*(ahead-of-print). https://doi.org/10.1108/JSTPM-08-2023-0143

[41] Sharma, M., & Joshi, S. (2023). Digital supplier selection reinforcing supply chain quality management systems to enhance firm's performance. *The TQM Journal*, *35*(1), 102-130. https://doi.org/10.1108/TQM-07-2020-0160

[42] Tan, C. L., Tei, Z., Yeo, S. F., Lai, K.-H., Kumar, A., & Chung, L. (2023). Nexus among blockchain visibility, supply chain integration and supply chain performance in the digital transformation era. *Industrial Management & Data Systems*, *123*(1), 229-252. https://doi.org/10.1108/IMDS-12-2021-0784

[43] Wajdi, M., Barata, F., Syamil, A., Prasetyani, D., Tunjungsari, H., Aliyyah, I., Fatmawati, E., & Aseri, A. (2023). Exploring the role of supplier integration, customer integration on operational performance by mediating the SMEs supply chain flexibility. *Uncertain Supply Chain Management*, *11*(4), 1851-1858. http://dx.doi.org/10.5267/j.uscm.2023.6.006

[44] Wang, J., & Feng, T. (2023). Supply chain ethical leadership and green supply chain integration: a moderated mediation analysis. *International Journal of Logistics Research and Applications*, *26*(9), 1145-1171. https://doi.org/10.1080/13675567.2021.2022640

[45] Xu, J., Yu, Y., Wu, Y., Zhang, J. Z., Liu, Y., Cao, Y., & Eachempati, P. (2022). Green supply chain management for operational performance: anteceding impact of corporate social responsibility and moderating effects of relational capital. *Journal of Enterprise Information Management*. https://doi.org/10.1108/JEIM-06-2021-0260