Uncertain Supply Chain Management 11 (2023) 1569–1578

Contents lists available at GrowingScience

Uncertain Supply Chain Management

homepage: www.GrowingScience.com/uscm

Optimizing manufacturing firms' operational performance through supply chain integration: Moderating effect of supply chain complexity

Zaher Abusaq[a*]

[a]*Industrial Engineering Department, College of Engineering, University of Business and Technology, Jeddah, 21448, Saudi Arabia*

A B S T R A C T

Article history:
Received March 12, 2023
Received in revised format June 18, 2023
Accepted July 17 2023
Available online
July 17 2023
Keywords:
Supplier integration (SI)
Customer integration (CI)
Internal integration (II)
Supply chain complexity (SCC)
Operational performance (OP)

This study investigates the relationship between integration, complexity, and operational performance in the industrial sector of Saudi Arabia. The sample comprised manufacturing firms in Saudi Arabia, and data were collected through the distribution of questionnaires. Supplier integration, customer integration and internal integration were examined as factors influencing operational performance, with supply chain complexity considered as a moderating variable. The findings highlight the positive impact of integration on operational performance in the Saudi Arabian industrial sector. The measurement scales used in the study demonstrated high reliability and internal consistency. Discriminant validity analysis confirmed the distinctiveness of the constructs. Structural model analysis revealed significant positive relationships between customer integration, internal integration, supplier integration, supply chain complexity and operational performance. The results emphasize the importance of fostering integration within and outside the organization to enhance operational performance. Furthermore, the moderating effect of supply chain complexity suggests that the relationship between integration and operational performance varies according to the complexity of the supply chain. Overall, this study contributes to the understanding of integration, complexity, and operational performance in the context of the Saudi Arabian industrial sector. The findings have practical implications for industrial companies, providing insights into strategies for improving operational performance through integration initiatives and consideration of the unique characteristics of the supply chain.

1. Introduction

Operational performance (OP) is the quantifiable characteristics of an organization's operations' results, such as dependability, production cycle time and inventory turns (Ali, 2022; Susanty, Sumiyati, Syaiful, & Nihlah, 2021). OP is referred to in the context of supply chains as measurements that quantify the efficacy and efficiency of the supply chain process (Susanty et al., 2021). In the same context, supply chain integration – which is still receiving a lot of attention (Al-Rawashdeh, Jawabreh, & Ali, 2023; Ali, 2022) is seen as a potential source of competitive advantage for businesses because it can improve quality, cut production costs, maximize response rates, shorten cycle times and increase customer satisfaction (Manhart, Summers, & Blackhurst, 2020). Supply chain integration can be divided into internal and external (customer and supplier) integration (Ataseven, Nair, & Ferguson, 2020). Some academics maintain that internal integration must occur before exterior integration can take place (Ataseven et al., 2020) and serves as the foundation for businesses to successfully obtain, interpret and apply information from external partners (Donkor, Papadopoulos, & Spiegler, 2022). A company must also integrate more internally and internationally as a partner in the supply chain. This entails increasing information system integration, teamwork, and information exchange both inside the company (internal integration), with their suppliers (supplier integration (SI)) and with their customers (customer integration (CI)). Additionally, SI can save transaction costs (Boehmer, Shukla, Kapletia, & Tiwari, 2020). These common objectives, achieved through SI reduce opportunistic behavior and uncertainty (Al-Hussein, Alabdallat, Abu, Rumman, & Ali, 2023; Jawabreh, Mahmoud, Alananzeh, & Ali, 2023). Additionally, successes such as averting

* Corresponding author
E-mail address zaher@ubt.edu.sa (Z. Abusaq)

doi: 10.5267/j.uscm.2023.7.012

uncertainty aid the center corporation in anticipating and adapting to alterations in client desires. Furthermore, CI accomplishes this by enabling the focus firm to deeply integrate into the business, culture, product and market of the client to effectively address their demands (Amoako, Huai Sheng, Dogbe, & Pomegbe, 2022). In general, supply chain partners share data, knowledge and information to increase SI (Yang, Rui, Rauniar, Ikem, & Xie, 2013).

Additionally, Pakurár et al. (2019) stressed how internal integration serves as the foundation for a company's ability to gather, analyze and utilize external information efficiently. According to Tarigan et al. (2021), internal integration is a requirement for external integration. This suggests that internal integration may aid businesses in understanding the requirements of their clients and suppliers, so it becomes challenging to meet consumer and supplier demands in an unstable business climate without the alliance of interconnected internal structures (Ebrahimi, 2015).

From this viewpoint, the literature on supply chains has conceptualized complexity as the number of suppliers, clients and goods that make up a firm's network of links. Akın Ateş et al. (2022) defined complexity in terms of diversity as the degree of differences among elements in a supply chain system, whereas (Afshar, Soleimanian, Akbari Variani, Vahabzadeh, & Molajou, 2021) defined complexity in terms of interrelatedness as the degree of interactions among elements within a system. Therefore, this study will look at how to improve the OP of manufacturing enterprises through the integration of supply changes and modifications to their complexity.

2. Literature Review and Hypotheses

2.1 Operational Performance

Academics have evaluated OP from several angles. For instance, efficiency served as the benchmark for measuring (OP) in the study by (Trattner, Hvam, Forza, & Herbert-Hansen, 2019). Another study developed many indicators for the (OP) measurement, such as delivery speed and transportation costs(Abu-AlSondos, Alkhwaldi, Salhab, Shehadeh, & Ali, 2023). Flexibility, quality, product flow and order variation reduction are other (OP) indicators (Siagian, Tarigan, & Jie, 2021). According to (Phan, Nguyen, Nguyen, & Matsui, 2019), flexibility also refers to an organization's capacity to react quickly to market changes in terms of volumes, scheduling and product mix. The term 'speed performance' refers to the time it takes to supply a good or service to a customer (Rajput & Gahfoor, 2020). The performance improves with less time spent on it (Li, Zhao, Bai, & Ali, 2022; Nawaiseh et al., 2022; Shan et al., 2022). The degree to which a product or service complies with standards and client demands is referred to as quality performance. Cost is the entire sum of money required to accomplish a certain operation inside the supply chain (De Feo, 2017).

2.2 Integration of Supply Chains

Over time, the notion of supply chain integration has undergone substantial research in the field of supply chain management (Kanan et al., 2022; Mohammad Kanan et al., 2023). Despite this, there are several definitions of the idea of supply chain integration provided by various scholars, and there does not seem to be a consensus on this term. For instance, according to (Wong, Sancha, & Thomsen, 2017), supply chain integration is a process where several businesses or entities collaborate and cooperate to accomplish desirable results. A different study defines supply chain integration as the strategic cooperation of supply chain partners to ensure the effectiveness of processes that add value (Chang, Ellinger, Kim, & Franke, 2016). According to (Ebrahimi, 2015), supply chain integration is a cooperative effort involving all supply chain participants, including buyers, sellers and focal organizations. These parties cooperate independently and reliantly to increase customer value through efficiency and cost savings.

2.3 Supplier Integration

According to Pakurár et al. (2019), SI refers to the cooperation and interaction that take place between businesses and their suppliers to improve supply flows. There are many supplier activities, including involving suppliers early in the design process to help with product design, setting up a very reliable, responsive system for processing supplier orders, establishing a trustworthy supplier network that supports a constant flow of information among suppliers and planning and managing inventory. According to (Fernando & Wulansari, 2021), SI makes use of the talents of each participating firm (supplier) to reap sizable, long-term benefits. According to (Min, Zacharia, & Smith, 2019), SCI has enormous benefits, including better decision-making and improved performance, because it is characterized by various features such as information sharing, trust, shared technologies, process integration, supplier capacity building and risk and reward sharing. Therefore, we propose the following hypothesis:

H_1: *SI influences operational performance.*

2.4 Customer Integration

According to (Schweitzer, Van den Hende, & Hultink, 2019), (CI) include a variety of activities such as establishing problem-solving initiatives, direct customer contact, addressing customer complaints, raising the level of customer satisfaction and establishing long-lasting customer relationships. (Dzogbewu, Fianko, Jnr, & Amoah, 2021) state that (CI) in manufacturing companies includes the sharing of demand, which enables organizations to have a significant understanding of customer needs as well as a more accurate forecast of the customer and the collaboration of customers in the design of products and services in order to better meet customer needs. This involves giving clients access to accurate and timely information about products, such as orders and order status, at the point of delivery. (CI) has several advantages, including increased market share, enhanced product and service distinction on the market, higher customer loyalty, a discernible depth of the client's wants and a better ability to meet those needs (Le, Huan, Hong, & Tran, 2021). Therefore, we propose the following hypothesis:

H_2: *CI influences operational performance.*

2.5 Internal Integration

According to Dzogbewu et al. (2021), internal integration is the interaction, communication and collaboration between the various functional units of an organization to achieve cohesion to provide exceptional customer service. This entails the linking and integration of data through computerized planning systems across various areas of an organization, including production, marketing and procurement (Errassafi, Abbar, & Benabbou, 2019). As a result, regular information flow across supply chain partners enables them to function as a unified entity in efficiently addressing customer expectations and market demands (Nenavani & Jain, 2022). For instance, Ellitan and Muljani (2017) contend that information sharing among organizational departments facilitates easy access to inventory information that is stored in an integrated database that is connected to the production process, marketing initiatives and other organizational departments using a computerized system. Therefore, we propose the following hypothesis:

H_3: *Internal control system influences (OP).*

2.6 Supply Chain Complexity

The number of actors and product lines connected to a focus firm's supply chain network is referred to as the (SCC) (Akın Ateş et al., 2022; M Kanan et al., 2023). Given its ability to create uncertainty and the decision-making and coordination costs that go with it, (SCC) may moderate the relationship between formal control mechanisms and operational performance, according to (Anin, Boso, & Asamoah, 2021), to the extent that higher decision-making and interfirm relationship coordination costs may act as a brake on the relationship. Contrarily, social control is anticipated to be a more effective instrument in regulating interfirm exchange hazards when uncertainties brought on by (SCC) are greater due to its high degree of flexibility and adaptive qualities (Poppo, Zhou, & Li, 2016). Therefore, we propose the following hypotheses:

H_4: *SCC moderates between SI and OP.*

H_5: *SCC moderates between CI and OP.*

H_6: *SCC moderates between internal integration and OP.*

3. Theoretical Framework

The theoretical framework in Figure 1 illustrates the optimization of a manufacturing firm's OP through the integration of supply chains: an enhancement of supply chain complexity.

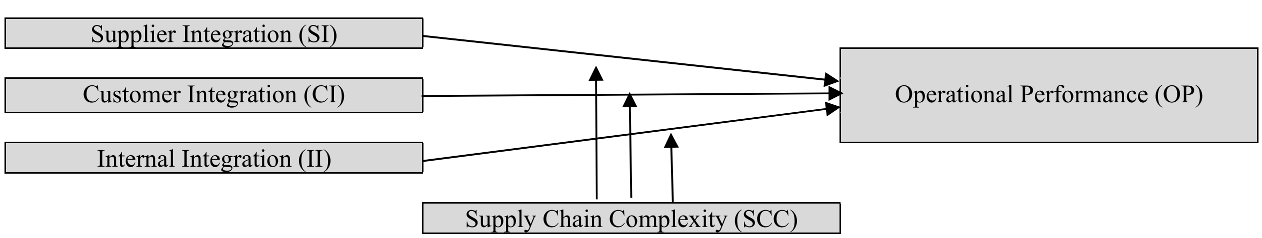

Fig. 1. Theoretical Framework

3. Research Methodology

This study involves descriptive research that tests hypotheses developed based on other studies to explain a phenomenon. To do this, sufficient data must be gathered. This study investigates the influence of SCC on supplier, customer, and internal integration in relation to operational performance.

A survey with five sections and 30 items was used to gather the data. In Section 1, the sample's sociodemographic characteristics are questioned. OP is covered in Section 2, and SI, CI and internal integration are covered in Section 3. Section 4 is concerned with supply chain complexity. The items were scored using a five-level Likert scale.

The validity of the questionnaire was established with professional input from academics, and the items were fixed following their feedback. Reliability was established using Cronbach's alpha. Alphas for each construct were greater than 0.7 (SI = 0.858, CI = 0.907, internal integration = 0.905, SCC = 0.868 and OP = 0.900), confirming the questionnaire's reliability and validity. The sample size was in accordance with the required power of analysis, which specifies that model complexity affects sample size. The minimum sample size was 98 in order to get a model with two predictors to have a medium effect size (Gefen, Rigdon, & Straub, 2011). A sample size of at least 100 is recommended for the structural equation model (SEM) analysis that was used (Hair, Risher, Sarstedt, & Ringle, 2019). To provide accurate results, the questionnaire was given to 500 logistics managers and production managers in manufacturing companies in Saudi Arabia. Table 1 lists the variables, along with their components and sources.

Table 1
Questionnaire items

No	Variable	No of items	Reference
1	(SI)	6	(Ali, 2022)
2	(CI)	5	(Ali, 2022)
3	Internal integration	7	(Ali, 2022)
4	(SCC)	4	(Al-Rawashdeh et al., 2023)
5	(OP)	8	(Al-Rawashdeh et al., 2023)

4. Data Analysis

The partial least squares (PLS) SEM is divided into two parts: the measurement model and the structure model. The latter describes the path coefficients between and among the latent variables, whereas the former explains the conceptual model's reliability and validity. We are presently in the middle of the study's two stages. Fig. 1 depicts the research's measurement framework, and the measuring model is shown in Fig. 2.

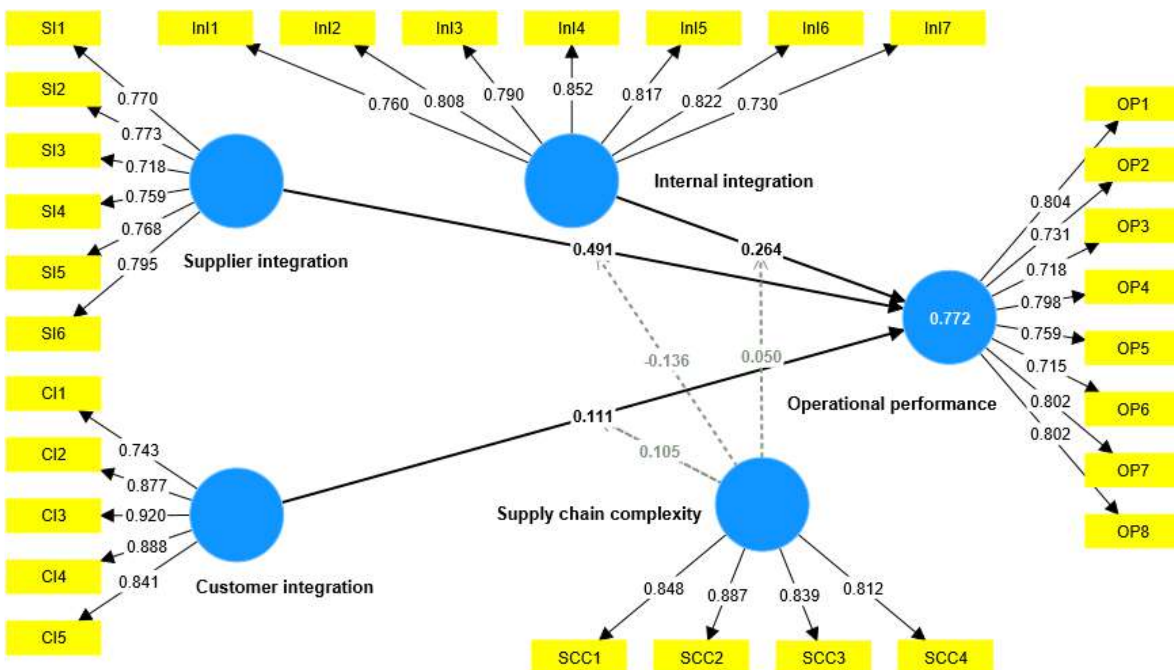

Fig. 2. The results of testing the hypothesis

4.1 Outer Loadings

In accordance with (Hair Jr, Howard, & Nitzl, 2020), outer loadings in PLS–SEM relate to the link between the latent concept and its measurable indicators. The route diagram in SmartPLS software shows the factor loadings of each indicator on its related build. The outer loading values for every indicator may be read as the strength of the association between the indicator and its construct and should ideally be greater than 0.7. The outer loadings in Table 1 give an insight into the links between the observable indicators and their associated latent variables. These loadings demonstrate the intensity as well as the direction of the correlations, which supports the measurement model's validity.

(CI) (CI1–CI5) indicators have loadings ranging from 0.743–0.920 (Table 1). These loadings imply moderate to strong positive connections between the observable indicators and the latent factor of CI (Hair et al., 2019).

Similarly, the internal integration (InI1–InI7) indicators had loadings ranging from 0.730–0.852 (Table 1), demonstrating moderate to high positive associations with the latent factor of internal integration (Hair et al., 2019).

The operational performance (OP1–OP8) indicators have loadings ranging from 0.715–0.804 (Table 1), demonstrating moderate to high positive associations with the latent factor of OP (Hair et al., 2019). Loadings for SI (SI1–SI6) indicators vary from 0.770–0.795 (Table 1), indicating a favorable connection with the latent variable of SI.

These results demonstrate the effectiveness of the observed indicators in reflecting the underlying components of CI, internal integration, OP and SI.

Table 1
Outer loadings

	Customer integration	Internal integration	Operational performance	Supplier integration	Supply chain complexity
CI1	0.743				
CI2	0.877				
CI3	0.920				
CI4	0.888				
CI5	0.841				
InI1		0.760			
InI2		0.808			
InI3		0.790			
InI4		0.852			
InI5		0.817			
InI6		0.822			
InI7		0.730			
OP1			0.804		
OP2			0.731		
OP3			0.718		
OP4			0.798		
OP5			0.759		
OP6			0.715		
OP7			0.802		
OP8			0.802		
SCC1					0.848
SCC2					0.887
SCC3					0.839
SCC4					0.812
SI1				0.770	
SI2				0.773	
SI3				0.718	
SI4				0.759	
SI5				0.768	
SI6				0.795	

4.2 Construct Reliability and Validity

Table 2 shows the reliability measurements for the study's latent variables. These indicators are evaluated for consistency and dependability within each variable.

All latent variables, including CI, internal integration, operational performance, SI and supply chain complexity, show appropriate levels of internal consistency and dependability, according to the findings.

Each variable's Cronbach's alpha value was greater than the 0.7 criterion, suggesting strong internal consistency. The composite reliability values were also above the specified level, validating the measurement model's dependability.

All variables reach or exceed the acceptance criterion of 0.5 for the average variance extracted (AVE), which assesses the percentage of variation captured by the latent variable, showing that the constructs explain a considerable amount of the variance in their respective indicators (Fornell & Larcker, 1981).

These reliability findings provide support to the measurement framework utilized in the research and imply that the measured indicators accurately assess their intended components.

Table 2
Cronbach's alpha and composite reliability

	Cronbach's alpha	Composite reliability	Composite reliability	Average Variance extracted
(CI)	0.907	0.912	0.932	0.733
Internal integration	0.905	0.908	0.924	0.637
Operational performance	0.900	0.906	0.919	0.588
(SI)	0.858	0.861	0.894	0.584
Supply chain complexity	0.868	0.868	0.910	0.717

4.3 Structural Model Analysis

The SmartPLS 4 software package was used in this research to perform SEM analysis. SEM using PLS enables the investigation of connections between variables in a complicated model. The factor that is dependent on this research is operational performance, whereas the independent variables are SI, CI and internal integration. Furthermore, SCC is regarded as a moderator variable.

SmartPLS 4 allows us to examine the complicated causal linkages between latent variables and their observable indicators. The measurement-based model, which defines the linkages between the latent variables and their observable indicators, and the structural framework, which investigates the relationships between the latent variables themself and their influence on the dependent variable, are both evaluated in this study. SmartPLS 4 has sophisticated analytical capabilities for evaluating and interpreting models (Hair et al., 2019).

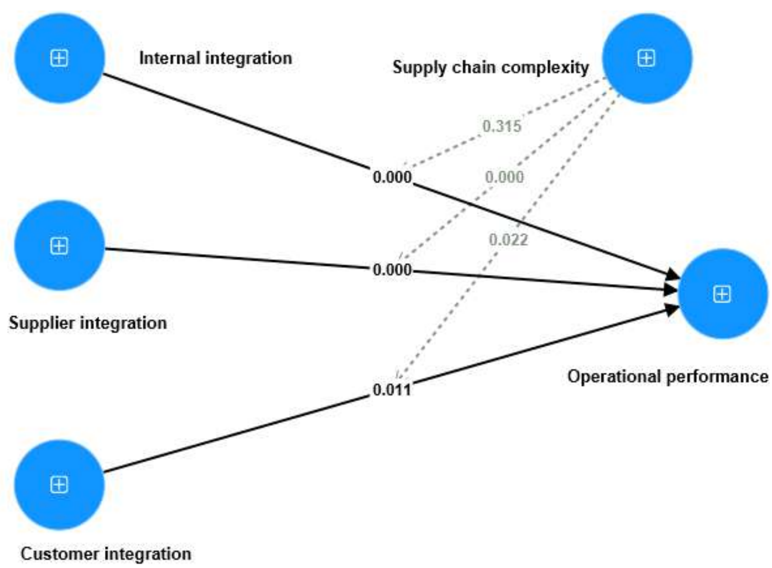

Fig. 3. depicts a model for structural.

4.4 Discriminant Validity

Table 3 shows the outcomes of the discriminant validity examination, which evaluates the distinctness of the latent variables in the research. It investigates whether the variables measure distinct notions and do not overlap. The study contributes to the reliability and validity of the method of measurement. The diagonal components in the table reflect the square root of the AVE for each construct. The AVE quantifies the amount of variation captured by the concept in relation to the error in measurement. The off-diagonal components reflect the relationships between the structures.

To prove discriminant validity, the square root of the AVE for each concept should be greater than the correlations with other components. In other words, the diagonal elements should be bigger than the equivalent off-diagonal components of their respective columns (Fornell & Larcker, 1981).

Based on the data in Table 3, we can see that the square root of the AVE for each construct is greater than the correlations with other constructs in the same column. This shows that the constructs have discriminant validity, suggesting that they assess diverse features of the phenomena in the research (Hair et al., 2019).

Finally, the findings in Table 3 confirm the discriminant validity of the latent variables and their interactions, which include (CI), internal integration, operational performance, SI and SCC (if applicable). These results suggest that the variables reflect distinct and non-overlapping features of the constructs, which improves the measurement model's robustness.

Table 3
Discriminant validity.

	Customer integration	Internal integration	Operational performance	Supplier integration	Supply chain complexity	Supply chain complexity × Customer integration	Supply chain complexity × Supplier integration	Supply chain complexity × Internal integration
Customer integration								
Internal integration	0.727							
Operational performance	0.609	0.721						
Supplier integration	0.454	0.569	0.844					
Supply chain complexity	0.569	0.592	0.765	0.643				
Supply chain complexity × customer integration	0.289	0.350	0.160	0.254	0.223			
Supply chain complexity × supplier integration	0.222	0.269	0.412	0.286	0.460	0.508		
Supply chain complexity × internal integration	0.325	0.359	0.211	0.285	0.255	0.860	0.563	

4.5 Path Coefficients

Table 4 displays the model's structural analysis coefficients, in particular the path coefficients, *t*-statistics, and *p*-values. These coefficients highlight the linkages that exist amongst the variables that are independent (CI, internal integration, SI and supply chain complexity) and the variable that is dependent (operational performance). The path coefficient denotes the intensity and direction of a link between an independent variable and a dependent variable. It expresses how much a change in the factor that is independent affects the dependent variable. The path coefficients are given as standardized estimates in this table. The *t*-statistic quantifies the importance of each route coefficient. It represents how much the observed connection deviates from the null hypothesis of no association. Higher absolute *t*-statistic values suggest a greater link between the independent and dependent variables. The *p*-values linked with each route coefficient represent the likelihood of seeing the computed association by chance, assuming no real relationship exists in the population. Lower *p*-values (usually less than a specific threshold of significance, such as 0.05) suggest a substantial association between the variables. The observations that follow are made based on the data in Table 4.

Table 4
Path coefficients

	Path coefficient	Sample mean (M)	Standard deviation	*t*-statistic	*p*-value
Customer integration → operational performance	0.111	0.111	0.044	2.530	0.011
Internal integration → operational performance	0.264	0.259	0.053	4.972	0.000
(SI) → operational performance	0.491	0.498	0.050	9.760	0.000
Supply chain complexity → operational performance	0.164	0.160	0.057	2.883	0.004
Supply chain complexity × Customer integration → operational performance	0.105	0.103	0.046	2.291	0.022
Supply chain complexity × supplier integration → operational performance	-0.136	-0.139	0.030	4.511	0.000
Supply chain complexity × internal integration → operational performance	0.050	0.055	0.050	1.004	0.315

CI improves OP in a favorable and substantial way (path coefficient = 0.111, *t*-statistic = 2.530, *p*-value = 0.011). This implies that more CI leads to better operational performance. Internal integration improves OP more than external integration (path coefficient = 0.264, *t*-statistic = 4.972, *p*-value = 0.000). The association is statistically significant as well as substantively significant, demonstrating that improving internal integration has a beneficial influence on operational performance. The greatest beneficial effect on OP is provided by SI (path coefficient = 0.491, *t*-statistic = 9.760, *p*-value = 0.000). The link is quite important, emphasizing the critical significance of SI in improving operational performance. SCC influences OP positively and significantly (path coefficient = 0.164, *t*-statistic = 2.883, *p*-value = 0.004). This implies that as (SCC) rises, operational effectiveness improves. Interactions between SCC and the independent variables (CI, SI and internal integration) have also been shown to have a major impact on operational performance. The path coefficients, as well as the *t*-statistics and *p*-values connected with them, demonstrate the strength and importance of these associations. However, the interaction term '(SCC) × internal integration' has a non-significant effect on OP (path coefficient = 0.050, *t*-statistic = 1.004, *p*-value = 0.315), indicating that the interaction between these two variables does not contribute significantly to OP improvement. In conclusion, the coefficients in Table 4 demonstrate the links between the independent factors and operational performance. According to the substantial and positive coefficients, CI, internal integration, SI and SCC all play key roles in determining OP in the examined scenario.

4.6 R-Squared

Table 5 displays the model's R-squared values. The R-squared score for OP is 0.772, suggesting that the independent variables can explain 77.2% of the variability in operational performance. The adjusted R-squared value is 0.766, which accounts for model complexity and offers a somewhat lower assessment of the model's goodness of fit. These results indicate that the model's independent variables considerably contribute to explaining operational performance.

Table 5
R-squared values

	R-squared	R-squared (adjusted)
Operational performance	0.772	0.766

5. Discussion and conclusion

The current research aimed to investigate the connection between SI, CI, internal integration, SCC and operational effectiveness in Saudi Arabia's industrial sector. The study's results provide important insights into the dynamics of supply chain management and their influence on operational performance, particularly in the Saudi industrial setting. In the Saudi industrial sector, the findings demonstrated considerable positive connections between SI, CI, internal integration and operational performance. These results are consistent with earlier research and support the premise that efficient supplier and CI, as well as internal coordination within the business, may improve operational performance. The coefficients derived for these correlations were statistically significant, confirming the results' robustness in the Saudi context.

In addition, the research revealed that SCC is a major mediator of the link between the independent variables and operational performance. The interactions between SCC and CI, SI and internal integration were all statistically significant, emphasizing the importance of considering the specific complexities of the Saudi industrial supply chain when implementing integration strategies. The discriminant validity analysis indicated that the concepts utilized in the research are different and assess separate features of the phenomena under inquiry in the Saudi industrial sector. The correlations between the constructs were lower than the threshold, showing that they reflect diverse characteristics of the overarching construct and are not affected by multicollinearity difficulties unique to the Saudi industrial sector. Table 4 shows the strength and importance of the correlations between independent variables and OP in the Saudi industrial sector. SI had the greatest beneficial effect, followed by internal integration and CI, which is consistent with past studies in comparable circumstances. Although SCC was connected to operational performance, it had a lower influence in the Saudi industrial sector. In the Saudi Arabian context, the coefficients indicated strong interaction effects between SCC and the integration factors.

In conclusion, the study's results give significant insights for managers and practitioners in the Saudi industrial sector, emphasizing the relevance of supplier, customer and internal integration in increasing operational performance. The findings highlight the significance of SCC as a moderator in the Saudi Arabian context, demonstrating that the influence of integration techniques on OP differs depending on the difficulties of the Saudi industrial supply chain. However, it is vital to recognize the study's shortcomings. The study was done inside Saudi Arabia's industrial sector, restricting the results' generalizability to other sectors or nations. Furthermore, the research relied on self-reported data, which might result in response bias. To increase the validity and generalizability of the results related to the Saudi industrial sector, future research should cover a larger variety of sectors and use objective performance indicators. Overall, this research helps to better understand the linkages between integration, SCC and operational effectiveness in Saudi Arabia's industrial sector. It offers significant insights for managers in the Saudi industrial sector, advising on how to improve OP via efficient integration techniques while considering the intricacies of the Saudi industrial supply chain.

References

Abu-AlSondos, I., Alkhwaldi, A., Salhab, H., Shehadeh, M., & Ali, B. (2023). Customer attitudes towards online shopping: A systematic review of the influencing factors. *International Journal of Data and Network Science, 7*(1), 513-524. doi: www.GrowingScience.com/ijds

Afshar, A., Soleimanian, E., Akbari Variani, H., Vahabzadeh, M., & Molajou, A. (2021). The conceptual framework to determine interrelations and interactions for holistic Water, Energy, and Food Nexus. *Environment, Development and Sustainability*, 1-22.

Akın Ateş, M., Suurmond, R., Luzzini, D., & Krause, D. (2022). Order from chaos: A meta-analysis of supply chain complexity and firm performance. *Journal of Supply Chain Management, 58*(1), 3-30.

Al-Hussein, M. A.-H. A., Alabdallat, W. I. M., Abu, M. A., Rumman, O. J., & Ali, B. J. (2023). Impact of E-Government Applications on Reducing Administrative Burden in Delivering Public Service. *Information Sciences Letters, 12*(3), 1663-1671 doi:http://dx.doi.org/10.18576/isl/120350

Al-Rawashdeh, O. M., Jawabreh, O., & Ali, B. J. (2023). Supply Chain Management and Organizational Performance: The Moderating Effect of Supply Chain Complexity. *Information Sciences Letters, 12*(3), 1673-1684. doi:http://dx.doi.org/10.18576/isl/120351

Ali, B. (2022). Integration of Supply Chains and Operational Performance: The Moderating Effects of Knowledge. *Information Sciences Letters, 11*(04), 1069-1076. doi:10.18576/isl/110407

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.

Anin, E. K., Boso, N., & Asamoah, D. (2021). Moderating effect of supply chain complexity in governance mechanisms and operational performance relationship: Evidence from a sub-Saharan African market. *Africa Journal of Management, 7*(3), 400-422.

Ataseven, C., Nair, A., & Ferguson, M. (2020). The role of supply chain integration in strengthening the performance of not-for-profit organizations: evidence from the food banking industry. *Journal of Humanitarian Logistics and Supply Chain Management*.

Boehmer, J. H., Shukla, M., Kapletia, D., & Tiwari, M. K. (2020). The impact of the Internet of Things (IoT) on servitization: an exploration of changing supply relationships. *Production Planning & Control, 31*(2-3), 203-219.

Chang, W., Ellinger, A. E., Kim, K. K., & Franke, G. R. (2016). Supply chain integration and firm financial performance: A meta-analysis of positional advantage mediation and moderating factors. *European Management Journal, 34*(3), 282-295.

De Feo, J. A. (2017). *Juran's quality handbook: The complete guide to performance excellence*: McGraw-Hill Education.

Donkor, F., Papadopoulos, T., & Spiegler, V. (2022). Supply chain integration and supply chain sustainability relationship: A qualitative analysis of the UK and Ghana pharmaceutical industry. *Production Planning & Control*, 1-24.

Dzogbewu, T. C., Fianko, S. K., Jnr, S. A., & Amoah, N. (2021). Assessment of the mediating effects of external integration on manufactury firms operational performance. *Journal of Industrial Engineering and Management (JIEM), 14*(4), 718-732.

Ebrahimi, S. M. (2015). *Examining the impact of supply chain integration on organization structure and operational performance in oil and gas supply chains: A contingency approach.* University of Sheffield.

Ellitan, L., & Muljani, N. (2017). The effect of information sharing and quality of information on the performance of supply chain: the case of east java manufacturing smes. *International Journal of Advanced Research (IJAR)*, 593-5407.

Errassafi, M., Abbar, H., & Benabbou, Z. (2019). The mediating effect of internal integration on the relationship between supply chain integration and operational performance: Evidence from Moroccan manufacturing companies. *Journal of Industrial Engineering and Management, 12*(2), 254-273.

Fernando, Y., & Wulansari, P. (2021). Perceived understanding of supply chain integration, communication and teamwork competency in the global manufacturing companies. *European Journal of Management and Business Economics, 30*(2), 191-210.

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics: Sage Publications Sage CA: Los Angeles, CA.

Gefen, D., Rigdon, E. E., & Straub, D. (2011). Editor's comments: an update and extension to SEM guidelines for administrative and social science research. *MIS quarterly*, *35*(2), 3-14.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European business review, 31*(1), 2-24.

Hair Jr, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research, 109*, 101-110.

Jawabreh, O., Mahmoud, R., Alananzeh, O., & Ali, B. (2023). An Empirical Analysis of the Factors Influencing Online Meal Delivery Services. *Journal of Statistics Applications & Probability, 12*(2), 415-423. doi:http://dx.doi.org/10.18576/jsap/120208

Kanan, M., Al-Khalili, R., Alshaibani, E., Saleh, Y., Assaf, R., Al-Mimi, A., & Bakir, A. (2023). Assessing Service Quality at Optical Centers in Palestine Using SERVQUAL: Measuring Ambiguity.

Kanan, M., Habib, M. S., Habib, T., Zahoor, S., Gulzar, A., Raza, H., & Abusaq, Z. (2022). A Flexible Robust Possibilistic Programming Approach for Sustainable Second-Generation Biogas Supply Chain Design under Multiple Uncertainties. *Sustainability, 14*(18), 11597.

Kanan, M., Zahoor, S., Habib, M. S., Ehsan, S., Rehman, M., Shahzaib, M., . . . Hamdan, A. (2023). Analysis of Carbon Footprints and Surface Quality in Green Cutting Environments for the Milling of AZ31 Magnesium Alloy. *Sustainability, 15*(7), 6301.

Le, T. T., Huan, N. Q., Hong, T. T. T., & Tran, D. K. (2021). The contribution of corporate social responsibility on SMEs performance in emerging country. *Journal of Cleaner Production, 322*, 129103.

Li, Y., Zhao, S., Bai, L., & Ali, B. J. (2022). Institutional investor company social responsibility report and company performance. *Applied Mathematics and Nonlinear Sciences, 7*(2), 641-654. doi: https://doi.org/10.2478/amns.2021.2.00107

Manhart, P., Summers, J. K., & Blackhurst, J. (2020). A meta-analytic review of supply chain risk management: assessing buffering and bridging strategies and firm performance. *Journal of Supply Chain Management, 56*(3), 66-87.

Min, S., Zacharia, Z. G., & Smith, C. D. (2019). Defining supply chain management: in the past, present, and future. *Journal of business logistics, 40*(1), 44-55.

Nawaiseh, K. H. A., Alawamleh, H., Al Shibly, M., Almari, M., Orabi, T. A., Jerisat, R., . . . Badadwa, A. (2022). The Relationship Between the Enterprise Resource Planning System and Maintenance Planning System: An Empirical Study. *Information Sciences Letters, 11*(5), 1-11. doi:https://digitalcommons.aaru.edu.jo/isl/vol11/iss5/2

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.

Pakurár, M., Haddad, H., Nagy, J., Popp, J., & Oláh, J. (2019). The impact of supply chain integration and internal control on financial performance in the Jordanian banking sector. *Sustainability, 11*(5), 1248.

Phan, A. C., Nguyen, H. T., Nguyen, H. A., & Matsui, Y. (2019). Effect of total quality management practices and JIT production practices on flexibility performance: Empirical evidence from international manufacturing plants. *Sustainability, 11*(11), 3093.

Poppo, L., Zhou, K. Z., & Li, J. J. (2016). When can you trust "trust"? Calculative trust, relational trust, and supplier performance. *Strategic management journal, 37*(4), 724-741.

Rajput, A., & Gahfoor, R. Z. (2020). Satisfaction and revisit intentions at fast food restaurants. *Future Business Journal, 6*, 1-12.

Schweitzer, F., Van den Hende, E. A., & Hultink, E.-J. (2019). There's more than one perspective to take into account for successful customer integration into radical new product innovation: A framework and research agenda. *IEEE Transactions on Engineering Management, 67*(3), 813-829.

Shan, R., Xiao, X., Dong, G., Zhang, Z., Wen, Q., & Ali, B. (2022). The influence of accounting computer information processing technology on enterprise internal control under panel data simultaneous equation. *Applied Mathematics and Nonlinear Sciences, aop*(aop), 1–9. doi:10.2478/amns.2022.2.0157

Siagian, H., Tarigan, Z. J. H., & Jie, F. (2021). Supply chain integration enables resilience, flexibility, and innovation to improve business performance in COVID-19 era. *Sustainability, 13*(9), 4669.

Susanty, A., Sumiyati, L. S., Syaiful, S., & Nihlah, Z. (2021). The impact of lean manufacturing practices on operational and business performances at SMES in the wooden furniture industry. *International Journal of Lean Six Sigma, 13*(1), 203-231.

Tarigan, Z. J. H., Siagian, H., & Jie, F. (2021). Impact of enhanced Enterprise Resource Planning (ERP) on firm performance through green supply chain management. *Sustainability, 13*(8), 4358.

Trattner, A., Hvam, L., Forza, C., & Herbert-Hansen, Z. N. L. (2019). Product complexity and operational performance: A systematic literature review. *CIRP Journal of Manufacturing Science and Technology, 25*, 69-83.

Wong, C. W., Sancha, C., & Thomsen, C. G. (2017). A national culture perspective in the efficacy of supply chain integration practices. *International journal of production economics, 193*, 554-565.

Yang, J., Rui, M., Rauniar, R., Ikem, F. M., & Xie, H. (2013). Unravelling the link between knowledge management and supply chain integration: an empirical study. *International Journal of Logistics Research and Applications, 16*(2), 132-143.