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Integrated Supply Chain Quality Management and an Organizational Performance Insights: a two-stage PLS-SEM and Artificial Neural Network (ANN) approach

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ABSTRACT

To generate value and optimize profitability, building successful partnerships with supply chain organizations is essential. This can be accomplished through training models, knowledge transfer, and support from top management. The implementation of advanced management practices is crucial to achieving these goals. In this context, an integrated approach to quality management, logistics, and supply chain management (SCM) is fundamental. Thus, harnessing the synergy between Quality Management (QM) and SCM is vital to enhance and promote organizational performance. Additionally, this study examines the significance and relationship between knowledge transfer, supply chain management capabilities, and top management support for organizational performance using PLS-SEM and ANN approaches. Primary data were collected through questionnaires from 200 respondents working in the manufacturing industry in Indonesia. Statistical analyses were performed using PLS-SEM with SmartPLS 4.0, and ANN with SPSS. The results reveal that supply chain quality management practices and top management support positively impact and have a strong relationship with organizational performance. This study provides insights into the role of supply chain quality management in organizational performance, especially in developing countries like Indonesia. It aims to help all manufacturing companies enhance their organizational performance by optimally combining selected SCQM practices with a focus on organizational performance.

Introduction

Digital globalization has created fierce competition in today's complex business world, causing significant barriers for organizations striving to achieve good performance. The concept of organizational performance refers to achievements beyond organizational profitability and places greater emphasis on economic, social, and environmental aspects, which are increasingly demanded by various stakeholders(Arora, Arora, Sivakumar, & Burke, 2020). With the growing concern for the environment as a key determinant of a company's performance, it is crucial to investigate environmentally friendly behaviour within the context of developing countries. By examining both economic and non-economic aspects, a company's long-term performance is regarded as the value derived from its communication principles and strategies (Ahmad, Ikram, Rehan, & Ahmad, 2022).

Supply Chain Management (SCM) facilitates the integration of customer bases, distribution networks, internal activities within the company, and supply bases. Consequently, SCM practices significantly impact organizational performance and sustainability performance, as well as how these are perceived by external stakeholders. In the current era of globalization and increasing competition, the strategic management of all external and internal stakeholders, from raw material suppliers to end-users, is a primary focus of SCM. This positions SCM as a crucial management method that influences an organization's sustainability performance (Lim, Lee, Foo, Ooi, & Wei–Han Tan, 2022). In today's intricate economic environment, digital globalization has intensified competition, posing serious obstacles to businesses aiming to attain sustainability. The notion of sustainability pertains to accomplishments that surpass the profitability of a firm and prioritizes economic, social, and environmental facets, which are progressively required by diverse stakeholders (Bastas & Liyanage, 2019).

Supply Chain Quality Management (SCQM) is a dynamic management approach that combines supply chain management (SCM) and quality management (QM) to enhance customer satisfaction and superior product and service quality by fostering cooperation between manufacturers and external stakeholders (Fernandes, Vilhena, Oliveira, Sampaio, & Carvalho, 2022). Business organizations that successfully implement this integrated SCQM strategy can achieve a competitive advantage and outperform competitors in highly competitive markets. The majority of this research reveals that SCQM can assist a business in efficiently organizing and carrying out every activity in its supply chain, enhancing operational quality and customer satisfaction levels (Hong, Liao, Zhang, & Yu, 2019). However, little is known about the potential applications of SCQM, its other main drivers, and how combining these with SCQM techniques may impact business performance.

Supply chain management practices are strongly linked to customer satisfaction. It requires coordination and integration of the business framework. Business processes that must be cohesive include manufacturing, purchasing, marketing logistics, and information systems. Therefore, supply chain management practices focus on customer response, quality, and environmental sustainability. SCM is an integrated concept that aims to manage the upstream and downstream flow of a distribution channel from suppliers and producers to end users (Chen, Tang, & Jia, 2019). Various SCM practices, such as strategic partnerships with suppliers, strong relationships with customers, maintaining the level and quality of information sharing (IS) throughout the supply chain, and delays, occur through supply chain processes implemented by various organizations and researchers. In contrast, QM has been defined as a critical leadership technique that maximizes product quality, design, and features to reach customer satisfaction.

Various elements of QM have been highlighted in various studies conducted in different sectors; however, most of the studies produced positive results for OP (Sadikoglu & Olcay, 2014), highlighting the six total quality management (TQM) pillars of supplier QM, knowledge and process management, leadership, training, and customer focus (CF) all of which have been embraced by numerous other academics for use in their empirical investigations. The literature is filled with investigations into multinational corporations and large organizations investigating the effects of supply chain management (SCM) and quality management (QM), two of the most significant strategic approaches in business management that are thought to be necessary for an organization's competitive advantage and success. Improved stakeholder satisfaction and organizational performance are among the primary goals of both approaches. Studies on how they're integrated into managerial techniques, however, are limited (Ahmad et al., 2022). Furthermore, several current studies emphasize the importance of integrating SCM and QM as a critical issue to support organizational advantages. These advantages generally include decreased process duplication between organizations, improved departmental coordination with a greater understanding of continuous improvement, increased process agility in delivery, and improved customer responsiveness, all of which lead to improved performance overall.

This work, therefore, seeks to close the gap in the existing literature by exploring the impact of each SCQM practice on the achievement of OP among manufacturing firms in Indonesia. A conceptual framework was developed in this study to postulate a causal relationship between SCQM and organizational performance. This allows statistical models to evaluate and identify SCQM factors or activities that may influence organizational performance. Structural Equation Modelling (SEM) is used to test the framework and implications for the success of SCQM derived from statistical applications. An Artificial Neural Network (ANN) method will then be used which is useful for research involving predictive settings and limited theory and does not require an understanding of the underlying correlations between the variables under study. The ANN method contributes to a significantly parallel distributed network consisting of simple processing units with a tendency for the formed network to store and provide experimental knowledge to be used as an additional analysis method to verify study results generated by other analysis methods, such as Structural Equation Modelling (SEM). Since top management's support and role in supply chain quality management practices seem to be limited in prior research, it is also examined supply chain quality management practices in organizational performance indicators. The two concepts were integrated to comprehend the intricate behaviour of organizational tools in the supply chain quality management implementation.

A previous study by (Ananda, Astuty, & and Nugroho, 2018) discussed the primary SCQM dimension and the relationship between it and its impact on organizational performance, particularly when using the Balanced Scorecard (BSC) perspective without providing an empirical basis. A survey was conducted in 2015 regarding global manufacturing and service companies, and statistical analysis was also conducted. The results will help to better understand the primary issues of QM and SCM integration by providing solid support to both practice and academics. Businesses must provide customers with timely and efficient products and services at reasonable prices, and within a reasonable time frame to succeed in the global marketplace. Therefore, it is imperative to ensure quality throughout the supply chain to continuously improve quality, fulfil customer needs and expectations, and deliver products and services of high quality. This scenario brings the idea of integration between QM and SCM practices, stemming from the importance of both approaches in a company to achieve competitive advantage. (Fernandes et al., 2022) Discovered parallels between QM and SCM to shed light on the phenomenon of SCQM integration. Consequently, the relationship between SCQM dimensions and organizational performance indicators was explained by developing a theoretical framework. The QM and SCM domains share many crucial areas—sustainability, strategic management and planning, stakeholder engagement and commitment/policy, information, leadership, continuous improvement, and innovation—according to the SCQM conceptual model. Furthermore, it considers particular procedures associated with SCM (procurement, internal logistics, and distribution) and QM (product/service quality and quality culture) throughout important supply chain processes. The integration of SCM with QM is seen as a prerequisite for achieving a competitive advantage in the global market (Phan, Nguyen, Trieu, Nguyen, & Matsui, 2019) However, the emergence of global supply chains and the growth and expansion of supply chain systems are forcing manufacturing companies to implement inter- and intra-organizational management strategies (i.e., SCQM) to be sustainable in a competitive market environment. This is because there is little research on the integration of these two concepts. Quality has become a top priority for all parties involved in a supply chain and a key supply chain goal. Relationships both inside and outside the organization contribute to quality performance (Fernandes, Sampaio, Sameiro, & Truong, 2017). One of the elements of the value-added process in the supply chain's product delivery and production is quality (Kumar, Singh, & Modgil, 2023).

Method

This study's cross-sectional design and narrow focus on Indonesia's manufacturing were used to test the hypotheses. The Smart-PLS (SEM) and SPSS (ANN) approaches were also used to investigate the relationship among the variables. Other disciplines, such as engineering, sciences, and management studies, also used this course of study.

Data Collection

To ensure that the sample chosen is a valid representation of the total population, this study was carried out via an online survey of manufacturing enterprises located throughout Indonesia to verify the assumptions. Top, mid, and executive-level employees were among the industry respondents who completed this survey; they were primarily from the departments of human resource management, corporate policy, sales, marketing, logistics, and corporate policy.

Four experts in the field of supply chain quality management reviewed the questionnaire's content validity before distribution; as a result, several modifications were made to prevent future misunderstandings and better suit the Indonesian environment. To evaluate the general design of the questionnaire and the comprehensiveness of the scale items, a pilot test involving 40 participants was carried out. Moreover, the pilot study was conducted to rigorously validate the instruments utilized in this study. In the pilot study, Cronbach’s alpha of all the constructs was greater than 0.7, which refers to high internal consistency. Based on the research's suggested assumptions, a questionnaire was created to gather information from Indonesia's industry regarding supply chain quality control and disposal decisions. The survey was modified based on (Fernandes et al., 2022). Data from Indonesia's industrial industry was gathered online using Google and a self-administered questionnaire. The respondents' email addresses received a cover letter and the study link. Web-based surveys are becoming increasingly popular among researchers because they save time, are more easily accessible, cost-effective, and provide real-time data.

A total of 274 completed questionnaires were collected. However, 74 questionnaires were incomplete, so only 200 samples could be used. Using the P-min introduced by (Hair & Alamer, 2022), The study required a minimum of 155 respondents, and since 200 questionnaires were completed, the sample size was deemed acceptable and compliant.

Data Analysis Technique

The information was collected and numerically coded in an MS Excel spreadsheet before being transferred to the Smart-PLS and SPSS software for further analysis and assessment. The data was visually checked for errors and missing numbers to make the necessary adjustments. The structural equation modelling technique was used to analyze both the measurement and structural models. Furthermore, utilizing the SEM analysis, it was discovered that structural equation modelling could assess the measurement models (Hair & Alamer, 2022). Using latent components, causal models with their observable variables can be systematically analyzed. This study adopted a two-step methodological approach in which the measurement model was analyzed initially, followed by the estimation of structural equation modelling. Smart-PLS software was used to analyze both the measurement and structural equation modelling. To complement PLS-SEM analysis, which was applied to discover statistically significant reflective independent variables that affect a reflective dependent variable, artificial neural network (ANN) analysis was subsequently carried out using SPSS. These significant reflective autonomous variables are then treated as input neurons for the resultant output neuron (the reflective dependent variable) in the ANN analysis. Because of its flexibility and lack of reliance on multivariate assumptions like normality and linearity, ANN is comparable to PLS-SEM.

Demographic profile of respondents

The full demographic profile of the respondents is shown in Table 1. From the gender profile, there were more male (57.5%) than female (42.5%) respondents. The primary activities of 22% of the companies classified as "Other" include the production of solar panels, medical equipment, solder products, cement products, and remanufacturing of recyclable products, and so fort second of primary manufacture automotive is 20%, food and beverage 19,5%, textile 12% and last is pharmaceutical 10,5%. For the division, most of the respondents work in the production division with 16%, the second is procurement and quality assurance with 11,5%, and the last is sales/marketing with 6%. Additionally, 79% of the respondents held junior management positions (supervisor and assistant manager), while only 21% held top management positions.

Results and Discussion

Measurement Models

To ensure that the measured variables were accurately observed, the validity and reliability of the suggested model frameworks were examined in the measuring model. Using Smart PLS software, the item's internal consistency, convergent and discriminating validity, and reliability were assessed. Moreover, the individual dependability of each product was assessed to determine whether a latent variable accounts for a significant percentage of the variance in its observed indices. It was determined by looking at the loading with each instrument's structure, and it needs to be at least 0.5. Internal consistency was also examined. This indicator measures the constructed concept while testing the internal consistency of all indicators. Internal consistency was also examined. This indicator measures the constructed concept while testing the internal consistency of all indicators. It demonstrates the rigour with which the same latent variable is measured by the deeply embedded elements. It can be assessed using composite reliability or Cronbach's alpha. According to (J. Hair & Alamer, 2022), Cronbach's alpha indicates that results have internal consistency reliability and that all loading variables are equally correct. The internal consistency of the recommended model under evaluation should be at least 0.7 in terms of composite reliability. The assessment model includes two parts: convergence validity and decrement validity. The assessment of convergence validity involved factor loadings (FL), composite reliability (CR), and average variance extracted (AVE). The outcomes show that most factor loadings for items exceeded the minimum value of 0.7 as Table 2 displays the result.

Table 1
Measurement Model

Constructs	Factor Loading (FL)	Composite Reliability (CR)	Average Variance Extracted (AVE)
Organizational Performance		0.935	0,645
OP 1	0.883		

OP 2	0.836		
OP 3	0.808		
OP 4	0.767		
OP 5	0.724		
OP 6	0.81		
OP 7	0.778		
OP 8	0.808		
Supply Chain Management		0.912	0.676
SCM 1	0.851		
SCM 2	0.763		
SCM 3	0.91		
SCM 4	0.825		
SCM 5	0.753		
Quality Management		0.924	0.708
QM 1	0,824		
QM 2	0.821		
QM 3	0.847		
QM 4	0.836		
QM 5	0.876		
Supply Chain Quality Management Practices		0.897	0.743
SCQMP 1	0.869		
SCQMP 2	0.814		
SCQMP 3	0.901		
Supply Chain Quality Management Capabilities		0.916	0.732
SCQMC 1	0.869		
SCQMC 2	0.814		
SCQMC 3	0.901		
SCQMC 4	0.916		
Support Top Management		0.906	0.763
STM 1	0.771		
STM 2	0.926		
STM 3	0.915		
Knowledge Transfer		0.90	0.645
KT 1	0.717		
KT 2	0.789		
KT 3	0.853		
KT 4	0.84		
KT 5	0.808		

Additionally, the constructs' CA and CR values were above 0.7, with AVE values surpassing the threshold of 0.5. Thus, these latent variables have no issues regarding convergent validity. The Heterotrait- Monotrait was used to test the discriminant validity model. Table 3 displays the results, which demonstrate that the discriminant values were within the HTMT threshold of 85 or 90, confirming the presence of discriminant validity.

Table 2

Discriminant validity based on the HTMT method

	OP	QM	SCM	SCQMC	SCQMP	STM	KT
OP							
QM	0.586						
SCM	0.514	0.588					
SCQMC	0.691	0.791	0.897				
SCQMP	0.646	0.814	0.672	0.888			
STM	0.547	0.805	0.485	0.674	0.828		
KT	0.379	0.483	0.787	0.824	0.637	0.55	

Note : OP =Organitazional Performance ; QM = Quality Management ; SCM = Supply Chain Management ; SCQMC: Supply Chain Quality Management Capabilities ; SCQMP = Supply Chain Quality Management Practices ; STM= Support Top Management; KT= Knowledge Transfer

Structural Model

The structural and measurement models of this study are based on a conceptual model consisting of latent variables and indicators. Figure 2 shows the structural and measurement models of this study.

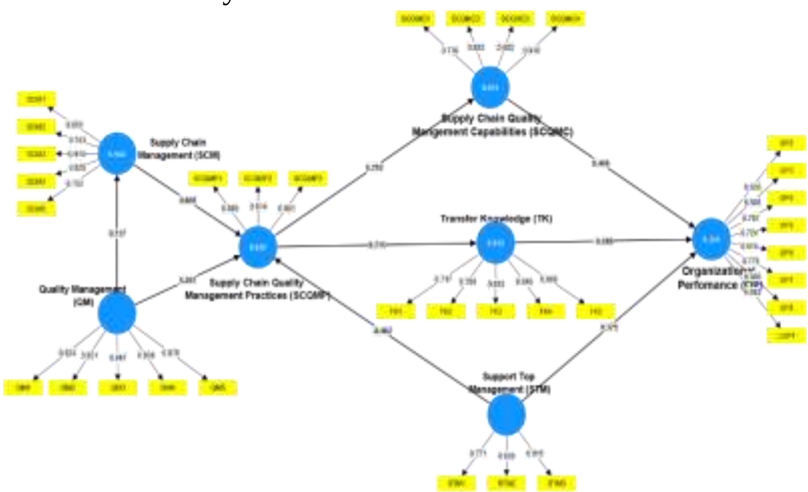

Figure 1 Develop PLS-SEM Structural Path Analysis for Factors Affecting OP in SCQM.

The hypotheses were tested using PLS-SEM, which followed the validation of the measurement model. As suggested by Hair et al., (2019), the reporting includes path-coefficient results, inner VIF values, and coefficient of determination (R2). The standardized R2 value ranges from 0 to + 1 with greater predictive accuracy values. Also, if the independent variable has R2 values greater than 0.7, it is considered a strong coefficient determinant. The variables having a value of less than 0.25 are considered weak, and 0.5 is assumed to be moderate. Effect sizes (f2) and predictive relevance of Q2 The model is considered good if its predictive relevance in Q2 is greater than zero. The collinearity issues have been examined to ensure that they did not affect the regression results. According to (Hair & Alamer, 2022), the VIF inner values should be below 5. The results indicate that all the items pass the threshold of 5. Furthermore, the tolerance values were within the acceptable range (0.1 and 1). Hence, it is evident that the dataset does not exhibit multicollinearity. Therefore, the bootstrapping approach with a resampling of 1,000 was utilized to estimate the significance of the path coefficient using SmartPLS 4 software.

Evaluation of the structural model follows the assessment of the measurement model. The structural model was utilized to predict the underlying hypothesized relationships among latent variables for various dimensions. Predicted construct associations were computed using the structural path model's coefficients. The intensity of the relationship between the two paradigms was represented by the path coefficient's value. Its regular value fluctuates between -1 and +1. The values closer to +1 are considered statistically significant and show a strong correlation between the constructs. On the other hand, weak correlations are represented by values that are closer to 0, and they are usually not significant. To evaluate the relevance of various connections between the components in further detail. In this investigation, the crucial value was determined using 5% of the significance level. Moreover, if the t-value is greater than the critical t-value, the hypothesis is accepted at the mentioned significance level; otherwise, it is rejected. Table 4 shows the values based on the evaluation criteria;

Table 3

Assessment of Structural Model

Constructs	Path Coefficient	VIF	R-Squared (R^2)	Effect Size (f^2)	Q-Square (Q^2)	P - Value	T-Value	Result
QM -> SCM	0.737	1.000	0,541	0.543	0.536	19.078	0.000	Accepted
QM -> SCQMP	0.285	2.527	0.623	0.278	0.455	3.288	0.001	Accepted
SCM -> SCQMP	0.603	2.643	0.623	0.364	0.455	7.134	0.000	Accepted
SCQMP -> SCQMC	0.783	1.000	0.611	0.613	0.255	26.958	0.000	Accepted
SCQMP -> KT	0.657	1.000	0.509	0.432	0.199	9.997	0.000	Accepted
SCQMC -> OP	0.41	1.984	0.344	0.168	0.280	7.281	0.000	Accepted

KT -> OP	-0.094	2.131	0.344	0.009	0.280	1.855	0.064	Rejected
STM -> SCQMP	-0.056	2.358	0.623	0.003	0.455	6.073	0.031	Accepted
STM -> OP	0.375	1.308	0.344	0.141	0.280	7.091	0	Accepted

Note : OP =Organitazional Performance ; QM = Quality Management ; SCM = Supply Chain Management ; SCQMC: Supply Chain Quality Management Capabilities ; SCQMP = Supply Chain Quality Management Practices ; STM= Support Top Management; KT= Knowledge Transfer

Based on Table 3, the path coefficient indicates that the supply chain quality management practices (SCQMP) variable and supply chain quality management capabilities (SCQMC) variable have a strong positive relationship with a path coefficient of 0.783. Subsequently, the variable quality management (QM) was influenced by supply chain management (SCM) with a value of 0.735; supply chain quality management practices (SCQMP) about knowledge transfer (KT) with a value of 0.657; supply chain management (SCM) about supply chain quality management practices (SCQMP) with a value of 0.603; supply chain quality management capabilities about organizational performance (OP) with a value of 0.41, support top management (STM) about organizational performance (OP) with a value of 0,375; and quality management (QM) about supply chain quality management practices (SCQMP) with a value of 0.285. There are two negative correlation variables, which are support top management (STM) with supply chain quality management practices (SCQMP) at -0.056 and knowledge transfer (KT) with organizational performance (OP)

The structural model will be assessed using a predetermined coefficient of determination (R2). According to Hair & Alamer, (2022), Substantial criteria were obtained when the R2 values were 0.75 (strong), 0.50 (short), and 0.25 (long). Table 4 displays the results, which show that the R2 value for the supply chain management variable is 0.541, or 54,1%; the supply chain quality management practices and capabilities are 62,3% and 61,1%; the transfer of knowledge is 50,9%; and the organizational performance is 34,4%. This indicates that the variable supply chain management may be explained by the variable quality management, which is 54.1%. However, supply chain management methods can be explained by the variables quality management, supply chain management, and support top management, which account for 62,3% of the variance. In addition, practices for supply chain quality management can explain the variable of supply chain quality management skills, which is 61.1%. Then, the supply chain quality management practices variable can explain knowledge transfer by 50.9%. The last variable, supply chain quality management capabilities, can explain organizational performance by 34.4% by supporting top management and transferring information. In this case, all of the R2 values had values that were less than 0.50, meaning that they were classified as negative values. Only one R2 value was classified as positive since it had a value of less than 0.50.

Another structural model evaluation method involves identifying the effect size or (f2) which shows the contributions of each exogenous variable to the endogenous variable. According to Leong et al., (2020b) The contribution is higher if the score f2¬¬ ≥ 0,35, normal if the score f¬2 ¬¬≥ 0,15, and low if the score f¬2 ¬¬≤ 0,02. The variables supply chain quality management capabilities (0,613) and top management support (0,432) significantly affect organizational performance. Therefore, the supply chain quality management technique significantly impacts knowledge transfer (0,364) and supply chain quality management competencies (0,543). The last testing of the inner model was conducted by examining the Q2 values using the blindfolding technique, which assesses predictive relevance. A hypothesized model will have good predictive power for endogenous constructs if the Q2 values exceed zero. Table 4 shows that all Q2 values are greater than 0, indicating the model has predictive relevance for the related endogenous variables.

Finally, when assessing the effect of the exogenous variable on the significant endogenous variable, the absolute t-statistics >1,96 and the p-value < 0.05 may be observed. Table 4 illustrates that eight hypotheses are accepted and satisfy the criteria, and one hypothesis is rejected because it does not satisfy the criteria.

Artificial Neural Network

The findings clearly show that organizational performance has been enhanced, and the understanding of supply chain quality management is strengthened by having defined capabilities and support from top management. However, non-linear linkages are beyond the scope of this approach. To verify the PLS-SEM results and identify the non-linear correlations, artificial intelligence analysis was used, as will be explained in the following discussion. PLS-SEM and ANN are used to demonstrate that the relationships between the constraints are not compensatory nor linear. Furthermore, according to Sternad (Sternad Zabukovšek, Kalinic, Bobek, & Tominc, 2019), ANNs can be helpful in research with little theory and a predictive setting and when comprehension of the underlying relationships between the variables being researched is not necessary. An enormously parallel distributed network made up of basic processing units with a neural tendency to store and make use of experimental information is facilitated by ANN techniques. Because of this, ANNs are frequently used as an extra analytical technique to confirm the conclusions of research conducted using other analytical techniques, including structural equation modelling (SEM) (Sternad Zabukovšek et al., 2019). In the most recent study, Sternad Zabukovšek et al., (2019) found that combining the ANN and SEM methods yields a more thorough analysis that helps to assess the relationships between each predictor more precisely. Moreover, by identifying both linear and nonlinear correlations between every variable, ANN yields extremely accurate results.

Given the contributions and acceptability of the ANN approach for evaluating our findings, we use ANN to measure the relationship between each predictor (i.e. SCQMC, KT, and STM) and the dependent variable (i.e. OP). SPSS was used to conduct ANN analysis. The model architecture uses the sigmoid function as the activation function in the hidden and output layers. In addition, to increase the effectiveness of training and obtain better model performance, all inputs and outputs are normalized to the range [0, 1]. The number of neurons in the input layer is equal to the number of predictor variables. In contrast, the number of neurons in the output layer is equal to the number of dependent variables, i.e., prediction variables, and both are determined by the problem structure. Furthermore, the model architecture in this study has three types of models: models with output variables of supply chain quality management capabilities (SCQMC), knowledge transfer (KT), and support top management (STM), with different input variables as shown in Figure 2.

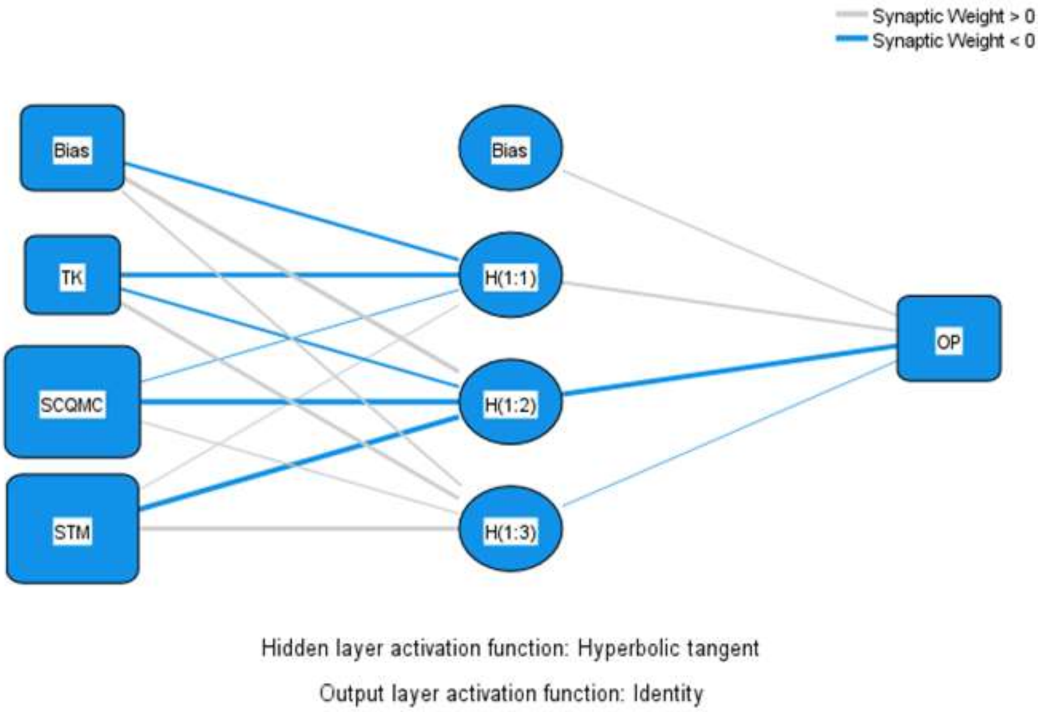

Figure 3. ANN Model Developed

All variables were re-analyzed using the ANN method because they qualified as significant variables in the SEM results. In this case, the input data for ANN is the latent score variable, the result of SEM analysis. The data normalization process is done automatically by selecting the rescaling method, which is normalized. The process result aims for normalized data to be in the range of 0 to 1. After normalizing the data, the data partition process is carried out. To prevent over-fitting, a ten-fold cross-validation procedure is performed, with 90 of the samples used for training and the remaining 10 used for testing.

According to Leong et al., (2015), ANN and PLS-SEM share similarities as both are adaptable and do not require meeting multivariate assumptions such as normality and linearity. The present study used a multilayer perceptron with a "feed-forward back-propagation" algorithm, using the significant predictors from PLS path analysis as input neurons. It was used because it is considered the most accepted and common model for this type of research. The output and the hidden layer were both activated using a sigmoid function. The RMSE values multiplied by ten are shown in Table 4.

Table 5
Artificial Neural Network values

Input: Supply chain quality management capabilities; knowledge transfer; support top management Output: Organizational performance					
Training			Testing		
N	**SSE**	**RMSE**	**N**	**SSE**	**RMSE**
142	36.300	0.5346	58	12.802	0.4915
142	34.136	0.5085	58	28.938	0.7765
141	36.731	0.5295	59	12.280	0.5006
141	36.905	0.5308	59	13.302	0.5210
144	37.975	0.5323	56	12.366	0.5185
139	39.024	0.5500	61	30.447	0.7727
125	35.112	0.5526	75	12.579	0.4399
132	36.104	0.5440	68	13.627	0.4847
138	34.608	0.5200	62	26.728	0.7169
144	36.846	0.5244	56	11.486	0.4997
Mean	**36.374**	**0.533**	***Mean***	**17.456**	**0.572**
Standard Deviation	**1.491**	**0.014**	***Standard Deviation***	**7.834**	**0.129**

In addition, the root mean square of error (RMSE) for each of the 10 neural networks in Table 5 is computed to assess the predictive accuracy of the ANN model. Given that a lower RMSE value denotes improved data fitness and increased prediction accuracy. The ANN model developed in this study shows higher prediction accuracy and reliable data fitness because the RMSE values for training (0.533) and testing (0.572) are relatively small.

The importance of each predictor measures how much the network model's predicted value changes for different predictor values. The normalized or relative importance value is calculated by dividing the importance value by the largest importance value, and the result is expressed in percentage. Table 6 shows the results of the sensitivity analysis calculation of the two models, namely models A and B.

Table 5
Sensitivity analysis

Neural Network (NN)	Model A (*output neuron: BI)*		
	KT	**SQCMC**	**STM**
NN (1)	0.377	1.000	0.945
NN (2)	0.384	0.918	1.000
NN (3)	0.373	1.000	0.981
NN (4)	0.460	0.922	1.000
NN (5)	0.360	0.970	1.000
NN (6)	0.309	0.978	1.000
NN (7)	0.340	0.869	1.000

NN (8)	0.356	1.000	0.893
NN (9)	0.464	0.998	1.000
NN (10)	0.402	0.807	1.000
Average Normal Importance	0.383	0.946	0.982
Normalized Importance	39%	96%	100%

Note : SCQMC: Supply Chain Quality Management Capabilities; STM= Support Top Management; KT= Knowledge Transfer

The normalized relevance value was used to rank the relative significance of each predictor variable derived from the sensitivity analysis displayed in Table 6. According to the results of the sensitivity analysis, STM has the highest normalized relative relevance (100%) impact on OP, followed by SCQMC (96%), and KT (39%).

This study aims to experimentally investigate whether extra STM and SCQM practices (QM, SCM, SCQMP, SCQMC, KT) impact OP achievement. Our results advance knowledge transmission based on capabilities theory and dynamic practice, even though only partial support was found for the correlations between the selected predictors and dependent variables. The knowledge-based view holds that organizations are information-bearing entities and that a company's primary function is to integrate and apply knowledge. Dynamic capability and practices, on the other hand, pertain to the capacity to build, create, and integrate information resources to perceive, identify, and address environmental difficulties. The fundamental mechanism of knowledge-based dynamic capabilities is made up of internal and external knowledge-related activities rooted in partnerships and networks, and our results indicate that SCQMC and STM relate to OP positively and significantly (i.e. normalized relative importance exceeding 50%), where as KT was surprisingly found to have no significant relationship to organizational performance.

Table 6
Comparison between PLS-SEM and ANN findings

Variable	**PLS SEM**				**ANN**		**Matched or Not**
	Total Effect	**Performance**	**Findings**	**Ranking (PLS-SEM) based on Path Coefficient**	**Ranking (ANN) [based on Normalized relative Importance (%)**	**ANN results: Normalized relative importance (%)**	
SCQMC	0,406	57,635	Significant	1	2	96%	Not
STM	0.360	53,176	Significant	2	1	100%	Not

KT	-0.089	47,121	Not Significant	3	3	39%	Matched

The significance of the predictors based on PLS-SEM and ANN is displayed in Table 7. Each variable's Path Coefficient and Normalized Relative Importance statistics affect its ranking in both PLS-SEM and ANN. The fascinating results originate from SQCMC's first-place rating in PLS-SEM influence rankings; conversely, it ranks second in ANN rankings. On the other hand, STM is ranked first in ANN and second in PLS-SEM in terms of influence. Still, KT comes in third in both categories. This discrepancy could be explained by ANN's unique ability to capture both linear and non-linear relationships. The data unequivocally shows that when the non-linear relationship with OP is considered, the significance of STM increases. Using only PLS-SEM would have obscured this crucial insight. The combined use of PLS-SEM and ANN techniques in our study offers a comprehensive perspective, enhancing the robustness and validity of our findings. Many studies have employed either technique in isolation, but our integrated approach provides a richer, more nuanced understanding of the relationships among the variables.

Theoretical Implications

The most crucial SCQM practice for improving an OP, practically speaking, was determined to be SCQMC. Therefore, to achieve customer satisfaction and OP, manufacturing firms should focus on sustaining tight cooperation and partnerships with their consumers. A company can accomplish quality objectives and advance desired sustainability results by working cooperatively with its consumers. Furthermore, our results demonstrate that STM is crucial to manufacturing firms' ability to maintain performance. To achieve the highest quality outcomes and the desired OP, Senior management support and initiatives to foster a work environment open to continuous improvement are therefore crucial. This study demonstrates that superior management's ability to influence people and manage resources in manufacturing companies has aided in achieving OP and improved quality of life.

The primary conclusion of the present study, concerning the relationships, is that KT has no discernible influence on the linkages between SCQMP and organizational performance. This outcome does not align with the findings. This demonstrates how successfully implementing the SCQM agenda may enhance businesses' knowledge transfer (KT) procedures, which has a major impact on business performance. Additionally, techniques for exchanging expertise with distributors offer a chance to obtain a competitive edge. Top management should set the stage for the formation and exchange of knowledge inside the supply chain by providing the required tools, operating systems, frameworks, and protocols. The OP of the bigger organization can be a source of knowledge transfer.

Manufacturers are thought to resist achieving OP since integrating the whole supply chain takes a significant amount of time and money. Consequently, it has been discovered that SCQM methods like QM, SCM, SCQMP, and SCQMC significantly affect manufacturers in developing nations like Indonesia. By combining specific SCQM methods with an emphasis on organization, Indonesian manufacturing companies may be able to improve their OP using the study's findings. Manufacturers can then choose which area to focus on to find effective and successful solutions to issues brought about by careless employees who frequently neglect SCQM standard practices.

Managerial Implications

Our study model has the potential to be a useful tool for future studies on sustainability. Additionally, the study model expands on recent SCM and QM literature. Foo et al., (2018) and Soares et al., (2017) examined each of the chosen SCQM practices separately on the three OP aspects. As a result, manufacturing companies can prioritize SCQM procedures that capitalize on their sustainable outcomes. Furthermore, the study's theoretical framework for SCQM procedures invites researchers to use and build upon these data in further research. As a modern sustainability approach that entails embracing a new management strategy to tackle dynamic organizational issues by incorporating the TBL into organizational management practices, the theoretical contribution of SCQM is linked to the philosophy of QM and SCM. Moreover, Indonesian OP responsiveness is still developing. Manufacturing companies appear to be exempt from significant environmental regulations, which have produced enormous amounts of waste, the depletion of natural resources, and the excessive use of energy. Environmental laws about the manufacturing sector must be implemented and strictly enforced to solve issues with waste and pollution. Thus, by employing an empirical methodology, this study contributes to sustainability research by highlighting the benefits of applying SCQM techniques to achieve sustainability goals, particularly in OP research. Furthermore, this study establishes the groundwork for future empirical investigations into the feasibility of applying the suggested research paradigm, in whole or in part, to another nation. Finding out how the research model functions in international commercial enterprises will be fascinating. The goal of this study is to overcome businesses' ignorance of open-poly and persuade them of the benefits of open-poly in terms of long-term success. Consequently, businesses can acquire positive approaches and modify their immediate negative.

Conclusion

In conclusion, this study looks at the range of SCQM procedures that manufacturing companies considering SP might implement. Many sustainable result studies have considered both SCM and QM practices; however, the current literature does not present the convergence of these two techniques into a set of SCQM practices, as this study does. Moreover, this study can aid in the successful application of SCQM practices since it integrates behavioural or soft (i.e., SCQMC, STM, and TK) and technical or hard (i.e., SCQMC) views of SCQM practices. According to (Kumar et al., 2023), firms in emerging economies must adopt behavioural or soft practices of SCQM to achieve OP. This is because soft practices can foster an environment in which hard SCQM practices can be further developed by the firms. In response to all hypotheses, the study's findings highlight the significance of the behavioural components of OP that are SCQMC, particularly for STM, which has the biggest influence on SCQMC and KT, come in second and third, respectively, according to our ANN sensitivity analysis. ANN shows that STM has the greatest impact on OP among the significant predictors identified, whereas KT has the least.

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