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The Effect of Knowledge Management Orientation on the Performance of Container Shipping Firms: Supply Chain Integration as the Mediator

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Abstract

Design/methodology/approach - This research employed a quantitative survey method for data collection purpose. Questionnaire responses were collected from 17 container shipping companies and 154 container shipping agencies. Analysis included demographics, validity and reliability tests, and hypotheses testing. The Partial Least Squares Structural Equation Modelling (PLS-SEM) analysis was applied. **Purpose** – The purpose is to determine if the debatable supply chain integration (SCI) could mediate knowledge management orientation (KMO) and firm performance in container shipping. This fills the gap to bridge KMO and firms' performance. In addition, it is to confirm the following relationships – KMO-Firm Performance, KMO-SCI, and SCI-Firm Performance. **Findings** - SCI has a mediation effect between KMO and firm performance. The findings confirmed KMO is positively related to SCI and firm performance, while SCI is positively related to firm performance. **Originality/value** – The results show firms could invest in SCI strategies to mediate firms' KMO and firm performance in an otherwise debatable SCI. The originality lies in the rare SCI mediator investigation in container shipping research

Keywords: Supply Chain Integration, Container Shipping, Performance, Knowledge Management, Competitive

Introduction

Maritime transportation remains the backbone of global trade, surpassing other logistics modes such as road, rail, and air in volume and strategic importance. In 2025, over 80% of global merchandise trade was transported via maritime routes (UNCTAD, 2025). According to UNCTAD (2024), global maritime trade volumes reached 12.292 billion metric tons in 2023, reflecting a 2.4% growth following a decline experienced in 2022 (UNCTAD, 2024).

Against this backdrop, enhancing the operational resilience and performance of firms within the shipping sector has become increasingly urgent, particularly in the face of post-pandemic disruptions and structural overcapacity. Within this context, the paradoxical role of supply chain integration (SCI)—capable of offering competitive advantage or, conversely, exposing

firms to risks (Mackelprang et al., 2014; Swink et al., 2007)—warrants further investigation. Although prior research has examined the linkage between knowledge management orientation (KMO) and SCI (Sangari et al., 2015; Simatupang et al., 2002; Zhang et al., 2015), and separately the relationship between SCI and firm performance (Lii & Kuo, 2016; Sinnandavar et al., 2018; Wong et al., 2015, 2021; Wiengarten et al., 2016), limited attention has been given to the mediating role of SCI in translating knowledge assets into tangible performance outcomes. This study seeks to address this research gap, with a particular focus on container shipping firms.

Like most industries, the supply chain is no stranger to the shipping industry. The chain involves the bilateral flow of information, materials and finance (Chen et al., 2014) to integrate the supply chain actors. Efficiency and accuracy in this flow is necessary to meet end customers' requirements (Fawcett et al., 2007). The SCI is important as it includes the sharing of information between a focal firm and its suppliers and customers. In this study, the customers of the focal shipping firm are the exporters and importers. The suppliers are the ship liners who provide the containers and ships. It is mindful to note that this description deceptively simplifies the actual more complex processes of the supply chain network because several other actors or stakeholders play their roles along the supply chain nodes. These involve the customs, hauliers, port authorities and the focal firm's inter-departmental integration (Wong et al., 2018). In this complexity, the strength of a supply chain is as strong as its weakest link (The World Bank, 2014).

This complex shipping supply chain is further affected by the fluidity of liner demand and shipping capacity, routing and scheduling among other factors (Meng et al., 2014). This is more complex than scheduling passenger airlines because shipping involves different types of capacity requirements and availability such as reefers and non-reefers. Complicating this matter is the capacity uptake at each port of call along the freight route because there are multiple container destinations and ports of call for additional container loadings with various cut-off booking time (Meng et al., 2014). Hence, information sharing is vital to the competitiveness and consequently revenue management of focal shipping firms (Meng et al., 2014) and they remain a challenge.

Although the container shipping sector saw improved market conditions during the first half of 2024, it continued to face several challenges. These included freight rate volatility, persistent concerns over the overcapacity (UNCTAD, 2024). Historically, this imbalance is not unprecedented. For many years, the expansion of global fleet capacity has consistently outpaced the growth of maritime trade volumes. Between 2010 and 2023, world fleet capacity expanded by 78.5%, whereas overall trade demand rose by only 34%. Specifically, in the container shipping segment, fleet capacity nearly doubled, while containerized trade grew by 49% over the same period (UNCTAD, 2024).

Following the 2008 global financial crisis, the larger container shipping firms collaborated to manage overcapacity of market supply (Huang, 2017). Further, with the global economic downturn in recent years, the idle capacity has forced major firms to implement aggressive strategies for survival (Huang, 2017). One such strategy is the consolidation of shipping firms. The fewer shipping firms would reduce redundant vessel orders because of reduced competitors. With industry consolidation, it is believed to have decreased the cost of moving

containers and introduced better empty container management. Therefore, firms which do not actively participate in consolidation or operational collaboration could be marginalised or acquired by other carriers because of poor firm performance and unsustainability (AlixPartners, 2017).

Another consolidation catalyst of container shipping firms is the One Belt, One Road (OBOR) which also has a bearing on development strategy in maritime industry. The OBOR initiative aims to foster connectivity through better infrastructures such as ports, depots, customs bays, and IT infrastructures of maritime, development of resources, co-operation among industries, and financial integration across the OBOR countries (Wong, 2015). These strategic alliances require collaborative SCI (Chen et al., 2022) to facilitate shipping operations and related industries like ports and terminals (Tan, 2015). These strategic measures have managed to sustain the shipping industry.

Apart from strategic development, expectations from shippers are increasing (PwC, 2016). Shippers face rising demand on customer service and support requirements while striving for cost reduction and supply chain flexibility (PwC, 2013). In response to these growing expectations, SCI has become essential, involving close coordination among internal functions, suppliers, and customers to meet shared goals. Such integration depends on strategic collaboration, which strengthens cross-functional communication and supports joint efforts across the supply chain network (Ashtiani & Bosak, 2013).Consequently, the logistics providers are compelled to provide an integrated service with efficient delivery and seamless customer service (DHL, 2016). With the convergence of both online and offline businesses, the ‘anytime, anywhere delivery models’ will be essential to meet the demands of the customer (DHL, 2016).

This study holds both theoretical and practical significance. From an academic standpoint, it addresses a clear research gap by investigating the mediating role of SCI between KMO and firm performance—an area previously underexplored, especially in the maritime sector. Practically, the study provides actionable insights for managers of container shipping firms facing mounting operational complexities, customer service expectations, and global supply chain uncertainties. By demonstrating how knowledge assets can be leveraged through SCI to achieve performance outcomes, the study contributes to strategic decision-making, supply chain agility, and organizational competitiveness. Furthermore, port authorities and policymakers may benefit by understanding the value of SCI in enhancing maritime industry resilience and service integration.

Pursuant to debatable role of SCI and against the background challenges to the shipping industry, the main objective of this study is to examine the relationships of KMO-SCI-Firm Performance in the container shipping firm context. SCI operates as the focal firm (internal integration), suppliers and customers and is introduced into the framework as a mediator to mediate the benefits from KMO to achieve firm performance. It specifically attempted to answer the following research questions by means of hypothesis tests.

a) Does KMO influence SCI?
b) Does KMO influence firm performance?
c) Does SCI influence firm performance?

d) Does SCI mediate the relationship between KMO and firm performance in container shipping lines?

Both KMO and SCI are studied through the empirical survey to explore managerial implications. This empirical study was aimed at answering questions related to the container shipping industry and investigated the theoretical relationship through hypothesis testing. The research findings provide theoretical contributions and practical implications. This paper is segregated into five sections. The second section contains literature review for a problem statement. The third section contains research methodology. The fourth section describes the research findings. The last section contains conclusions and implications.

Supporting Theories

The main theory in this study is the Knowledge-based Theory derived from RBV. While the RBV has a firm focusing on internal resources as its competitive competencies (Barney, 1991; Peteraf, 1993), the Knowledge-based Theory (Kogut & Zander, 1992) supports the KMO consisting of organisational memory, knowledge sharing, knowledge absorption and knowledge receptivity directed at the firm's SCI activities. It is useful to note that the KMO nestled in the Knowledge-based Theory refers to a firm's relative propensity to reshape its attained wisdom and its disposition to share internally and externally, and assimilate this new wisdom (Anand et al., 1998; Feldman & March, 1981; Levitt & March, 1988; Schulz, 2001; Simonin, 1999; Szulanski, 1996). The sharing and assimilation of KMO is assisted by the SCI mediator for firm performance in the theoretical framework. Notably, the focal firm depends on its supply chain partners to process and integrate important resources to mitigate the uncertain and dynamic environment since focal firms do not possess all required resources (Pfeffer & Salancik, 1978). Hence, firms are expected to seek resources externally via SCI. This is supported by the studies of Panayides and Song (2008), Silvestr and Lustrato (2014) and Tseng and Liao (2015) which indicate both internal and external resource integration have positive impact towards the firm performance.

Development of Research Hypotheses

The relationship between KMO and SCI is supported by Sangari et al (2015), Simatupang et al. (2002) and Zhang et al. (2015) who emphasise the role of knowledge management in integration among supply chain partners. The KMO embraces all the four dimensions suggested by Wang et al. (2009) and Lin (2015). In the manufacturing industry, a lack of knowledge management leads to the absence of realisation of potential benefits of external and internal integration (Ayoub et al., 2017). We extend this KMO-supply chain relationship to the service industry of container shipping. The dimensions of KMO encourage the supply chain partners' integration. As such, the following hypothesis is proposed:

H1. KMO is positively related to SCI.

The Knowledge-based Theory of the firm hypothesises the relationship between knowledge management and performance (Grant, 1996). This knowledge management and performance relationship is unlikely a direct relationship because knowledge must first be exploited to recognise its value (Wang et al., 2009). Therefore, the hypothesis below is proposed to identify whether KMO has a direct relationship towards firm performance in container shipping industry.

H2. KMO is positively related to firm performance.

Integration among the supply chain partners could maintain the reliability of the service and enhance the firm performance of the container shipping industry (Esper and Williams, 2013; Panayides and Song, 2008; Tseng and Liao, 2015). The relationship is also supported by recent studies of Lii and Kuo (2016), Wong et al. (2015) and Wiengarten et al. (2016) where SCI has positive effects on both financial and non-financial performance in other fields such as manufacturing and wholesale trading companies. Therefore, the following hypothesis is proposed:
H3. SCI is positively related to firm performance.

In this study, the view of SCI as the missing link between KMO and firm performance was noted earlier. Traditional view suggests that competitive advantage is a complete function of internal capabilities (Barney, 1991). There are market views on firms' competitiveness as well such as by Porter (Porter, 1988). Studies by Das and Teng (2000) and McEvily and Zaheer (1999) highlight that both internal and external capabilities are important to firm performance. SCI, therefore, represents the alignment and coordination of a firm's relationships, functions, and processes with external partners—such as suppliers and customers—to form a cohesive and collaborative network (Asnordin et al., 2021).Thus, to improve the container shipping firms, the study of KMO alone without the involvement of external partnership is insufficient. A mechanism is required to exploit the KMO. Hence, the role of mediation is introduced in the study of the effect of KMO towards container shipping firm performance. With the introduction of the mediating mechanism suggested earlier, hypothesis 4 is proposed as follows:
H4. SCI mediates the relationship between the KMO and firm performance in container shipping firms.

Research Design and Sample Selection
The research work attempts to explore the relationship between KMO (independent variable) and container shipping firm performance (dependent variable) in Malaysia through SCI (mediating variable). The study is a cross-sectional study where the data was collected once over a three-month period using the questionnaire. The questionnaire instrument consists of five sections: Section A contains respondents' demographic profile, Section B measures KMO, Section C evaluates SCI, Section D surveys container shipping companies and agencies performance. A cover letter regarding the objective and purpose of the survey was attached on the first page. This was to assure the confidentiality of the data collected. There are four demographic items in this section. The demographic items comprise business type, designation, number of employees, average annual revenue and years working in the company.

KMO consists of 30 items that address its four dimensions, namely organisational memory, knowledge sharing, knowledge absorption and knowledge receptivity. Wang *et al*. (2009) construct KMO as the firm's resources to build on its achieved wisdom (organisational memory) and the inclination to share (knowledge sharing), assimilate (knowledge absorption), and be receptive to new wisdom (knowledge receptivity). The 7-point Likert-type scale ranging from 1 represents "strong disagree" to 7 "strongly agree" was applied to measure KMO items. This study measures SCI with nine items reflecting both internal and external integration which include customer integration, supplier integration and internal integration. The nine items were adapted from Tseng and Liao (2015). There are three items

measuring customer integration, three supplier integration and three internal integration. The 7-point Likert-type scale ranging from 1 representing “strongly disagree” to 7 “strongly agree” was applied to measure SCI items. Firm performance was measured by three dimensions with a total of 12 items.

The three dimensions of firm performance consist of market performance, financial performance and customer service. There are four items for measuring market performance, three for financial performance and five for customer service. All questions were adapted from Tseng and Liao (2015). Similar to the KMO and SCI, the 7-point Likert-type scale ranging from 1 representing “strong disagree” to 7 “strongly agree” was applied to measure firm performance.

To increase the generalization of the findings and increase their usability, the census technique was applied because the sampling frame was small aggravating the possibility of low response rate from management executives (Haberman & Yao, 2015). Therefore, the study targeted all 202 companies The respondents of the survey were management executives inclusive of vice president, director and manager in each firm. Postal and email surveys were the two methods deployed in the data collection process. Twenty-two sets of survey questionnaire were mailed to container shipping companies with postage-paid return envelope. A cover letter which explained the purpose of the survey and assured confidentiality was attached to the questionnaires. One hundred and eighty shipping agents were invited to the online survey via email.

Table I shows the company and respondent profiles who responded to the questionnaires. These respondents were employed by the 17 container shipping companies and 154 container shipping agencies. Of the 202 targeted companies, 84.65 percent participated in the survey. Most of the respondents held managerial positions. A total of 96.5 percent of respondents were mainly sales or operations managers, and 3.5 percent of respondents held other positions which included branch managers, finance managers, managing directors and operations supervisors. Of the companies surveyed, 30.4 percent had 6 - 50 employees and 5.9 percent had 201- 250 employees. Age wise, 55 percent of the companies were 15 years and above. In the last 3 years, 18.1 percent of the companies achieved less than RM1 million average annual revenue. Most respondents had worked 5 to 10 years in 42.69 percent of the companies while those had worked more than 15 years worked in 12.28 percent of the companies. There were no missing values in the data collected.

Table I
Attributes of container shipping company and shipping agent

Attributes	Categories	Frequency	Percent (%)
Business Type	Container Shipping Company	17	9.94
	Shipping Agent	154	90.06
Respondent Position	Sales Manager or Operations Manager	165	96.50
	Others	6	3.50
Number of Employee	less than 5 or 5 people	13	7.60
	6-50 people	52	30.40
	51-100 people	40	23.40
	101- 150 people	11	6.40
	151- 200 people	18	10.50
	201- 250 people	10	5.90
	251 - 300 people	4	2.30
	more than 300 people	23	13.50
Age of Company	less than 5 years	5	2.90
	5 to 10 years	48	28.10
	11 to 15 years	24	14.00
	15 years and above	94	55.00
Average annual revenue (RM) in last 3 years	less than RM1 million	31	18.10
	RM1 million up to RM10 million	22	12.90
	RM10 million up to RM20 million	11	6.40
	RM20 million up to RM40 million	24	14.00
	RM40 million up to RM60 million	16	9.40
	RM60 million up to RM80 million	20	11.70
	RM80 million up to RM100 million	19	11.10
	RM100 million and above	28	16.40
Years been working with your current company for	less than 5 years	50	29.24
	5 to 10 years	73	42.69
	11 to 15 years	27	15.79
	above 15 years	21	12.28

Results

This section discusses assessments of the reflective measurement model for convergent validity and discriminant validity. These assessments were carried out to examine how well the indicators load into the theoretically defined constructs. The exogenous construct is KMO while the endogenous constructs are SCI and firm performance.

Convergent validity is established by assessing the factor loading, composite reliability (CR) and average variance extracted (AVE). In this study, all indicators with a loading value below 0.5 were removed. This complies with Byrne (2016) who suggests items with factor loading values higher than 0.5 are retained as they could contribute to the AVE. After the removal of below 0.5 loading coefficients, Table II shows the loading values of indicators in this study ranging from 0.547 to 0.874 and are considered as strong factor loading coefficients (Hair *et*

al., 2019). Meanwhile, the composite reliability values are higher than the threshold level of reliability at 0.7 (Hair *et al*., 2019) and they are 0.955, 0.951 and 0.928 (see Table III). The AVE values for KMO, SCI and firm performance are 0.507, 0.707 and 0.518 respectively which exceeded the 0.5 benchmark set by Hair *et al*. (2019). These confirmed that the constructs meet reliability and convergent validity. The discriminant validity is assessed by cross loadings and Heterotrait-Monotrait (HTMT).

Table II
Results of measurement model

Construct	Items	Loadings	AVE	CR
KMO	OM1	0.718	0.507	0.955
	OM2	0.610		
	OM3	0.747		
	OM4	0.691		
	OM5	0.777		
	OM6	0.768		
	OM8	0.680		
	KA2	0.757		
	KA3	0.622		
	KA4	0.631		
	KR1	0.746		
	KR3	0.547		
	KR5	0.585		
	KS1	0.797		
	KS2	0.815		
	KS3	0.770		
	KS4	0.711		
	KS5	0.758		
	KS6	0.722		
	KS7	0.750		
	KS8	0.682		
Supply Chain Integration	SI1	0.805	0.707	0.951
	SI2	0.851		
	SI3	0.829		
	II1	0.868		
	II2	0.798		
	II3	0.841		
	CI1	0.874		
	CI3	0.860		
Firm Performance	MP1	0.724	0.518	0.928
	MP2	0.762		
	MP3	0.726		
	FP1	0.749		
	FP2	0.670		
	FP3	0.675		
	CS1	0.782		
	CS2	0.669		
	CS3	0.741		
	CS4	0.748		
	CS5	0.650		
	CS6	0.726		

Note: OM: Organisational Memory; KA: Knowledge Absorption; KR: Knowledge Receptivity; KS: Knowledge Sharing; SI: Supplier Integration; II: Internal Integration; CI: Customer Integration; MP: Market Performance; FP: Financial Performance; CS: Customer Service

Table III
Results of cross loadings

	KMO	Supply Chain Integration	Firm Performance
OM1	**0.718**	0.679	0.471
OM2	**0.610**	0.576	0.509
OM3	**0.747**	0.670	0.513
OM4	**0.691**	0.535	0.449
OM5	**0.777**	0.629	0.567
OM6	**0.768**	0.658	0.456
OM8	**0.680**	0.604	0.406
KA2	**0.757**	0.674	0.463
KA3	**0.622**	0.466	0.387
KA4	**0.631**	0.525	0.507
KR1	**0.746**	0.622	0.524
KR3	**0.547**	0.387	0.476
KR5	**0.585**	0.460	0.409
KS1	**0.797**	0.703	0.435
KS2	**0.815**	0.782	0.529
KS3	**0.770**	0.656	0.578
KS4	**0.711**	0.590	0.562
KS5	**0.758**	0.676	0.496
KS6	**0.722**	0.580	0.384
KS7	**0.750**	0.673	0.445
KS8	**0.682**	0.502	0.347
SI1	0.741	**0.805**	0.530
SI2	0.707	**0.851**	0.577
SI3	0.704	**0.829**	0.610
II1	0.720	**0.868**	0.531
II2	0.686	**0.798**	0.453
II3	0.730	**0.841**	0.444
CI1	0.753	**0.874**	0.583
CI3	0.717	**0.860**	0.548
MP1	0.482	0.393	**0.724**
MP2	0.520	0.437	**0.762**
MP3	0.463	0.411	**0.726**
FP1	0.535	0.566	**0.749**
FP2	0.337	0.273	**0.670**
FP3	0.305	0.293	**0.675**
CS1	0.635	0.649	**0.782**
CS2	0.560	0.542	**0.669**
CS3	0.481	0.488	**0.741**
CS4	0.455	0.439	**0.748**
CS5	0.298	0.313	**0.650**
CS6	0.471	0.471	**0.726**

Note: Bolded values are the indicators on its designated construct

The cross loading results presented in Table III compare the cross loadings between constructs. The output shows that the indicators loaded higher on the respective constructs than on other constructs in the model. For example, OM1 has the highest cross loading for KMO (0.718) compared to SCI (0.679) and firm performance (0.471). The discriminant validity is confirmed as the constructs are clearly distinct from each other (Chin, 1998).

The Heterotrait-Monotrait (HTMT) ratio of correlations was examined to further confirm discriminant validity. The results of HTMT are shown in Table IV. The values of the HTMT in this study are 0.685 (KMO versus firm performance), 0.654 (SCI versus firm performance) and 0.898 (KMO versus supply chain) which is lower than the threshold value 0.90 (Gold *et al*., 2001). They establish discriminant validity. Meanwhile, HTMT ratio of correlation using bootstrapping technique was assessed and the results show the confidence intervals do not include a value of 1 (see Table IV) which reinforce discriminant validity.

Table IV
Results of Heterotrait-Monotrait Ratio

	Firm Performance	SCI
KMO	**0.685** CI.97.25 (0.521,0.819)	**0.898** CI.97.25 (0.795,0.948)
SCI	**0.654** CI.97.25 (0.455,0.805)	

Note: Bolded values are the HTMT of correlation

Upon the confirmation that the constructs are valid and reliable, the next step in Partial Least Squares analysis is to formulate a structural model to test the relationships among KMO, SCI and firm performance. The path coefficient (β) in the Partial Least Squares is used to indicate the strength of all path estimates or relationships between the constructs. The coefficient of determination (R^2) represents how much variance of endogenous variable is explained by exogenous variable. The predictive relevance, Q^2, shows the model has predictive relevance for a certain endogenous construct and the relative impact of predictive relevance can be compared by means of the measure to the q^2 effect size. The level of effect size (f^2) is the relative impact of a predictor construct on the endogenous construct. The effect size (f^2) reveals how strongly the exogenous construct explains the endogenous construct by the R^2 (Ramayah *et al*., 2018).

The results of the R^2 output are shown in Table V. Following the benchmark of R^2 values suggested by Chin (1998), SCI (R^2= 0.733) has a substantial predictive accuracy. Meanwhile firm performance (R^2 =0.462) has a moderate predictive accuracy in this study. Cohen (2013) suggests that values of f^2 of 0.35, 0.15, 0.02 are considered large, medium and small effects respectively. The results in Table VI show that both KMO (f^2 =0.101) and SCI (f^2 =0.032) have small effects on the endogenous construct.

Table V
Result of Coefficient of Determination (R^2)

Endogenous variable	R^2
SCI	0.733
Firm Performance	0.462

Table VI
Result of Effect Size (f^2)

Exogenous variable	f^2
KMO	0.101
SCI	0.032

The predictive relevance (Q^2) is assessed with blindfolding procedure which is the resampling technique used to investigate predictive relevance of exogenous construct on the endogenous construct (Fornell and Cha, 1994). A positive value greater than 0 specifies that the exogenous construct has predictive relevance on the endogenous construct (Hair *et al*., 2016). The predictive relevance of SCI has a value of 0.500 and firm performance 0.222 indicating that the model has predictive relevance because the values are above zero. The results are shown in Table VII.

Table VII
Result of Predictive Relevance (Q^2)

Construct	SSO	SSE	Q^2 (=1-SSE/SSO)
KMO	3591	3591.000	
SCI	1368	684.417	0.500
Firm Performance	2052	1596.406	0.222

Table VIII shows the path coefficients, standard errors, *t*-values for the relationships among KMO, SCI and firm performance after 5000 bootstraps. Path coefficient value closer to +1 represents strong positive relationship and path coefficient value closer to -1 represents strong negative relationship (Hair *et al*., 2019). Hair *et al*. (2019) suggest that the path coefficients are required at least at 0.05 level of significance. From Table VIII, hypothesis 1 and hypothesis 2 met the 0.01 level of significance meanwhile hypothesis 3 met the 0.05 level of significance. KMO (β =0.856, *p*-value<0.01) is significantly and strongly positive to SCI. KMO (β =0.451, *p*-value<0.01) is significantly and moderately positive related to firm performance. Meanwhile, SCI (β =0.252, *p*-value<0.05) is significant but relatively weak as it relates to firm performance. Therefore, hypothesis 1, hypothesis 2 and hypothesis 3 are supported as presented in Figure I.

Table VIII
Results of path coefficient for hypothesis 1, hypothesis 2 and hypothesis 3

Hypothesis	Relationship	Std Beta (βi)	Std. Error	*t*-value	Decision
H1	KMO → SCI	0.856	0.046	18.550**	Supported
H2	KMO →Firm Performance	0.451	0.108	4.172**	Supported
H3	SCI → Firm Performance	0.252	0.125	2.013*	Supported

Note: **p<0.01 (t>2.33)，*p<0.05 (t>1.645)

Hypothesis 4 focus on examining the mediating effect of SCI as a mediator in the relationship between KMO and firm performance. The results presented in Table IX shows that SCI mediates the relationship between KMO and firm performance. Based on the results in Table IX, mediation is significant at *t*-value >1.96 and *p*-value <0.05. The number of bootstrap samples was 5000 and a path coefficient with 5% or less probability of error would be considered significant (Hair *et al*., 2016). The bootstrapping analysis are presented in Table X,

the indirect effect β=0.216 is significant with t-value of 1.998. The indirect effect 95% confidence interval bias corrected has a lower limit of 0.011 and upper limit 0.414 and no zero values straddle between them demonstrating there is mediation (Preacher and Hayes, 2004). Thus, the mediation effect is statistically significant.

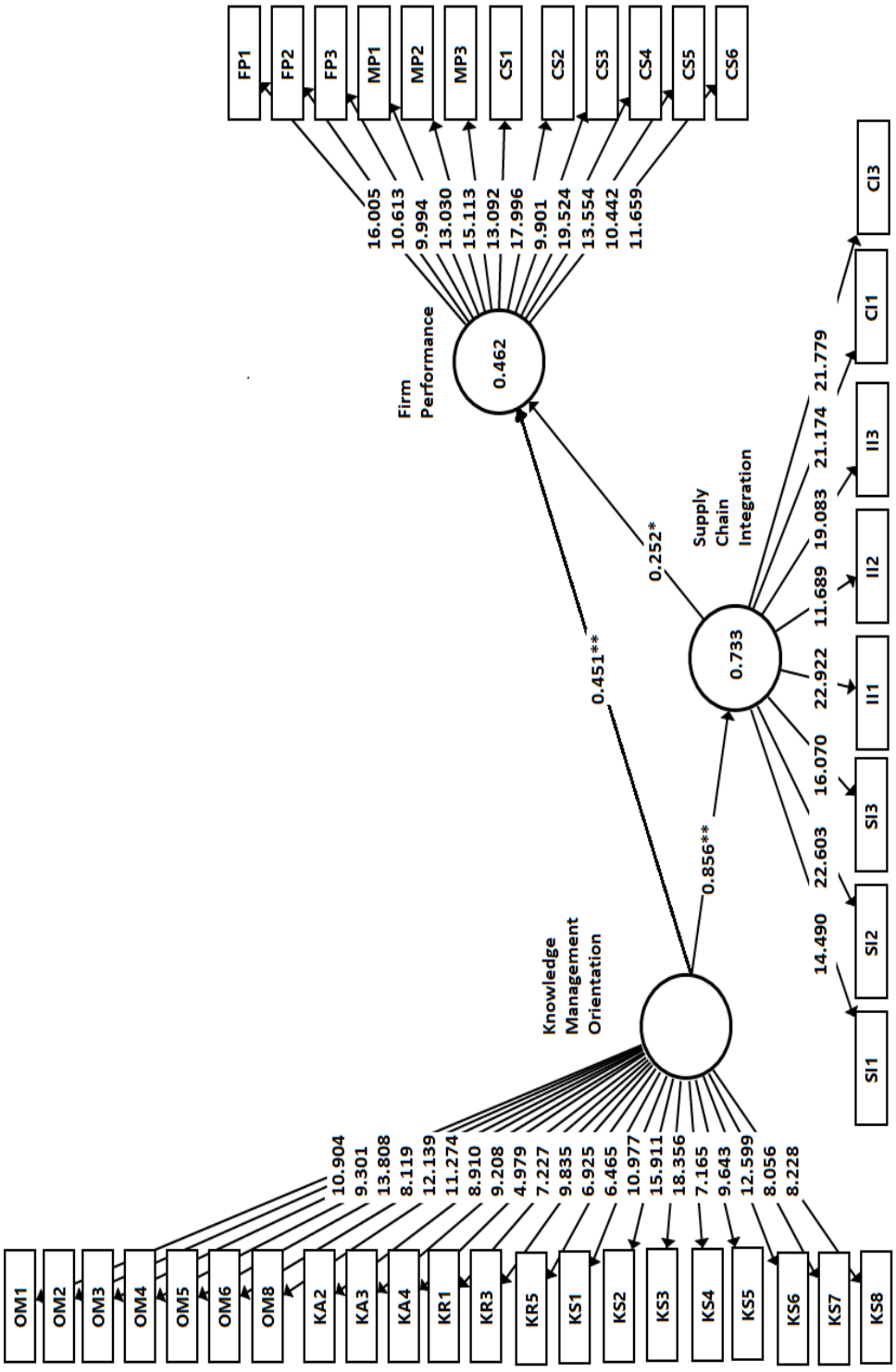

Figure I Structural model framework
Note: **p<0.01 (t>2.33)，*p<0.05 (t>1.645)

Table IX
Result of hypothesis testing on mediation

	Original Sample	Sample Mean	Standard Deviation	*t*-value	*p*-value
KMO → SCI → Firm Performance	0.216	0.215	0.108	1.998*	0.046

Note: *p<0.05 (t>1.96)

Table X
Results of hypothesis testing on mediation after bootstrapping

Relationship	Std. Beta	Std. Error	*t*-value	Confidence Interval (Bias Corrected) LL	UL	Decision
KMO → SCI → Firm Performance	0.216	0.108	1.998*	0.011	0.414	Supported

Note: *p<0.05 (t>1.96)

Discussion

The results answered the four research questions and supported the hypotheses. This research confirmed KMO could influence SCI; KMO and SCI could independently and directly influence firm performance; and SCI could mediate KMO and firm performance which is the primary aim of this research. The KMO is a bundle of organisational memory, knowledge sharing, knowledge absorption and knowledge receptivity, SCI is supplier integration, internal integration and customer integration, and firm performance is market performance, financial performance and customer service. Remarkably, all sub-dimensions are represented in the final structural model.

Theoretically, this study introduced SCI as a mediator to examine the relationship between KMO and firm performance based on the Knowledge-based Theory. These theory established the structural model to examine the influence of KMO on firm performance with SCI as the mediator.

This study contributes to the existing literature in terms of new findings particularly the theoretical justification SCI as a mediator and simultaneously filling the theoretical link in KMO-firm performance. This gap was pointed out by Wang *et al*. (2009) and this study now has expanded theoretical knowledge. The findings also suggest the possible reasons some firms could outperform the others with KMO in the knowledge management literature (Lii & Kuo, 2016; Lin, 2015; Wang et al., 2009). Further theoretical contribution is extending the influence of KMO on SCI to container shipping firms which previously was limited to IT applications (Tseng and Liao, 2015).

The theoretical firm performance in this research is represented by the three dimensions namely market performance, financial performance and customer service. These three dimensions are distinctly different from the current KMO studies in the maritime field which are service, operations, logistics, efficiency and effectiveness (Woo *et al*., 2011; Woo and Pettit, 2010). Therefore, the research has also validated these “new” dimensions in maritime literature. In summary, the relationships among KMO, SCI and firm performance were

formulated and examined as supply chain management research anchored in knowledge management theory. The overall results have expanded the theoretical implication of KMO and firm performance dimensions to maritime supply chain management.

The managerial implications of this research are functional. First, management could instill and perpetuate KMO such that the four dimensions of organisational memory, knowledge sharing, knowledge absorption and knowledge receptivity are collectively absorbed and practised in an integrated fashion for the firm to retain its knowledge even when employees leave the firm. The orientation will help etch knowledge of the firm into its memory as they are shared and absorbed.

With the uncompromised and valuable knowledge, the firm could effectively integrate its supplier, internal processes and customers. This supply chain integrative intangible abilities emerge as the firm's competitive advantage They would bring forth a firm's performance in the form of market performance, financial performance and customer service. In meeting customer needs and wants with these services which are attractive and satisfying, customer loyalty follows. This would enhance market performance with greater market share through word-of-mouth mechanisms. The revenue increase with appropriate management would likely result in financial returns and higher market capitalization if the company is publicly listed.

This finding implies that SCI mediates the relationship between KMO and firm performance. The finding is supported by Wang *et al*. (2009) that KMO has implication on performance and now incorporated with the mediating role of SCI. The results of the mediation role of SCI to firm performance is also in accordance with previous study by Tseng and Liao (2015) in container shipping firms. In this context, the hypothesis of this research analysed the relationships between KMO, SCI and firm performance. The SCI is perceived as valuable because it can create and maintain competitiveness for a firm to improve business performance (Barney, 1991; Barney *et al*., 2011; Li *et al*., 2009). Therefore, the SCI which comprises supplier integration, internal integration and customer integration should not be neglected by firms and this is supported by Tseng and Liao (2015) and Thai and Jie (2018). In addition, it was appropriate to study the relevance of SCI and firm performance in container shipping firms rooted in Knowledge-based Theory. In the face of the inverted-U theory, the positive role of SCI is affirmed in this particular study.

It is reasonable to conclude that SCI among container shipping firms is associated with firm performance. This is because better collaboration and information exchange among suppliers, focal firms and customers would favour firm performance. With better business for market performance, increase revenue and profits for financial performance follows. Satisfying end user needs constitute as better customer services. In other words, collaboration among supply chain members endows container shipping firms with competitiveness to improve performance.

Conclusion

This paper presented an empirical study which studied KMO and SCI in container shipping firms and their impact on firm performance. By analysing data of container shipping firms, PLS-SEM was applied to examine the hypotheses. The findings indicated that SCI mediates the

relationship between KMO and firm performance in container shipping firms. The results also confirmed SCI has a positive effect on firm performance and that KMO and SCI independently and directly positively influence firm performance.

The limitations of this study are as follows. Though the sample size is adequate, it is confined to a particular country. This would limit its generalization beyond the national border. This is notwithstanding perceptual differences in KMO which could occur among respondents in other nations. In addition, company culture about job security when knowledge sharing, and information systems and information technology could also differ because of company's affordability could bear mixed results. Finally, this research did not impose control variables to rule out their influences.

Future studies could explore other possible mediators beyond SCI. Due to the complex environment of container shipping and with its global service features, there are potential determinants which could mediate the role and effects of KMO to firm performance. Lastly, additional insights could be acquired in applying the research model to maritime industries in other countries.

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