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## **CONFIRMATORY FACTOR ANALYSIS FOR TESTING THE VALIDITY AND RELIABILITY OF AN INTERNAL CAPABILITY AND LOGISTICS OUTSOURCING MEASUREMENT SCALE**

**Summary.** This study aims to develop and validate a measurement scale for internal capability and logistics outsourcing. Regarding the goal of this study, data were obtained from 180 respondents who are currently performing logistics outsourcing in different fields in Sudan (oil industry, telecommunications, logistics services and manufacturing). Depending on the questioner technique, a total of 36 items and 5 subscales were generated based on the literature. The study uses a five-point Likert-style response scale (ranging from strongly agree to strongly disagree). The scale was subjected to confirmatory factor analysis (CFA) for determining the validity and reliability of the study dataset. Cronbach's alpha reliability coefficient ( $\alpha$ ) of the scale was reported to be 0.88. Findings of the study indicate that the resulting internal capability and logistics outsourcing measurement scale can serve as a valuable tool for measuring the logistics outsourcing drivers, namely time-related drivers, cost-related drivers, flexibility-related drivers, and quality-related drivers.

### **1. INTRODUCTION**

During the last decade, outsourcing, or the use of third-party logistics (TPL [alternatively 3PL]) providers as some authors prefer to define it, has been considered to play an important role in the manifestation of "inter-organizational" issues within logistics and supply chain management. The increase in outsourcing partnerships has contributed to the development of more flexible organizations [1]. According to Sarmiento, Byrne, Rene, and Rich [2], much of the literature on TPL is based on a functional explanation of its existence. It has recently been united in the opinion that flexibility, quality, delivery and costs are the most capabilities that can reinforce the company's rank in the marketplace. Furthermore, each one of those capabilities in itself consists of various subdivisions. For example, flexibility refers to the ability of firms to modify their production volume or production mix. Delivery could relate to the speed of transmission or dependability. Quality has been considered in terms of conformance to specifications or the features of products [3].

Van der Steen and Siegel [4] in their survey to investigate chemical industry revealed that the rate of outsourcing partnerships for companies included in their study had grown overall, with some 60% of companies indexed in "Fortune 500" reporting at least one contract with a TPL provider. The manufacturing capabilities could be considered to encompass the ability of the company's manufacturing system to compete on basic dimensions, such as quality, cost, flexibility, and time [2].

Furthermore, the speedy delivery, reliability and outstanding quality of the products, trustworthy delivery promises and the ability to produce new products speedily are performance areas which can be a source of a high level of competitiveness for manufacturing companies [5].

The main assumption of this research is that companies have a higher chance of achieving supply chain agility (SCA) and enhancing performance if they build their own strong logistic capabilities, and that delegating their logistics activities to a third party will further increase their logistics capability and reinforce the company's overall performance by leveraging the third party's experiences in management and fulfilment [6]. Trying to develop a theoretical base for the analysis, the research draws on "The Resource-Based View of the Firm" (RBV). The RBV is a theory that attempts to elaborate the way a company can attain SCA through the acquisition and managing resources, as well as enabling better management of internal capabilities. According to the RBV, resources must be VRIN (valuable, rare, inimitable, and non-substitutable), which are considered as the source of the company's competitive advantage [7].

## 2. LITERATURE REVIEW

Kersten and Koch [8] stated that in today's international and dynamic marketplace, companies of different sizes are frequently faced with difficulties in managing their own business value chains. Effective business value chains exhibit innovative capability and influence the timely delivery of products and materials and cost-effective operations. Suppliers, as third-party providers, are increasingly becoming an important strategic partner because of their impact on a company's short- and long-term success. Thus, the overall aim of a firm's management is to find the best possible supplier or third party able to provide the buyer with products and/or services of the right quality, at the right price, in the right quantities and at the right time, enabling the firm to react flexibly to business uncertainty.

Previous studies on the reasons for adopting outsourcing strategies have considered these to relate to successful performance as a result of using TPL. According to Hilletoft and Hilmola [9], to remain competitive in the business environment, companies have started to outsource many of their activities, delegating them to specialists and concentrating on those activities that they regard as their core business. Based on the need to fulfill the demand for new services, outsourcing by companies of their non-core activities has created an emerging business opportunity, attracting several new actors to enter the market, especially in the field of logistics. The outsourcing of logistics in general, i.e. TPL, has received considerable attention in the literature [10]. This involves the use of external companies to perform logistics functions that have traditionally been performed by the company itself [11]. The functions performed by TPL providers can encompass the entire logistics process or selected activities within that process. It can involve traditional logistics functions, such as customs clearance, inbound and outbound transportation, catering and exploration, as well as other services. These services have to be provided faster, at higher quality and in a more efficient manner than ever before.

The majority of research on the reasons for the outsourcing decision has centered on the type of outsourced activities and benefits of logistics outsourcing [9]. Several reasons are reported in the literature to motivate companies to outsource logistics activities, such as a lack of competences and resources required within the own company, reduction of the capital employed [12], increased environmental awareness [12], expansion into unfamiliar markets, trends towards centralized distribution systems and increased flexibility [13, 14]. Several benefits of logistics outsourcing have also been reported in the literature, such as increased market coverage, improved customer service, reduction in capital investments and cost savings, reduction in the complexity of logistics operations and increased flexibility towards the changing requirements of customers.

### 2.1. Functional integration in logistics outsourcing

The effective outsourcing processes of individual or multiple logistic functions are driven by potential improvements in customer satisfaction, in terms of time, place, service quality, form utility,

and cost effectiveness as a result of the more effective use of financial resources in the development of core competencies [12]. Tezuka [13] went further by stating that researchers also agreed that in integrating outsourced logistics functions across multiple functional areas, firms can contract processes as opposed to discrete activities. The contracting of processes allows firms not only to streamline their flows of goods and information and human resources in their supply chains, but also to reduce costs associated with asset ownership, the monitoring of performance, and the hiring, management, and training of personnel [14].

In essence, companies outsource clusters of non-core activities to create strategic subsystems. The strategic benefits and competitive advantage generated by a well-executed outsourcing plan can provide numerous competitive benefits, for instance, improving quality, lowering costs, and increasing flexibility. Firms outsource their activities because these have a joint impact on what customers perceive as important product attributes and because activities in the clusters outsourced share highly specialized operational skills, physical assets, processes, technologies, and transactional information, enabling the achievement of economies of scale, making the firm more responsive to customer requests and building greater customer loyalty and better customer–firm relations [15].

### **3. DEVELOPMENT OF MEASURES**

In this study, which deals with firms' internal capabilities that determine logistics outsourcing, four main constructs were developed to measure internal capabilities related to logistics (namely time, cost, flexibility, and quality) and the outsourcing variable. Previous studies were reviewed to develop scale items, as described in what follows.

#### **3.1. Time-related drivers**

The Institute of Logistics in 1994 defines logistics as "... the time-related positioning of resources" [16]. The major point here is that logistics is viewed on the basis of time and the importance of acquiring resources in time. It follows that effective logistics management is the process required to affect the positioning of all types of resources, so that they are in the right place and the right time in the company's supply chain. Logistics focused on total system design, the integration of one process with system efficiency, sustaining a company's competitive advantage, the deployment of resources and above all the effective management of time.

A majority of authors have concluded that effective outsourcing processes of individual or multiple logistics functions are, in general, driven by potential improvements in customer satisfaction in terms of ensuring on-time delivery, speeding up the manufacturing process, and addressing place and form utilities as a result of the more effective use of financial resources in the development of core competencies [13]. This drives firm towards the contracting out of logistics processes, thus allowing them not only to streamline the flows of goods and information in their supply chain, but also to reduce the costs associated with asset ownership, the monitoring of performance, and the hiring, management, and training of personnel [14].

#### **3.2. Cost-related drivers**

TPL faces strong cost-based competition [8]. In several studies [17, 11], costs have consistently been identified as the main reason for outsourcing logistics services. Through the specialization and economies of scale, logistic service providers (LSPs) are able to offer their services more cheaply than companies would be able to perform the same functions in house. Furthermore, Chen Chee-Cheng [18] argued that for both internal customers (manufacturers) and external customers (end consumers), LSPs are concerned with achieving cost-effective satisfaction of customer requirements through buyer–supplier integration [19]. For example, the goal of inbound logistics is to reduce the total costs by having the right materials in the right place at the right time. An effective LSP thus enables the carrier to partner with a variety of service providers to manage the operation of a supply chain, which

ultimately leads to a variety of benefits – including improved market performance, competitive advantage, higher levels of customer service and improves cost-effectiveness between the shipper and the carrier [20].

### 3.3. Service quality drivers

Many studies have been conducted to examine service quality as a reason for the outsourcing decision. For instance, Gotzamani [21] stated that the outsourcing of logistics activities to a TPL provider has become a mainstream trend in the current business environment. The main reason forcing companies towards this alternative solution is providers' experiences and traits that are difficult to acquire. Many companies have recognized the potential benefits to be gained through a high-quality system of logistics services, provided either internally or externally by a TPL. The TPL is positioned between the company and its customers in a newly shaped logistics triad, playing a crucial role in handling end-customer information and feedback. Thus, service quality becomes one of the most important criteria for the decision to outsource logistics services and further to select a provider.

### 3.4. Flexibility-related drivers

According to Manuj and Mentzer [22], flexibility is “the ability to change or react with little penalty in time, effort, cost or performance”. In uncertain supply chain and logistics demand markets, a more flexible supply chain can exercise its options faster than its competitors. The flexibility is very important in international supply chains and logistics because it plays an important role in coordinating processes, and TPL provides a unique ability to help firms manage the high levels of environmental and operating uncertainty inherent in global operations. Firms that achieve higher levels of flexibility significantly outperform their less flexible counterparts. Flexibility positively affects not only the firm's ability to extend its global reach, but also its ability to enhance comparative performance relative to leading industry competitors. In sum, supply chain flexibility provides an inherent capacity to respond to emerging circumstances that cannot fully be anticipated in the planning cycle [23].

A comprehensive set of item measures was generated from previous studies to measure the firm's internal capability (time, cost, flexibility, and quality) and outsourcing. Logistics capability was examined and analyzed based on the work of the GLRT at Michigan State University [24], while outsourcing measurement was derived from different studies [18]. Participants were asked to express their level of agreement with a set of important issues that would drive them to outsource logistics activities using a Likert's five-point scale (ranging from between strongly agree to strongly disagree). Original questionnaire of this study had six items measuring time, seven items for cost and flexibility, six items for quality, and, finally, ten items measuring outsourcing.

## 4. METHODS

### 4.1. Research design

The major aim of the study was to develop and validate a measurement model of internal capabilities and logistics outsourcing. As described above, a measurement tool was developed comprising a total of 36 items generated from the literature. Internal capability has four dimensions that are assessed using 26 items, such as time-related drive (TRD) measured by 6 items, cost-related drive (CRD) evaluated by 7 items, flexibility-related drive (FRD) measured using 7 items, and, finally, quality-related drive (QRD) estimated 6 items, in addition to logistics outsourcing (OUTS) measured by 10 items. Table 1 shows the distribution of items. The questionnaire was anchored using a five-point Likert scale, such as 1 = strongly disagree, 2 = not agree, 3 = neutral, 4 = agree, and 5 = strongly agree. A total of 180 questionnaires were distributed to participants, of which 116 completed questionnaires were collected; the overall response rate was 64.44% and the usable response rate was

62.75%. Data were analyzed using SPSS and checked for incorrect entries and missing data. In terms of reliability, Cronbach's alpha was employed to establish internal consistency [25]. Then, the data were transferred to AMOS.16 to conduct the remaining analyses.

Table 1

## The distribution of items

Factors	Dimensions	Items code	Items*
Internal capability	Time-related drive	TRD1	To increase delivery speed
		TRD2	To Improve process lead time
		TRD3	To improve process capability and cycle time
		TRD4	To allow a resource to focus on core competences-time
		TRD5	To accomplish projects schedule
		TRD6	To perform activities quickly
	Cost-related drive	CRD1	To reduce logistics cost
		CRD2	To reduce regulatory and legal costs
		CRD3	To increase volume through new market penetration
		CRD4	To reduce capital spending
		CRD5	To lower manufacturing cost
		CRD6	To eliminate unproductive assets
		CRD7	To lower total costs
	Flexibility-related drive	FRD1	To Improve process responsiveness
		FRD2	To Increase supply chain flexibility
		FRD3	To increase volume capability
		FRD4	To multiple sourcing for uncertainty preparedness
		FRD5	To increase respond to customer requirements
		FRD6	To flexibly react to variations in customer demand
		FDR7	To react flexibly to manufacturing uncertainty environment
	Quality-related drive	QRD1	To improve process responsiveness
QRD2		To improve the conformance of activities	
QRD3		To improve performance reliability	
QRD4		To meet customers' design specifications	
QRD5		To improve on-time delivery	
QRD6		To Deliver high-quality performance	
Logistics outsourcing		OUTS1	Customer satisfaction
		OUTS2	Achieving cost-effectiveness
		OUTS3	Improve market performance
		OUTS4	Reduce logistics cost
		OUTS5	Achieve the potential economies of scale and flexibility
		OUTS6	Streamline their flows of goods and information
		OUTS7	Monitoring of performance
		OUTS8	Better response to customer requests
		OUTS9	Facilitate inventory planning activities
		OUTS10	Reduce costs associated with asset ownership

\* Item deleted after CFA

Confirmatory factor analysis (CFA) was selected to validate the measurement scale. CFA allows the assessment of the convergent and discriminant validity of the instrument. Researchers use CFA because it is an appropriate statistical test to identify the number of factors that are required to clarify the inter-correlation among the measurement variables [26] and to identify which variables are considered to be reliable indicators of a particular factor. In CFA, the correlations between the factors are an explicit part of the analysis because they are collected in a factor correlation matrix. Researchers are able to decide a priori whether factors will be correlated or not [27]. Moreover, they are able to establish which factor pairs are correlated and which observed variables are affected by which common factors, as well as which variables are affected by a unique factor and which pairs of unique factors are correlated [28]. Finally, CFA is considered as a tool to confirm the proposed factors of internal capabilities and logistics outsourcing. A two-step approach was used to purify the measurement model [29], identifying and determining whether items are eliminated from the measurement model considering a number of criteria, such as weak loading, cross loading, multiple loading, commonalities, error residuals and theoretical determination. Then, Cronbach's alpha coefficient and "alpha if item deleted" values were set to determine construct reliability.

In the first stage of the CFA, all 36 items generated were included in the first-order measurement model of internal capabilities and logistics outsourcing. Initial model fitness was assessed and subjected to re-specification. In the second stage, second-order CFA was performed based on the re-specified model. To achieve an "overidentified" model, the regression path in each measurement component was fixed at 1. To evaluate the items, error variance estimate was used; evidence of items needing to cross-load on more than one component factor was indicated by large modification indicators, the extent to which item gives rise to significant residual covariance, parsimony purpose, the regression coefficient of each item, the reliability of the item and the reliability of the whole construct. In addition, the logic and consistency of the data related to the theoretical framework were considered when evaluating each item. Table 2 shows the fit indicators for the initial model of internal capability and outsourcing.

Table 2

Fit indicators for the initial model (internal capability and outsourcing)

First MODEL	CMIN (X2)	DF	P	CMIN((X2)/DF)	RMR	GFI	AGFI	CFI	NFI	TLI	RMSE A	PCLOSE
<b>Internal Capability</b>	876.131	299.000	0.000	2.900	0.120	0.607	0.539	0.626	0.530	0.594	0.129	0.000
<b>Outsourcing</b>	124.434	35.000	0.000	3.555	0.074	0.824	0.728	0.833	0.786	0.786	0.149	0.000

The initial model fit indicators indicated poor fit and the original model required to be re-specified to provide a better fit with the data. Initial estimates, based on 26 items for the internal capability measurement model and 10 items for the logistic outsourcing measurement model, showed that the following items with poor squared multiple correlations and low regression weights should be eliminated: TRD4, TRD5, CRD4, FRD4, FRD6, QRD5, OUTS2 and OUTS3. For example, the squared multiple correlations were 0.13 and 0.015 for TRD4 and TRD5, respectively. The regression weights for the outsourcing items OUTS2 and OUTS3 were 0.32 and 0.28, respectively. The modification indicators (MIs) showed large error covariance between CRD1 and CRD2 (58.384) and the regression weights of the two items had lower effects on the constructs; thus, both items were eliminated. Item TRD1 for the time-related drive factor was loaded onto other factors, namely the cost-related drive (MI = 8.455), outsourcing (MI = 11.489) and flexibility (MI = 9.465) factors. Error variances for TRD2, CRD5, QRD1, QRD4, OUTS4, and OUTS8 were high at 2.49, 1.58, 1.17, 1.44, 2.96 and 1.84, respectively; these items were eliminated because they did not significantly affect the other items. Finally, item CRD3 was retained even though it had a low squared multiple correlation

(0.248) and relatively low regression weight (0.498) because removing this item would impact other items to lose their overall effects on the component factor and would weaken the reliability value of the cost-related drive factor, whereas retaining this item would not affect the model fit indicators. Following the above, 14 items were eliminated from the internal capability measurement model and 4 items were eliminated from the outsourcing measurement model. The modified CFA model fit indicators are shown in Table 3.

Table 3

Fit indicators for the second model (internal capability and outsourcing)

Second MODEL	CMIN (X2)	D F	P	CMIN((X2)/D F)	RMR	GFI	AGFI	CFI	NFI	TLI	RMSEA	PCLOSE
Internal Capability	73.224	53	0.03	1.382	0.058	0.900	0.852	0.965	0.887	0.96	0.058	0.331
Outsourcing	9.780	8	0.28	1.222	0.032	0.98	0.939	0.993	0.964	0.99	0.044	0.478

#### 4.2. Modified models

Testing of the modified models for internal capability and outsourcing indicated a close fit with the sample data (see Table 2) and resulted in the following statistical values:  $X^2 = 1.382$  ( $df = 53$ ) for internal capability and  $X^2 = 1.222$  ( $df = 8$ ) for the outsourcing measurement model. The comparative fit index (CFI) values were greater than 0.95 (0.965 for internal capability and 0.993 for outsourcing). Collectively, these statistics lead us to judge the overall measurement model for internal capability and outsourcing as very close [30]. Table 4 summarizes the results for modified models. The modified models may contribute to facilitating the future adoption of SEM, as shown in Figures 1 and 2.

As shown in Figures 1 and 2, all items in the two measurement models load well onto the internal capability and logistics outsourcing constructs. The regression weights range from 0.498 to 0.86 and the critical ratio is above 1.96 (see Table 3). A factor loading less than 0.50 should be eliminated [31], but we have retained item CRD3, as mentioned above, because the elimination of this item would cause other items to lose their overall effects on the component factor. Figure 1 shows that all 12 items converge in the internal capability construct, with the items apportioned into four factors: time-related drivers, cost-related drivers, flexibility-related drivers, and quality-related drivers. In addition, Figure 2 shows 6 items that converge in the logistics outsourcing construct. Each of the items is loaded on only one of these five factors, without any cross-loading.

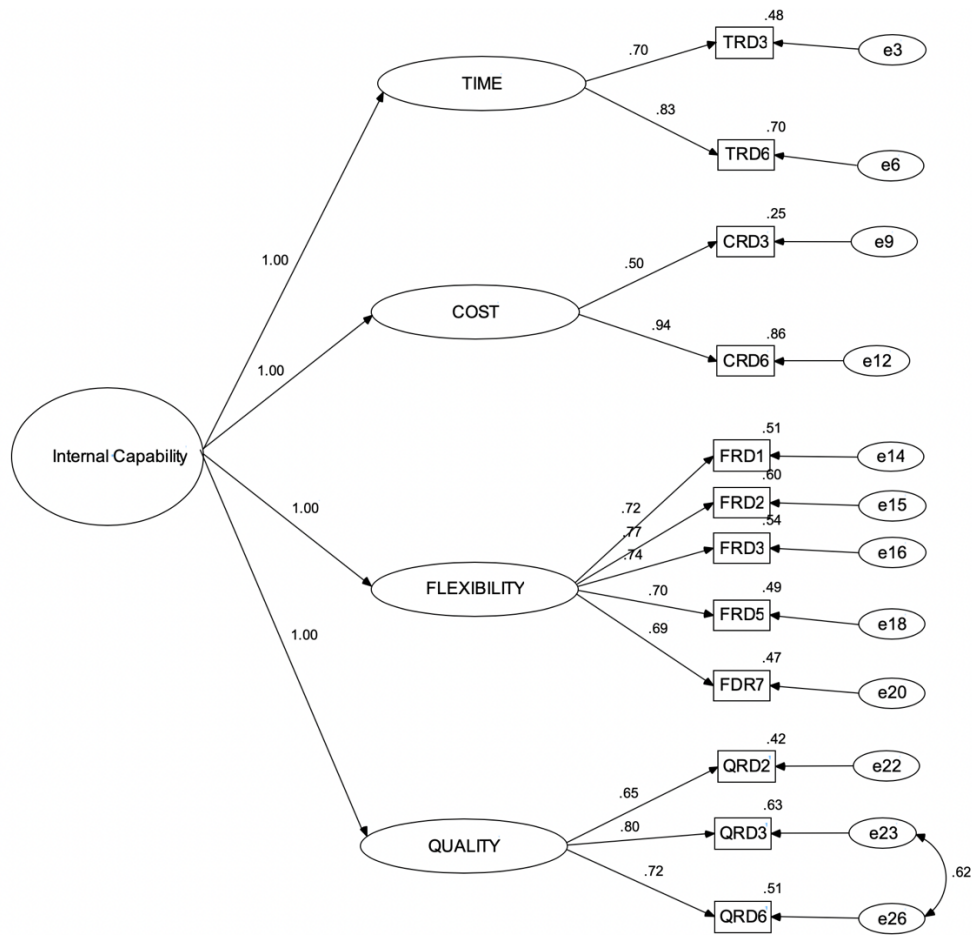


Fig. 1. CFA for the modified model of internal capability

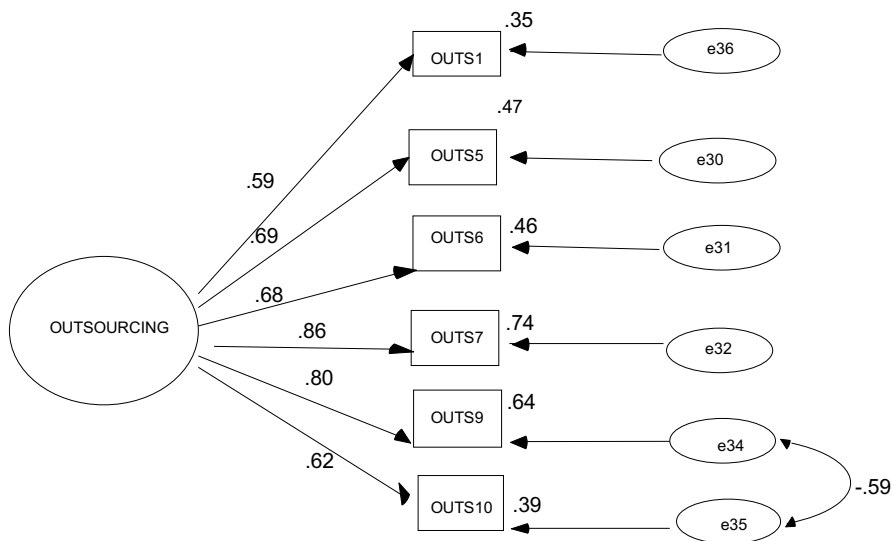


Fig. 2. CFA for the modified model of logistics outsourcing



### 4.3. Testing of multivariate normality

Table 4 shows the results of multivariate normality testing and the results of the CFA. When reviewing multivariate normality, the distribution of the variables is not far from normality because the absolute values of kurtosis are not larger than 3 or 4 [32] and the absolute values of skewness are less than 3 [33].

### 4.4. Validity and reliability

To standardize the measurement scale, validity and reliability tests were conducted, as well as to ensure that the constructs measure what they are supposed to measure. Our measurements need to meet certain empirical properties.

#### 4.4.1. Validity

The most important empirical properties for the measurement model concern validity. The first of these properties is convergent validity, which indicates the degree to which items measure the underlying construct. CFA verified that each item loads onto one single component factor without any cross-loading onto other component factors. The individual item's standardized coefficient should be significant and greater than twice its standard error [29]. Based on these criteria, we used the critical ratio (CR) to evaluate the statistical significance; parameters with a critical ratio greater than 1.96 can be considered significant. As shown in Table 3, the coefficients for all items are greater than the standard error, the coefficients for all items are large and significant, and the values of the CR are greater than 1.96. Thus, the convergent validity of the constructs of the two measurement models is supported.

In addition to convergent validity, discriminant validity measures the extent to which the latent variables differ [34] and the individual items measure a single latent construct and do not measure different latent constructs at the same time [35]. The average variance extracted (AVE) of the two constructs must exceed the square of their correlation [36]. Table 4 presents the AVE and squared correlation for each pair of factors. The AVE for each latent variable is larger than the squared correlation for the same pair, indicating that each construct is a distinct construct and is different from other constructs.

Table 4  
Discriminant validity test outcomes

Construct	Time	Cost	Flexibility	Quality	Outsourcing
Time	0.590				
Cost	0.179	0.570			
Flexibility	0.364	0.375	0.520		
Quality	0.325	0.138	0.402	0.520	
Outsourcing	0.303	0.232	0.490	0.361	0.510

#### 4.4.2. Reliability

Cronbach's alpha coefficient, composite reliability and AVE values were calculated to measure the reliability of each factor. Composite reliability should be greater than 0.7 and AVE greater than 0.5 [31; 36]. As shown in Table 5, the composite reliability and AVE values, calculated based on Fornell and Larker [37], exceeded the minimum acceptable values, indicating that the measures are reliable and there are no errors to introduce inconsistent results [34].

Table 5

Results of descriptive statistics, multivariate normality, and confirmatory factor analysis

Item#	Cronbach's alpha	Mean	SD	Skewness	Kurtosis	Standardized path coefficient	SE	CR	P	SMC	Composite reliability	Average variance extracted (AVE)
Time-related drive	0.885										0.74	0.59
TRD3		3.92	0.943	-1.032	1.085	0.696				0.484		
TRD6		4.06	0.916	-1.277	1.95	0.834	0.156	5.32	0.000	0.696		
Cost-related drive	0.888										0.710	0.57
CRD3		3.40	1.141	-0.572	-0.526	0.498				0.248		
CRD6		3.68	1.108	-0.694	-0.139	0.941	0.28	4.56	0.000	0.885		
Flexibility-related drive	0.915										0.850	0.52
FRD1		3.72	0.883	-0.861	1.009	0.716				0.513		
FRD2		3.83	0.916	-0.743	0.453	0.773	0.141	7.93	0.000	0.598		
FRD3		3.72	0.921	-0.413	-0.021	0.735	0.144	7.44	0.000	0.540		
FRD5		3.93	0.862	-1.34	2.854	0.702	0.134	7.12	0.000	0.493		
FDR7		3.65	0.989	-0.872	0.522	0.687	0.154	6.98	0.000	0.472		
Quality-related drive	0.891										0.760	0.52
QRD2		3.82	0.947	-0.989	1.105	0.646				0.417		
QRD3		3.84	0.992	-0.759	0.466	0.795	0.202	5.51	0.000	0.632		
QRD6		4.06	0.963	-1.354	2.209	0.715	0.198	5.58	0.000	0.511		
Logistics Outsourcing	0.827										0.860	0.51
OUTS1		3.97	0.986	-1.187	1.313	0.591				0.349		
OUTS5		3.65	0.837	-0.425	0.517	0.688	0.215	5.230	0.000	0.473		
OUTS6		3.66	0.941	-0.857	0.692	0.680	0.240	5.20	0.000	0.462		
OUTS7		3.72	1.068	-1.068	0.634	0.859	0.315	5.69	0.000	0.738		
OUTS9		3.73	0.990	-0.958	0.783	0.800	0.274	5.65	0.000	0.640		
OUTS10		3.79	1.084	-0.9	0.337	0.624	0.266	4.41	0.000	0.389		
Note: SE= Standard Error, CR= Critical Ratio, SMC= Squared Multiple Correlation												
SE and CR for the first item in each factor are not shown because the regression weight of the first variable of each factor is fixed at 1.												

## 5. DISCUSSION

This study differs from previous studies as it focuses on the validity and reliability of the measurement of logistic capability and outsourcing in an emerging market. The logistics capability measurement variable has previously been tested and validated through numerous studies in Western settings. However, there was a lack of a goodness-of-fit measurement for logistics capability and outsourcing in emerging markets, which is of importance taking into consideration the different environmental context and infrastructure in emerging markets. With respect to the length of time, the respondents had been engaged in logistics, the majority had been involved in logistics outsourcing for more than five years (62.1%), thus giving them a sound understanding of the nature of logistics and how to achieve their goals and policies.

A review of the literature on logistics capability was conducted. The researchers [38] selected eight logistics capability variables, including pre- and post-sale customer service, delivery speed, delivery reliability, responsiveness to the target market, widespread distribution coverage (availability), selective distribution coverage, and low total cost of distribution. Thus, the measures of logistic capability were used recently by Bihter and Ali [39] to measure IT capability. The measure of outsourcing used in this study was adapted from Rabinovich et al. [12]. This provides a cluster of measures that capture firms' trend in outsourcing their activities, using a scale consisting of 10 items measuring logistics outsourcing.

The scale was developed as a result of a comprehensive literature review and validation of items, drawing on the opinions of experts to improve face and content validity. A total of 36 items were subjected to first-order confirmatory factor analysis (CFA), based on the 116 usable questionnaires. CFA was selected to validate the measurement scale, assessing convergent and discriminant validity, as well as to identify the number of factors required to explain the inter-correlation among the measurement variables, as it is considered a tool to confirm the proposed factors of internal capabilities and logistics outsourcing. Multivariate normality analysis revealed that the distribution of the variables was not far from normality, based on the kurtosis and skewness values.

The initial model was subjected to re-specification because the indicators indicated a poor fit for both models (internal capabilities and logistics outsourcing). Initial estimates based on 26 items for the internal capability measurement model and 10 items for the logistics outsourcing measurement model resulted in items with poor squared multiple correlations and low regression weights being eliminated: 14 items were eliminated from the internal capability measurement model and 4 items from the outsourcing measurement model. The modified second CFA model fit indicators indicated a close fit with the sample data based on the  $\chi^2$  and CFI values. All items in the two measurement models were found to load well onto the internal capability and logistics outsourcing constructs. Reliability and validity tests were conducted; the Cronbach's alpha, composite reliability and AVE values exceeded the minimum acceptable values, indicating that the measures were reliable and without error. Moreover, convergent validity analysis verified that each item loaded onto one single component factor without any cross-loading onto other component factors. The critical ratio (CR) was used to evaluate statistical significance, supporting the convergent validity for the constructs of the two measurement models. The results also supported discriminant validity, i.e. an individual item measured one latent construct and did not measure different latent constructs at the same time. The AVEs for each latent variable were larger than the squared correlation for the same pair, indicating that each construct was a distinct construct and differed from the other constructs.

## 6. CONCLUSIONS

The theoretical implication identified by this study is that the measurement is reliable and valid. Moreover, collectively, the results of the study lead us to conclude that the overall measurement model may lend itself to the future adoption of structural equation modeling. In terms of its practical implications, the study provides firms with an overall view of important components involved in the

decision-making process concerning logistics capability and outsourcing. Specifically, this paper attempts to acknowledge and also to validate previous research on functional processes related to logistics.

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