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Viable Supply Chain Management Model Towards Company Sustainability During COVID-19 Pandemic: A Measurement Model Analysis

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Abstract
Two main concepts, viable supply chain management (VSCM) and business sustainability, are the subject of this study. Top management support, integration and partnership, digital technologies, information sharing, and customer focus are the five dimensions used to measure VSCM. This study's objective is to create and verify the Viable Supply Chain Management (VSCM) model for manufacturing companies in Malaysia during the COVID-19 pandemic. 197 respondents from Malaysian manufacturing companies were surveyed using a quantitative approach. Using SmartPLS analysis, all surveys are examined. The PLS-SEM analysis of the measurement model revealed that the composite reliability (CR) values obtained for each construct ranged from 0.887 to 0.966, with the economic performance contributing the greatest CR value (0.966) and top management support scoring the lowest (0.887). The implication of this study is to strengthen the viability and reliability of viable supply chain management and contribute further to the COVID-19 outbreak's impact on company sustainability. Moreover, a successful supply chain model would guarantee that manufacturers are compelled to respond swiftly to safeguard and support their employees and maintain operations that are critical lifelines for consumers and communities.
Keywords: Company Sustainability, COVID-19 Pandemic, Reliability, Resilient Supply Chain Management, Viable Supply Chain Management

Introduction

COVID-19 impacts a new normal way of life including social activities, health, education, economic activities in the business sector, medicine, transportation, and telecommunications. The manufacturing industry is also vulnerable to the impacts of COVID-19 (Chatterjee & Chaudhuri, 2021). Since the manufacturing sector is a contributor to Malaysia’s economic development, the negative effects of COVID-19 have impacted the nation's economic growth for example supply chain disruptions, demand uncertainty, country boarder restrictions and others (Nguyen et al., 2021). The first half of 2020 has been most challenging for Malaysian manufacturers as the impact of the economic disruptions resulting from Movement Control Order (MCO), Conditional Movement Control Order (CMCO) and Recovery Movement Control Order (RMCO) during this period weighed heavily on their businesses. The Purchasing Managers Index (PMI) is a useful tool for determining the

direction of economic trends in manufacturing and for providing information about present and future business conditions to firm executives, analysts, and investors. The PMI is a numeric number between 0 and 100. A PMI value more than 50 implies economy increase in comparison to the previous month, while a value less than 50 suggests contraction of economy. The more one deviates from 50, the bigger the magnitude of change (Investopedia, 2020). The PMI is intended to give an advanced signal of what is really happening in the economy. The PMI is based on response from manufacturers about new order from customer, production rate, employment rate, supplier deliveries, inventories, import and export activities. According to Figure 1, the greatest slump was in April, which is 31.3 from 48.4 in March 2020. The sector is contracting as a result of the negative economic impact of the COVID-19 outbreak. Among the factors declining PMI is due to the lack of new demand (new order) from importing countries, shortage of supply and slowdown of export/import activities (Mohamad, 2020). The movement control order implementation at the end of March contributed bad impact on demand, buying levels shrank the most on record and employment declining modestly (Trading Economics, 2020).

Problems related to the supply chain occur again due to the emergence of new variants of COVID-19. In January 2021, Malaysian manufacturers reported more drops as the Omicron variant hit manufacturers all over the world, hurting demand and making supply chain delays worse than ever before. Malaysia's Manufacturing Purchasing Managers' Index (PMI) by IHS Markit, a composite indicator of manufacturing performance, eased to 50.5 in January from 52.8 recorded in December 2021 (Bernama, 2022).

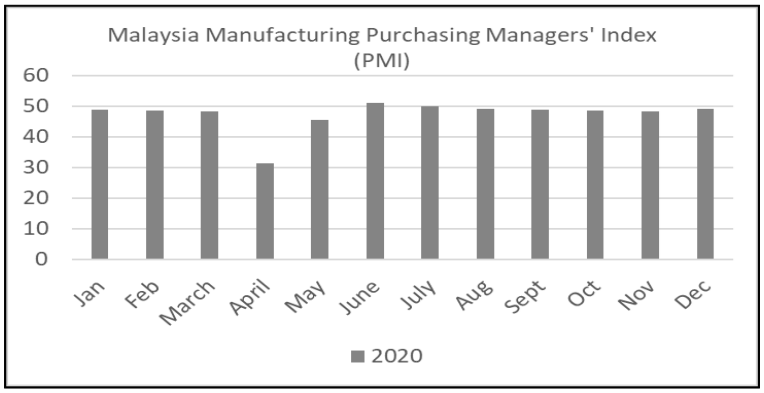

Figure 1. Malaysia Manufacturing Purchasing Managers's Index

Malaysia's PMI continues to decline, falling to 48.4 points in March 2020 from 48.5 points in February 2020. The PMI for the majority of countries involved in the MCO of COVID-19 is below 50. The fall in PMI can be attributed to a lack of new demand (new orders) from importing countries, a shortage of supply, and a slowdown in export/import activity.

To accomplish the study's research objectives, the author must address the research questions. These are the research questions: 1) Can the constructs and sub-constructs describe the viable supply chain management (VSCM) model? And 2) Do VSCM and company sustainability fulfil the criteria for validity and reliability?

Measurment Model Analysis

PLS-SEM was used in this study because it was capable of analyzing large structural equation models with numerous constructs and indicators (Haenlein & Kaplan, 2004). The analysis was carried out through the use of a model that measured the internal consistency and reliability

of the model. Because of its capacity to both predict and explicate target constructs, a PLS-SEM analysis was selected as the method of choice to be carried out. The analysis of the measurement model will be performed first, followed by the analysis of the structural model (Hair et al., 2019). Any interpretation of the structural model would be completely useless if the validity and reliability of the scale being employed had not been examined. This is due to the fact that structural equation modelling (SEM) models are frequently based on a basic theoretical model with the addition of newly constructed variables to meet the invested research goals. It takes measurement model analysis to support the SEM's scale adaptation from various studies.

Research Methodology

Quantitative approach is utilized in this study. The sample was chosen from among the manufacturing companies in Malaysia that are members of the Federation of Malaysian Manufacturers (FMM). The sampling approach that will be used in this study is stratified random sampling. This study requires a total of 200 samples from the population of Malaysian manufacturing companies. The questionnaire is constructed based on the comprehensive review of previous VSCM literatures as shown in Table 1. The questionnaire consists of two (3) main sections which are demographic, VSCM practices and company sustainability. The questionnaire will employ a five-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Natural, 4 = Agree, 5 = Strongly Agree) to measure responses. Only 197 of the initial 500 surveys returned with complete responses.

Table -1
Number of Items in the Research Instruments

Constructs	**Total of Items**	**Sources**
Viable Supply Chain Management		
Top Management Support	**6**	(Darmasaputra Leksono, Siagian, & Josowanto Oei, 2020; Ifinedo, 2008)
Integration/ Partnership	**6**	(Baah et al., 2022; Shukor et al., 2020)
Digital Technologies	**6**	(Ajmal et al., 2021; Khin & Ho, 2019; Ruel et al., 2021)
Information Sharing	**6**	(Baah et al., 2021; Omar, 2010)
Customer Focus	**6**	(Al-Shboul et al., 2017; Li et al., 2005; Sin et al., 2005)
Company Sustainability		
Economy Performance	**6**	(Ajmal et al., 2021; Baah et al., 2022)
Social Performance	**6**	(Ajmal et al., 2021; Eltayeb, Zailani, & Ramayah, 2011; Paulraj, 2011)
Environment Performance	**6**	(Baah et al., 2022; Suprawan, 2015)

Result and Discussion

In this study, data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). Measurement model is used to measure validity and reliability values. To measure the reliability of the constructs, construct reliability (CR), Cronbach's Alpha and average variance extracted (AVE) were used. For measuring constructs validity, convergent validity and discriminant validity were used.

Findings of Measurement Model

In this study, PLS-SEM analysis was used to obtain the result of measurement model. In this research, because the research model contains multidimensional latent variables, the variables were modelled as second-order constructs. The hierarchical component model (HCM) is another name for the measurement model with second-order constructs (Hair Jr et al., 2020). HCM is a higher-order structure that consists of many construct layers and a greater level of abstraction (Sarstedt et al., 2019). This study assessed the reliability and validity of higher order components (HOC) in a PLS-SEM path model using the "embedded two stage approach" technique (Sarstedt et al., 2019).

Figure 2 illustrates the first stage of measurement model assessment, whereby there are 10 latent variables with two higher order constructs (HOC); 1. Viable supply chain management (VSCM), 2. Company Sustainability and eight lower order constructs (LOC); 1. Top management support (TMS), 2. Integration/ partnership (IP), 3. Digital technologies (DT), 4. Info sharing (IS), 5. Customer focus (CF), 6. Economy performance (Eco), 7. Social performance (Sp) and 8. Environment performance (Env). LOCs represent the dimensions of HOCs.

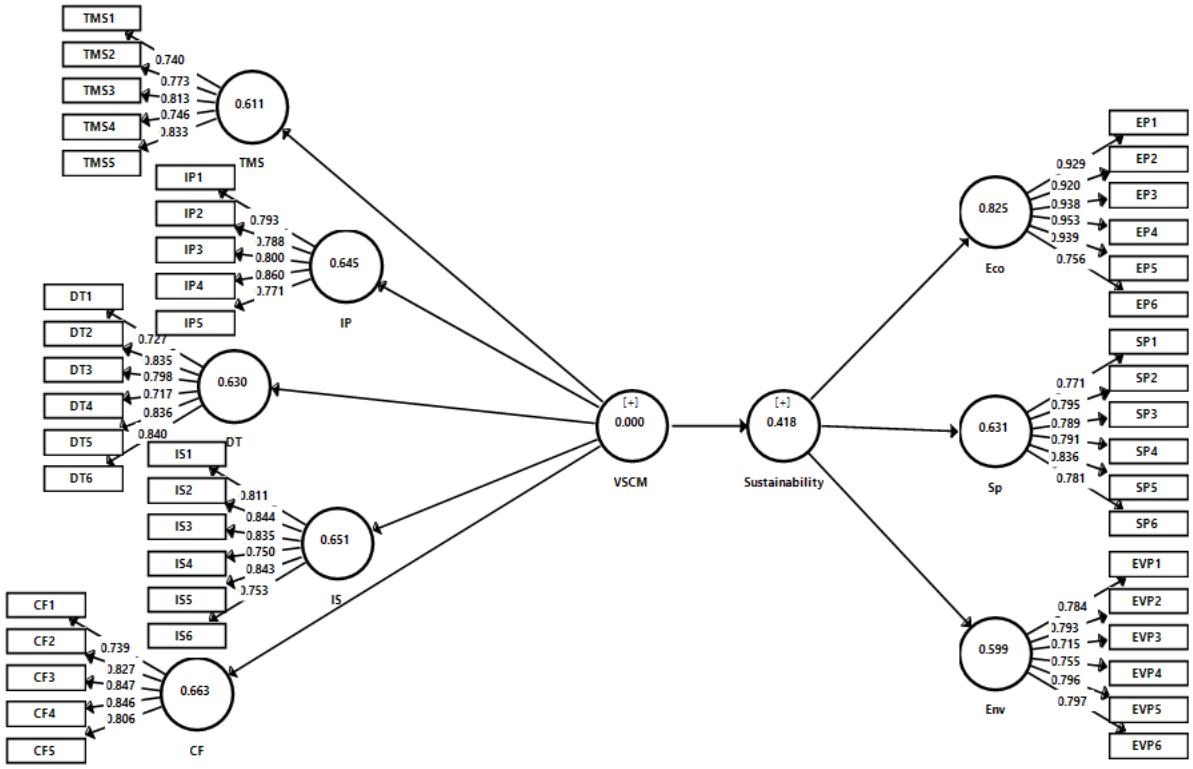

Figure 2. The First Stage of Measurement Model Assessment

Figure 3.

In the second stage, LOC latent variable scores serve as the indicator for determining HOC. Here, the reliability and validity of HOC are evaluated as shown in Figure 3. The value inside constructs is AVE and the values on arrows is factor loadings. Figure 3 shows the second stage of measurement model evaluation, wherein only two latent variables exist: 1. VSCM and 2. sustainability. Using the latent variable scores of each respective dimension, the dimensions of 1. VSCM (TMS, IP, DT, IS, and CF) and 2. sustainability (sp, eco, and env) were turned into indicators (items) at this stage. In PLS-SEM, construct reliability and validity tests include internal consistency reliability, convergent validity, and discriminant validity.

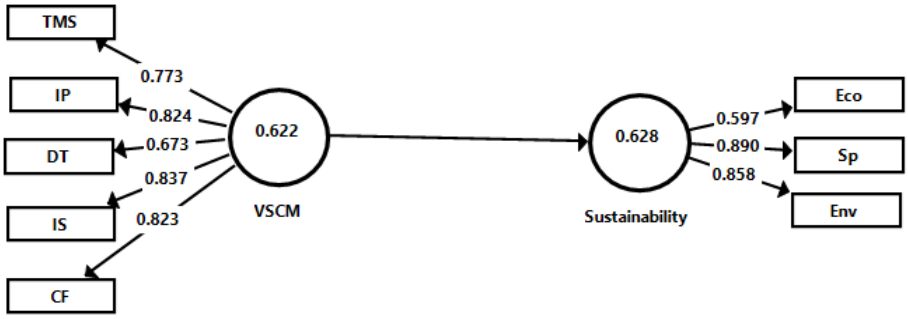

Figure 4. The Second Stage of Measurement Model

Internal Consistency Reliability

In this study, the composite reliability is employed to examine internal consistency. Acceptable composite reliability ratings should be more than or equal to 0.60 or between 0.70 and 0.90. For the examination of composite reliability, a cut-off value of 0.70 or higher was utilized to indicate good convergent or internal consistency (Gefen et al., 2000). The Cronbach's Alpha must be more than 0.7 to measure the reliability of the constructs (Hair et al., 2006). The values of composite reliability and Cronbach's Alpha for each construct in this study are presented in Table 2.

Table -2
Internal Consistency Reliability Result

Constructs	Cronbach's Alpha	Composite Reliability
Viable Supply Chain Management	**1.0**	**-**
Top Management Support	**0.840**	**0.887**
Integration/ Partnership	**0.862**	**0.901**
Digital Technologies	**0.882**	**0.911**
Info Sharing	**0.892**	**0.918**
Customer Focus	**0.872**	**0.907**
Company Sustainability	**0.917**	**0.928**
Economy Performance	**0.956**	**0.966**
Social Performance	**0.883**	**0.911**
Environment Performance	**0.866**	**0.899**

The PLS-SEM analysis of the measurement model revealed that the composite reliability (CR) values obtained for each construct ranged from 0.887 to 0.966, with the economic performance contributing the greatest CR value (0.966) and top management support scoring the lowest (0.887). Moreover, the Cronbach's Alpha values obtained for each constructs ranged from 0.840 to 1.0. Therefore, all constructs in this measurement model achieved indicator reliability because the values obtained are more than 0.7.

Convergent Validity Assessment

The study also utilized convergent validity to determine how well an item measures comparable constructs. Three tests can be used to verify convergent validity analysis: outer loading assessment, composite reliability (CR), and average variance extracted (AVE). The outer loading values must be greater than 0.708 (Hair et al., 2019). AVE must have a value

larger than 0.5, and CR must be greater than 0.7. Table 3 summarized the result of outer loadings, CR and AVE for lower order constructs (LOC) and higher order constructs (HOC). For outer loadings for lower order constructs (LOC), all items exceeded 0.708 except items TMS6, IP6 and CF6 which have been deleted due to lower values. For higher order constructs (HOC), all items exceeded 0.708 except items DT and Eco. However, according to Hair et al (2019), when a minimum AVE result of 0.5 is reached, indicators with loadings lower than 0.708 may be retained. Consequently, no item is deleted. The composite reliability (CR) for LOC and HOC are greater than 0.7 which means all the items showed good reliability. For AVE, all the values obtained for each construct ranged from 0.599 to 0.825 which means all the values exceed the minimum value of AVE.

Table -3
Convergent Validity Result

Constructs		**Items**	**Loading**	**Composite Reliability**	**AVE**
LOC	**HOC**				
Top Management Support (TMS)		**TMS1**	**0.740**	**0.887**	**0.611**
		TMS2	**0.773**		
		TMS3	**0.813**		
		TMS4	**0.746**		
		TMS5	**0.833**		
Integration/ Partnership (IP)		**IP1**	**0.793**	**0.901**	**0.645**
		IP2	**0.788**		
		IP3	**0.80**		
		IP4	**0.860**		
		IP5	**0.771**		
Digital Technologies (DT)		**DT1**	**0.727**	**0.911**	**0.630**
		DT2	**0.835**		
		DT3	**0.798**		
		DT4	**0.717**		
		DT5	**0.836**		
		DT6	**0.840**		
Info Sharing (IS)		**IS1**	**0.811**	**0.918**	**0.651**
		IS2	**0.844**		
		IS3	**0.835**		
		IS4	**0.750**		
		IS5	**0.843**		
		IS6	**0.753**		
Customer Focus (CF)		**CF1**	**0.739**	**0.907**	**0.663**
		CF2	**0.827**		
		CF3	**0.847**		
		CF4	**0.846**		
		CF5	**0.806**		
	Viable Supply Chain Management (VSCM)	**TMS**	**0.773**	**0.891**	**0.622**
		IP	**0.824**		
		DT	**0.673**		
		IS	**0.837**		

		CF	**0.823**		
Economy Performance (Eco)		**Eco1**	**0.929**	**0.966**	**0.825**
		Eco2	**0.920**		
		Eco3	**0.938**		
		Eco4	**0.953**		
		Eco5	**0.939**		
		Eco6	**0.756**		
Social Performance (Sp)		**Sp1**	**0.771**	**0.911**	**0.631**
		Sp2	**0.795**		
		Sp3	**0.789**		
		Sp4	**0.791**		
		Sp5	**0.836**		
		Sp6	**0.781**		
Environment Performance (Env)		**Env1**	**0.784**	**0.899**	**0.599**
		Env2	**0.793**		
		Env3	**0.715**		
		Env4	**0.755**		
		Env5	**0.796**		
		Env6	**0.797**		
	Company Sustainability	**Eco**	**0.597**	**0.831**	**0.628**
		Soc	**0.890**		
		Env	**0.858**		

Discriminant Validity

An analysis of discriminant validity is used to validate that a set of indicators are distinct across constructs. It analyses the correlations between the measurements for any overlap and verifies that the investigated constructs are truly distinct from one another (Hair et al., 2019; Sarstedt et al., 2019). This research included two test analyses to determine the discriminant validity: Fornell and Larcker's criteria and the Heterotrait Monotrait Ratio (HTMT).

The Fornell and Larcker criteria is an analysis that compares the square root of the AVE value to the correlations between latent variables. The value should be larger than any other construct's value. The evaluation is predicated on the notion that a construct has greater variation with its own indicators than with those of any other construct. Table 4 shows that the Fornell and Larcker's criterion with the correlation value for each construct was higher than other construct, indicating adequate discriminant validity.

Table -4

Fornell and Larcker's Criteria Result

	Sustainability	**VSCM**
Sustainability	**0.792**	
VSCM	**0.76**	**0.789**

Because cross-loading and Fornell-criteria Larcker's have been criticised for their inability to determine discriminant validity, this Heterotrait Monotrait Ratio (HTMT) was developed (Hair et al., 2019). A score closer to 1 indicates a lack of discriminant validity, hence the projected value should be less than 1. The HTMT value must fall below 0.9 (Gold et al., 2001). Table 5

shows that the value of HTMT were all below the threshold value of 0.9, indicating that the discriminant validity had been met.

Table -5
HTMT Result

	CF	DT	Eco	Env	IP	IS	Sp	Sustainability	TMS
CF									
DT	**0.555**								
Eco	**0.313**	**0.276**							
Env	**0.63**	**0.523**	**0.299**						
IP	**0.651**	**0.514**	**0.428**	**0.606**					
IS	**0.7**	**0.511**	**0.331**	**0.576**	**0.735**				
Sp	**0.634**	**0.538**	**0.399**	**0.729**	**0.585**	**0.599**			
Sustainability	**0.65**	**0.552**	**0.777**	**0.885**	**0.676**	**0.623**	**0.899**		
TMS	**0.632**	**0.355**	**0.405**	**0.624**	**0.644**	**0.65**	**0.72**	**0.726**	

Conclusion

This research focuses on two key constructs: viable supply chain management and company sustainability. Measurement of VSCM is based on five dimensions: top management support, integration/partnership, digital technologies, information sharing, and customer focus. In the meanwhile, the sustainability of a company is assessed across three dimensions: economic performance, social performance, and environmental performance. The measurement analysis result shows that the reliability and validity of the construct have been achieved. If the reliability and validity of the construct are problematic, structural analysis to test the research hypothesis will not be able to be carried out.

One component of a path model is the measurement model, which details the indicators and how they relate to the constructs. For PLS-SEM purposes, it is often referred to as the "outer" model. The research objective addressed in this study is whether or not VSCM and company sustainability meet the criteria for validity and reliability, and this was determined by assessing the measurement model using the PLS algorithm method in SmartPLS version 3.3.3. If the validity and reliability of the scale being used in the study were not evaluated, any interpretation of the structural model would be absolutely pointless. This is because structural equation modelling (SEM) models are typically built on a fundamental theoretical model, and then newly constructed variables are added to the mix to achieve the objectives of the invested study.

In order to meet the challenge of COVID-19, supply chain management must undergo severe adjustments. COVID-19 has introduced a new dimension in which this supply chain must be enhanced by incorporating aspects of viability and durability into all supply chain

management practices. There is always the risk that raw material supplies could abruptly decrease or the product demand will spike dramatically. Due to these disruptions, planning has become increasingly challenging. Supply chains need to be viable and robust so that they can withstand unexpected changes and adapt quickly to new circumstances. This study will continue by examining structural modelling in order to investigate the relationship between VSCM and company sustainability. The findings of this structural modelling investigation will assist the Malaysian manufacturing industry in fending off challenges such as COVID-19 and others. In light of the fact that the notion of viable supply chain management is relatively new in relation to the COVID-19 epidemic, there is a need for further research in this area so that more strategies may be employed to cope with long-term interruptions.

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