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THE MODERATING EFFECT OF PRODUCT ATTRIBUTES IN VENDOR MANAGED INVENTORY (VMI) PERFORMANCE

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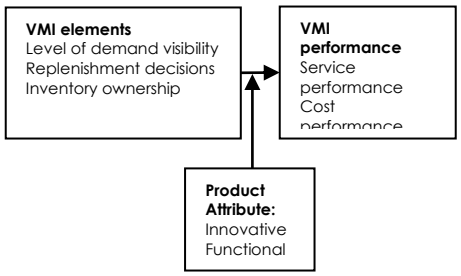
Graphical abstract



Abstract

The suitability of product attributes forsuccessful VMI program has been discussed by numerous authors and but not concluded yet. This study is to explain the moderating effects of product attributestoward VMI performance. The data was gathered from 101 of suppliers in manufacturing companies. Data analysis was conducted by employing factor analysis, reliability test, and hierarchical multiple regressions. The findings show that only level of demand visibility is the main predictor of service performance. While, replenishment decision and inventory ownership were predictor to cost performance. The innovative product moderates the relationship between level of demand visibility and VMI performance. The functional product moderates the relationship between replenishment decision and service performance; and the relationship between inventory ownership and cost performance. Suppliers in manufacturing companies should urge their customer to share demand information when engaging in VMI program.However, supplier should give less authority in replenishment decision for functional product to increase the service performance. Supplier also should have low ownership of inventory to ensure better cost saving for functional product.

Keywords: VMI performance, VMI elements, product attributes

1.0 INTRODUCTION

VMI was first popularized by Wall-Mart and Procter Gamble in the late 1980s in the retail industry. Successful VMI initiatives also have been trumpeted by many companies such as Whitbread Beer Company, Barilla, Johnson & Johnson, Kodak Canada Inc. and Campbell Soup. Presently, VMI was not only belonging to particular industry, but also variety of industry, which comprises range of products, accessories, and raw materials had practicing VMI [1].

VMI can be defined as collaboration between business partners, with the help of the customers demand and inventory level information, the supplier manages and replenishes the customer's inventory [2]. The vendor is given access to current customer inventory and forecast and sales order information to initiate replenishment as required.

Although many studies indicated that VMI programs significantly improved a company's performance, actual results of many VMI programs are disappointing [3]. One of executives in the fields of Supply Chain Management exposed that out of ten VMI implementations, only three or four had achieved great benefits [4]. Five cases of VMI program, which involved many industries included machinery services, chemicals, packaging, grocery, and paper has been conducted [5]. They reported that all the customers experienced increase in material availability, but two of suppliers had increased and no impact on inventory levels. The cases also revealed that only one supplier

experienced production efficiency from implementation of VMI.

While, six interviews were conducted to cover smaller and larger organizations in a variety of industries especially retail, chemical, construction, equipment, and electronics [6]. Although the finding indicated that there was improved in services when implementing VMI, but with finding on cost reduction were mixed. Some had the advantage of reduced transportation costs while others benefited more from reduced inventory costs. However only one buyer mentioned a reduction in administration costs.

Many manufacturing companies in Malaysia have driven to increase the number of their suppliers to engage in VMI [7]. However, the study also revealed that many manufacturers who had no experience with VMI found the topic of interest and wanted to learn more about the concept. They primarily want to know "Would the concept be suitable under the conditions of which they were operating?". In fact, Malaysian researcher's also has proposes VMI as a solution to increase the performance of inventory management in Malaysian manufacturing companies [8][10].

1.1 Problem Statement

Although many studies indicated that VMI programs significantly improved a company's performance, actual results of many VMI programs are disappointing [3]. Past studies showed that most of the discourage results are from supplier side [4][5]. Due to the replenishment of customers' inventory was on supplier responsibility, the capability of supplier to operationalize VMI program should be look as a focus of the study. Unfortunately, the operating issues in VMI gained less attention than strategic issues [11]. Among the important operating elements of VMI are inventory location, ownership of inventory, visibility of demand, replenishment decisions, and inventory control limits [11][1][12].

In Malaysia, manufacturing companies faces several issues that need to be resolved, which include the impact of bullwhip effect on demand, increase of inventory cost, on-time delivery, and inventory shortage [13]. VMI can make significant and crucial contributions to the current issues of Malaysian manufacturing companies, if properly designed. Therefore, many manufacturing companies in Malaysia have driven to increase the number of their suppliers to engage in VMI [7]. However, most of the manufacturers who had no experience with VMI found the topic of interest and wanted to learn more about the concept. Thus, based on the literature inventory location, ownership of inventory, visibility of demand, replenishment decisions, and inventory control limits will be including in this study as the basic of VMI elements.

In addition, there is an increasing awareness of VMI in variety of industries, and practitioners are curious about the suitability of the concept. Practitioners also want to know whether VMI is suitable for their company, and if so, how they should proceed [6].

Although researchers have recognized that VMI can increase the performance, there has been limited empirical research that has directly associated the inventory location, ownership of inventory, visibility of demand, replenishment decisions, and inventory control limits and VMI performance, particularly in the supplier perspective and Malaysia manufacturing context. Therefore, the purpose of this research is:

i) to investigate the influences of VMI elements (visibility of demand, replenishment decisions, inventory ownership) on VMI performance (services, cost);
ii) to examine the moderating effect of attribute of product on the relationship between VMI elements and VMI performance.

2.0 LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1 VMI Performance

The concept of VMI program has received attention in the industrial world [14], as the model differs significantly from the traditional practice in bringing benefits to the company [15]. There are two main benefits that always highlighted in the litertaure, which include cost reduction and service improvement.

Research carried out by [16] shown that synchronizing the production schedule according to downstream production plan can reduce the inventory level and reduce the order cycle time from 0 to 20 days with a more accurate order due to precise of aggregate forecast. However, synchronizing the planning process was compensated for the rise of production cost.

Meanwhile, a study by Claassen et. al [6] has shown a fairly positive effect, in terms of inventory cost, administration cost, flexibility, customer service level, and number of stockout. However, transportation and material's handling cost, customer responsiveness and forecasting accuracy was received less effective. From the buyer perspectives, VMI helps to reduce incorrect order, but only one buyer mentioned a reduction in administration costs. However, in three cases, an increase in the sales margin for the supplier was noticed. Both buyers and suppliers mentioned the advantage of increased supply chain control. With respect to costs, their findings were mixed. Some had the advantage of reduced transportation costs while others benefited more from inventory costs reduction.

On the other hand, a model was developed to comparing the performance of the supply chain between non-implementing VMI and implementing VMI[17]. They summarized that VMI can reduce the total logistic cost of the supply chain, but the total logistic cost for the supplier is not decisive. In addition, the contract purchase price between supplier and customer also not deceived under VMI practice. The results also show an increase of profit for the buyer.

However, profit for the supplier is not discussed in the study.

Another model also was developed to value the benefits and distribution of benefits from VMI program with a two-level supply chain (supplier and customer) [18]. Results from the model revealed that frequent replenishments have reduced the cycle stocks and safety stock. However, benefits from inventory reduction are not equally distributed between the manufacturer and the retailer. They also stated that the distribution of benefits is determined by certain parameter, such as replenishment frequency and inventory holding costs. The results show that when the replenishment frequency was higher, and the inventory holding cost was low; the more manufacturers will benefit from inventory reduction.

An exploratory multiple case studies were conducted with the data from five operational VMI dyads [5]. The result shows a mix impact in terms of inventory reduction at the buyer and supplier side. Three buyers reported that they could reduce the inventory level, and the other two buyers claim no impact. Meanwhile, two suppliers reported an increase of inventory level, one supplier showed decrease impact, and one supplier shows no impact. All the three suppliers say no impact on production efficiency, except one, stated an increase of production efficiency. However, all the buyers and suppliers noted a positive impact on the material availability to the buyer and forecast accuracy of the supplier. Further, at the buyer side shows a decrease in replenishment work. Conversely, the supplier shows an increase in replenish works. This circumstance could be due to the shifts of responsibility to replenish inventory from buyer to supplier. The available empirical studies had shown mixed results specifically in terms of cost reduction and service improvement. Some of the studies have shown a positive effect and in the other studies have shown conversely. Therefore, it is important to identify the factor that contributes to VMI performance.

2.2 VMI Elements

2.2.1 *InventoryOwnership*

Inventory ownership refers to the ownership of the inventory and when the invoice was issued to the customer [1]. Owning the inventory mean the company was responsible for the capital costs, obsolescence costs, and subject to a fluctuation in prices of inventory [19]. However, with a more accurate forecast based on demand data shared by customer, supplier can keep inventory at minimum level just to meet the customers' need. Though, managing the entire inventory system by one of the partners allow the supply chain to be better synchronized according to both companies's cost characteristic [20]. Among the others advantage of owning inventory [12][21] for supplier includes to push new products to the market and to place special products to top of the line to their retailer's assortment that then boosts the sales of the manufacturer's other products [12].

2.2.2 *VisibilityOf Demand*

This elements concern the type of demand information provides to the supplier in order to control the customer's inventory. The different types of demand information communicated in VMI practice was studied by several researchers. Among demand information that visible to the supplier comprises of sales data, stock withdrawal, production schedule, inventory level, goods in-transit, back order, incoming order, and return [8][22]. Increased visibility of demand information will allow the supplier a larger time window for replenishment planning [23] through the improvement in the supplier's production planning, which result in more stable production plan [22]. In fact, by sharing demand information between supplier and customer can faster the replenishment, easy to identify goods and materials flow, increase the accuracy of forecast, and high customer service level through product availability [24].

2.2.3*ReplenishmentDecisions*

This element concerns the extent to which the supplier is authorized to make replenishment decisions about quantity and delivery time. In VMI program, replenishment decision can be made fully determined by supplier [2][8][25] where the supplier has the right to decide on both quantity, time for delivery [1]., and location [21]. This alternative would logically give the supplier most freedom and flexibility in the inventory control process. According to Yao et al. [2], when suppliers have the autonomy to retain orders until an agreeable dispatch time is reached, it is expected that economic consolidated dispatch quantity will accumulate before an order is dispatched. In addition, supplier can gains more benefit by means improved optimization of its manufacturing and distribution [26] as well as for minimization of out-of-stock expenses through the possibility to prioritize customer orders [27].

2.3 ProductAttributes

During the literature, review several characteristics of product considered important for VMI performance was found. Products can be either functional or innovative, depending primarily on its characteristics. According to Fisher [28], attribute of product can fall into one of two categories based on demand perspective, which consist of demand predictability, product life cycle, contribution margin, product variety, and average margin of error in the forecast, average stockout rate, average forced end of season markdown as percentage of full price, and production lead time.

De Toni and Zamolo [22] argued that standard products with a steady demand and long life cycle, referred to functional products by Fisher [28] are most

suitable products for VMI practice. Kuk [21] also urged that VMI practice typically be implemented for repetitive production situations involving standard products rather than custom, continuous flow, or project situations. Meanwhile, Stank et al. [29] also added that most of the acclaimed benefits of VMI program apply to a few selected high volumes, profitable products with stable demand patterns. However, De Toni and Zamolo [22] argued that the replenishment of innovative products in which based on actual needs and not by warped forecasts also can gained benefits from the VMI practice.

While, Yao and Dresner [18] had analyzed the benefits realize by manufacturer and retailer under the VMI practice. Their analysis shows that VMI brought varying benefits in terms of inventory cost savings to firms. The results suggest that when demands become relatively more predictable, the benefits from using VMI program decreased. They also argued that the different attribute of product was possessing different patterns of demand. Thus, by carefully choose the attribute of product to be managed in VMI practice; managers may be able to increase the program's success rate.

3.0 RESEARCH FRAMEWORK

Based on the above discussion, the following hypotheses andresearch framework were proposed (Figure 1):

H1: The VMI elements have significantly explained the variance of service performance.
H2: The VMI elements have significantly explained the variance of cost performance.
H3: Product attributes (innovative product and functional product) moderates the relationship of VMI elements and service performance.
H4: Product attributes (innovative product and functional product) moderates the relationship of VMI elements and cost performance.

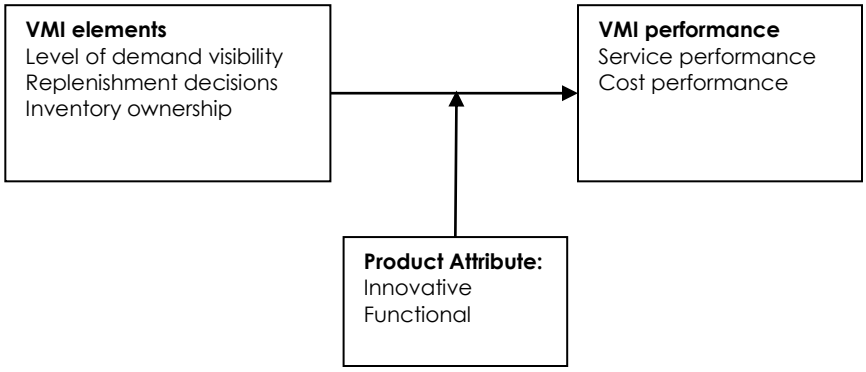


Figure 1 Research framework of the moderating effect of product attributes on Vendor Managed Inventory (VMI) performance

4.0 RESEARCH METHODOLOGY

4.1 Samplingand Data Collection

The unit of analysis for this study is the Malaysia manufacturing companies that play a role as a supplier or vendor in the VMI collaboration. We investigate two dependent variables: organizational factors and performance of VMI in terms of service and cost. Little empirical data has been published on this topic; therefore; a survey method of data collection was considered appropriate [30]. The sampling frame for the data collection included members of the Federation of Malaysia Manufacturer (FMM) 2011. FMM members are likely to be involved in the inventory management of the firm.

4.2 Measurement Scale

A survey instrument was developed and pretested with business executives and managers. The discussion made by Sarpola [12], Elvander et al. [1] and Wallin et al [19] was used as a guide to develop items for inventory ownership scale. The visibility of demand scale was developed based on Elvander et al. [1] and Vigtil [8]. The work byElvander et al. [1] also was used to develop the replenishment decisions scale. To measure the type of product, items from Fisher [28] was adapted and used. The extent, to which performance of VMI among the supplier in manufacturing company is measured based on several authors, includes Claasen et al. [6], Kuk [21], and Myer et al [31]. A six-point Likert scale was mainly used in this study to indicate the degree of agreement for each criterion, with 6 (strongly agree) as the maximum and 1(strongly disagree) as the minimum. After modifying the questionnaire to incorporate

panels' suggestions, 495 of companies was recognized through the random sampling. The surveys were then sent to these companies, with reminder cards being sent two weeks later. After reminding, 114 questionnaires were returned. However, 13 were excluded due to incomplete questionnaires, not engage with the VMI program, and reluctant to answer. Thus, this study had achieved 20 percent of respond rate from the total number distributed and 31 percent from the sample size required.

4.3 Data Analysis

This study uses Statistical Package for Social Science (SPSS) as a tool to run the multiple regression analysis. Before testing the hypotheses, the data must be evaluated in terms of missing values, normality, multivariate outlier, linearity, and homoscedasticity test. Normality can be observed through the skewness and kurtosis. All the constructs in the research variables have a skewness value lower than 2.0 and kurtosis value smaller than 7.0. Therefore, the variables were normally distributed [32]. The multivariate outliers also were detected through the Mahalanobis distance (D2) or chi-square value. As the rule of thumb, the maximum Mahalanobis distance should not exceed the critical chi-squared value with degrees of freedom equal to number of predictors and alpha = .001, or else outliers may be a problem in the data [33]. The Mahalanobis Distance have the minimum value = 2.025 and maximum value = 30.097, Chi-square value = $\chi 2$ (11 independent data variable, 0.001) = 16.3. Thus, it confirms the normality of the outlier. The other test such as multicolinearity, linearity and homoscedasticity also was performed in order to comply with the assumptions under multiple regressions. To assess multivariate multicollinearity, this study used tolerance or VIF (variance influence factor), which build in the regressing of each independent on all the others [34]. The VIF shows less than 10 while tolerance value should not be 0.01 or less to indicate that independent variables were not highly correlated each other. Meanwhile, the scatter plot also shows an oval shape as indicator of linearity and homoscedasticity. In addition, to test the autocorrelation of the model, the Durbin-Watson coefficient results were ensured within the acceptable range of 1.5-2.5 [32], while the condition index should not be more than or equal to 30. The above assumptions were checked and proper action was taken to reduce multicolinearity by deleting the outliers.

4.4 FactorAnalysis

Factor analysis was conducted to group the items related to each other under the same construct [34]. A Varimax rotation method was applied to all variables. The selected factors were based on eigenvalues equal to or greater than 1.00. Within a factor, the cut-off point for significant factor loading were at least 0.55 to be considered necessary for practical significance Hair et al., 2006.

Factor analysis also was performed on 16 items in the VMI performance scale. The KMO was 0.849 and Bartlett's test of sphericity was significant at the 0.01 level. The anti-image correlation matrix ranged from 0.755 to 0.893 (> 0.50), so there were also sufficient correlations among the items. Four factors were extracted. However, only two components had three or more acceptable loading of items and without cross loading. The first component was identified as cost performance and the second component captured on service performance. These factors accounted for 72.03% of the variance. The reliability test showed an alpha scores range from 0.846 to 0.893.Table 1 presents the result of factor analysis for VMI performance.

Factor analysis also was performed on 18 items in the VMI elements' scale. The result is shown that KMO was 0.767 and Bartlett's test of sphericity was significant at the 0.01 level for VMI elements' scale. The anti-image correlation matrix ranged from 0.543 to 0.901 (> 0.50), so there were sufficient correlations among the items. Five factors were extracted; these factors accounted for 71.59% of the variance. The factor analysis had formed five components. However, only three components had three or more acceptable loading of items. The first component focused more on level of demand visibility in assisting inventory replenishment by supplier, the second component focused on level of replenishment decision made by supplier, and the third component focused on the ownership of inventory by supplier. Based on reliability test,the alpha scores were range from 0.800 to 0.899. Table 2 presents the result of factor analysis for VMI elements.

Table 1 Results of factor analysis for VMI performance

[a]

Dimensions and Measurement Items	Loading	Communalities	Reliability
Cost Performance:			0.893
1. Reduce the material handling cost.	.866	.807	
2. Reduce the administration cost.	.860	.786	
3. Reduce the holding cost.	.767	.691	
4. Lower the transportation cost due to more efficient planning.	.746	.811	
Service Performance:			0.846
1. Productivity improvement should be achieved with automation of manual tasks.	.797	.768	
2. Improve the accuracy of forecast resulting in better planning.	.793	.722	
3. Improve the reliability of delivery.	.776	.657	
4. Improve the relationship with customers.	.668	.637	
5. Improved ability to react to upsides/downsides of customer demand.	.634	.710	

Table 2 Results of factor analysis for VMI elements[a]

Dimensions and Measurement Items	Loading	Communalities	Reliability
Level of demand visibility:			0.899
1. Our customer provides us with the historical data to assist the inventory replenishment decision.	.814	.732	
2. Our customer provides us with the point-of-sales data to assist the inventory replenishment decision.	.793	.708	
3. Our customer provides us with the goods in-transit information to assist the inventory replenishment decision.	.791	.707	
4. Our customer provides us with the backorder information to assist the inventory replenishment.	.766	.726	
5. Our customer provides us with the forecast information to assist the inventory replenishment decision.	.756	.649	
6. Our customer provides us with the return order information to assist the inventory replenishment.	.748	.723	
7. Our customer provides us with the inventory level information to assist the inventory replenishment decision.	.681	.805	
Replenishment decisions:			0.812
1. Our customer does not propose the quantity of inventory to be replenished.	.821	.744	
2. We make replenishment order decisions.	.802	.724	
3. We can decide the quantity of inventory to be replenished.	.615	.675	
Inventory ownership:			0.800
1. We are still responsible for holding cost of inventory even it has been delivered to customer.	.850	.772	
2. We are exposed to price fluctuation in inventory even it has been delivered to customer.	.816	.702	
3. We still own the inventory even it has been delivered to customer.	.730	.651	

Then, attribute of product dimensions also was run through the factor analysis (Table 3). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for attribute of product was shown at acceptable level (0.685) and correlation among the analysed items range from 0.569- 0.802 (anti-image). The communalities range from 0.505 to 0.737. The rotated component produced three useful components. However, the third component was successfully loads with one item. Thus, only component 1 and 2 were used to represent the type of product. The first component captured on functional product of the

firm while the second component focused on the innovative product. The scores for reliability test were range from 0.613 to 0.793.

Table 3 Result of factor analysis for product attributes

Dimensions	Loading	Communalities	Reliability
Functional product:			0.793
1. Our product demand is predictable.	.849	.838	
2. Our product has a low forecasting errors/forecasting problems.	.851	.856	
3. Our product has a low stock-outs or late deliveries.	.696	.790	
Innovative product:			
1. Our product variant is high.			0.613
2. Our product has a high contribution margin.	.742	.696	
3. Our product has a high average end-of-season markdown.	.776	.832	
	.689	.679	

2.0 FINDINGS

The hierarchical multiple regression analysis was used to answer the hypotheses number one and three. The results of the moderating effect of product attributes on the relationship between VMI element dimensions and the service performance of VMI were presents in Table 4.The first block showed the direct influence of VMI elements on service performance of VMI. The VMI elements contributed 22.4 percent of variants (R^2 0.224) in service performance. The overall regression model was significant (Sig. F change = 0.002, R square = 0.224, F change = 9.245, $p < 0.001$). From the individual coefficients, only level of demand visibility (beta =0.361, $p < 0.001$) was significant. This indicated that level of demand visibility was a critical factor to the service performance of VMI. In the second block, when attribute of product (innovative and functional) was entered, the R square was 0.303. This showed that total variance explained by the model as a whole became 30.3% (R square = 0.303, F change = 5.288, $p < 0.001$). The additional variable explained an additional 7.8% of the variance in service performance, after controlling level of demand visibility, replenishment decisions, and inventory ownership (R square change = 0.078). Again, the overall model was significant (Sig. F change = 0.007, $p < 0.05$). In third block (step 3), when the interaction was performed, then R square became 0.447. This showed the total variance explained by the model as a whole was 44.7%. The interaction effect was noticed by the increase in R square value by 14.4% (R square change = 0.144) which explained an additional 14.4% of the variance in service performance (R square = 0.44.7, F change = 3.824, $p < 0.000$). The overall model was significant (Sig. F change = 0.002, $p < 0.001$).The result shows that innovative product interacted with level of demand visibility (beta = 0.194, $p < .05$) to predict service performance. The significant result also was found in interaction of functional product with replenishment decision (beta = - 0.085, $p < .10$). However, only innovative product shown insignificant relationship with service performance (Pearson correlation -0.103, significant at 0.307), which indicated the existence of a pure moderator. Meanwhile, the relationship between functional product and service performance was significant (Pearson correlation 0.336, significant at 0.001), which indicated the existence of a quasi moderator [35]. While, the significant beta coefficient for the interaction term (beta = 0.194, $p < .05$) indicated that the impact of level of demand visibility on service performance differ by the degree of innovative product. Meanwhile, The significant beta coefficient for the interaction term (beta = -0.085, $p < .10$) also indicated that the impact of replenishment decision on service performance differ by the degree of functional product.Thus, hypothesis 3 was partially supported.

The hierarchical multiple regression analysis also was conducted to examine the relative impact of VMI elements on cost performance. The first block showed the direct influence of VMI elements on cost performance of VMI. The VMI elements contributed 8.4 percent of variants (R^2 0.084) in cost performance. The overall regression model was significant (Sig. F change = 0.038, R square = 0.084, F change = 2.918, $p < 0.05$). From the individual coefficients, only replenishment decisions (beta = 0.136, $p < 0.10$) and inventory ownership (beta = -0.191, $p < 0.05$) was significant. This indicated that replenishment decisions and inventory ownership were critical factor to the cost performance of VMI. In the second block, when type of product (innovative and functional) was entered, the R square was 0.101. This showed that total variance explained by the model as a whole became 10.1% (R square = 0.101, F change = 0.916, $p < 0.10$). The additional variable explained an additional 1.8% of the variance in service performance, after controlling level of demand visibility, replenishment decisions, and inventory ownership (R square change = 0.018). Again, the overall model was not significant (Sig. F change = 0.404, $p > 0.10$). In third block (step 3), when the interaction was performed, then R square

became 0.579. This showed the total variance explained by the model as a whole was 57.9%. The interaction effect was noticed by the increase in R square value by 49.1% (R square change = 0.491) which explained an additional 49.1% of the variance in cost performance (R square = 0.579, F change = 3.946, p < 0.001). The overall model was significant (Sig. F change = 0.002, p < 0.001).Further, this study examines the moderating influence of attribute of product (innovative product, functional product) on the relationship between VMI elements (level of demand visibility, replenishment decisions, and inventory ownership) and cost performance of VMI. As shown in Table 5 (step 3), innovative product interacted with level of demand visibility (beta = 0.207, p <.05) to predict cost performance. The interaction of functional product with inventory ownership also was significant (beta = -0.295, p <.001). Both, innovative product (Pearson correlation -0.073, significant at 0.470) and functional products (Pearson correlation 0.158, significant at 0.114) had shown insignificant relationship with cost performance, which indicated the existence of a pure moderator [35]. Thus, hypothesis 4 was partially supported. The significant beta coefficient for the interaction term (beta = 0.207, p < .05) indicated that the impact of level of demand visibility on cost performance differ by the degree of innovative product. Meanwhile, The significant beta coefficient for the interaction term (beta = 0.295, p < .001) also indicated that the impact of inventory ownership on cost performance differ by the degree of functional product.

Table 4 The moderating effect of attribute of product on the relationship between VMI element dimensions and the service performance of VMI

Variable(s)	Step 1 Independent variables	Step 2 Moderating variables	Step 3 With interaction
Level of demand visibility	0.361***	0.354**	-0.118**
Replenishment decisions	-0.078	-0.048	-0.008
Inventory ownership	0.014	0.063	0.395
Innovative product		-0.089	-1.102***
Functional product		0.123**	0.783**
Level of demand visibility x Innovative product			0.194**
Replenishment decisions x Innovative product			0.044
Inventory ownership x Innovative product			0.016
Level of demand visibility x Functional product			-0.085
Replenishment decisions x Functional product			-0.047***
Inventory ownership x Functional product			0.045
R^2	0.224	0.303	0.447
R^2 Change	0.224	0.078	0.144
Significant F change	0.000	0.007	0.002

*p<.10; ** p<.05; ***p<.001

Table 5 The moderating effect of attribute of product on the relationship between VMI element dimensions and the cost performance of VMI

Variable(s)	Step 1 Independent variables	Step 2 Moderating variables	Step 3 With interaction
Level of demand visibility	0.102	0.100	-1.820**
Replenishment decisions	0.136*	0.156**	0.310
Inventory ownership	-0.191**	-0.160*	0.695
Innovative product		-0.065	-0.803***
Functional product		0.073	-0.479
Level of demand visibility x Innovative product			0.207**
Replenishment decisions x Innovative product			0.073
Inventory ownership x Innovative product			-0.115
Level of demand visibility x Functional product			-0.100
Replenishment decisions x Functional product			-0.087
Inventory ownership x Functional product			-0.295***
R^2	0.084	0.101	0.579
R^2 Change	0.084	0.018	0.491
Significant F change	0.292	0.191	0.002

*p<.10; ** p<.05; ***p<.001

5.0 DISCUSSION

Though this study fails to support the total influence of VMI elements on VMI performance; however partially, the model was significant which indicated that VMI elements (level of demand visibility, replenishment decision, inventory ownership) had significantly influence on VMI performance (service, cost) of the suppliers of manufacturing companies. The result of data analysis showed that visibility of demand was predictors to service performance of VMI. This study provide findings on type of demand shared between partner in VMI and complement the previous research that sharing information can increase performance of VMI [24][6][36]. The implications by providing information on demand in time are faster replenishments can be achieved, slow and fast moving goods can be identified, accurate demand forecasts can be made to match the inventory flow, and high level of customer service through product availability [24]. On the other hands, a probable explanation a small contribution of replenishment decision and inventory ownership to cost performance is VMI was involved with different market interaction strategy applied by customer. Therefore, the supplier had different value of authority in replenishing and owning the inventory.

The result shows that there was significant interaction between innovative products with level of demand visibility and functional product with replenishment decision on service performance. In other words, level of demand visibility could lead to increment in service performance of the supplier in manufacturing companies if they engages innovative product in their VMI program. Meanwhile, replenishment decisions made by supplier only could lead to increment in service performance if manufacturing companies involves with low functional product in their VMI program. In term of cost performance, the results indicate that innovative product interact with visibility of demand on cost performance.The firm with high innovative product characteristic had positively influenced cost performance with the increase in level of demand visibility. In addition, the functional product also interact with inventory ownership on cost performance. At high functional product (moderator variable), increasing ownership of inventory is associated with the decrease of cost performance.

6.0 CONCLUSION

The results of these analyses confirm that the overall model of VMI elements was significant but only level of demand visibility had the greater influence on VMI performance. Therefore, manufacturer should focuses on sharing demand information among partners in the VMI program in order to benefit of service improvement and cost reduction. In term of significant interaction of attribute of product (innovative, functional) with level of demand visibility indicates that irrespective of attribute of product involved in VMI program, the level of demand visibility should be priority to ensure the VMI performance (services, cost) increase. This study also recommends that supplier should urge their customer to share demand information even it is involve with innovative product that carries confidential information. Besides, the interaction of functional product with replenishment decision on service performance signals that suppliers with functional product characteristic requires less authority to decides replenishment of inventory on behalf of customers. This responsibility would allow supplier to provide better services to their customers. Similarly, supplier in VMI program also requires less ownership of inventory while engaging with functional products in order to reduce the cost associated to inventory management.

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