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The Significant Impact of Customer Relations Practices (CRP), Information Technology (IT) and Information Sharing between Supply Chain Partners (IS) on Product Sales

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ABSTRACT

This paper examines the relationship between supply chain management programs and sales in manufacturing companies in Malaysia. The study measures senior quality managers' or production manager's perception of SCM practices and sales in the industry. This study investigates relationships between supply chain management programs and sales through statistical methods such as Spearman's correlations, Friedman's rank test and multiple regression analysis. The findings suggest that SCM programs and implementations especially 'customer relations practices' (CRP), 'technology & information' (IT) and 'information sharing between supply chain partners' (IS) have significant correlations and associations with sales. The result also indicates that 'High sales-generated companies' emphasized more on SCM programs such as

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'Customer Relations Practices', 'Technology and Innovation' and 'Strategic Supplier Partnership'.

Keywords: *supply chain management, sales, manufacturing companies, Spearman's correlation, Friedman test and multiple regression analysis.*

Introduction

In order to compete successfully in today's challenging business environment manufacturing companies should be able to effectively integrating the internal functions within a company and effectively linking them with the external operations of suppliers and supply chain members. As global competition increases, businesses should be more involved in how their suppliers and customers do business. They need to focus on process that has an impact on enhancing supply chain management processes such as where materials come from, how their suppliers' products are designed and assembled, how products are transported and stored and what consumers really wants. The process of making and distributing products and services to customers is becoming the most effective and efficient way for businesses to stay successful and is central to the practice of supply chain management.

The manufacturing industry has played important role in the development of consumers' products and contributed major portions of national export. Increasing global competition, the demands of customers for higher product quality, greater product selection, and better customer service, the desire of firms to shrink their supply bases while striving to contain costs, and the rising costs of natural resources today have led many Malaysian manufacturing companies to adopt cooperative, mutually partnership strategies with suppliers, distributors, retailers, and other firms within their supply chains to maintain or improve profitability and overall firm sales.

This paper explores the possibility of adopting SCM as the basis for enhancing sales in manufacturing companies in Malaysia. First, this paper proceeds with a brief explanation on the SCM principles and literature review; second, it discusses the methodology adopted, the objectives of the study and the test conducted to obtain the reliable measures of SCM variables. Third, it determines the correlations between SCM and sales; fourth, it highlights the results of Spearman's correlation,

Friedman test and multiple regression analysis. Finally, the results are then discussed and implications highlighted.

Literature Review

Supply Chain Management (SCM) is "the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole" (Christopher, 1998). According to Ganeshan and Harrison (1999), a supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers.

Fundamentally, SCM involves integration, co-ordination and collaboration across organizations and throughout the supply chain. Supply Chain Management seeks to enhance sales by closely integrating the internal functions within a company and effectively linking them with the external operations of suppliers and chain members. Supply Chain management requires coordination with customers and suppliers. Firms must achieve a relatively high degree of integration before implementing SCM.

Supply Chain management has the potential to assist the organization in achieving both cost and a value advantage (Christopher, 1998). To gain competitive advantage, organizations have to adopt Supply Chain Management (SCM) approach and consider the supply chain as a whole. Many researchers claim that Supply Chain Management can result in better supply chain sales (Christopher, 1998; Christiansee & Kumar, 2000), but very few empirical studies have been carried to investigate the impact of SCM on sales in Malaysian manufacturing companies.

Independent Construct Measurement: Validity and Reliability

Validity and reliability tests were used to select and assess the final items of the independent constructs that would be used for statistical testing. Content validity represents the sufficiency with which a specific domain of content (construct) was sampled (Nunnally, 1978). Content validity is subjective and judgmental but is often based on two standards

put forward by Nunnally: does the instrument contain a representative set of measures, and were sensible methods of scale construction used (Flynn et al, 1990,1995). The critical variables of supply chain management in this study had content validity because an extensive review of the literature was conducted in selecting the measurement items and the critical factors, and all the items and factors were evaluated and validated by professionals in operation management areas. The SCM variables in this study were adopted from prominent studies or sources (Gunasekaran et al., 2003,; Kuei et al., 2001; Li et al., 2002; Hill, 2003; Vickery, 1999).

In this study, SCM measurements was operationalized based upon seven different kinds of programs that manufacturers commonly used to integrate their operations with suppliers and customers namely Strategic Supplier Partnership, Customer Relations Practices, Information Sharing, Quality Information Exchange, Lean System, Postponement Concept and Technology & Innovation. One of the foundations of SCM is Strategic Supplier Partnership. Suppliers can provide benefits to the manufacturing company and the entire supply chain. They also can gain benefits from these relationships in term of long-term and high-volume sales. In addition, Customer Relations Practices or customer relations management involves activities such as how to meet delivery due dates, how to resolve customer complaints, how to communicate with customers, and how to determine the distribution services required. Simultaneously, when there is a high degree of trust, Information Sharing system between SCM partners can be customized to serve each other more effectively. However, confidentiality of sensitive financial, product, and process information must be maintained. In addition, Quality Information Exchange is also crucial in SCM and factors that are important are related to the timely, accurate, complete and adequate information. On the other hand, Lean System is related to activities such as reducing setup time, continuous improvement programs, pull production system, shorter lead times, streamlined paperwork and small lot size. Further, Postponement Concept is a principle for a manufacturing company to constantly keeping product standardized in the process to minimize complexity. Lastly, Technology & Innovation enables companies to achieve competitive advantage in terms of both lower cost and faster service by applying modern and updated technology (Davis & Heineke, 2005 pp 80; Wisner et al., 2005 pp 13, 15, 64; Li et al., 2002).

In the initial stage of the data analysis, the seven SCM variables constructs were subjected to validity and reliability tests before a single score can be calculated to represent each construct. Multi item scales

were developed for each construct in the study. Before creating the final scales, the data were checked for normality and outliers. Next, confirmatory factor analysis (CFA) or a measurement model using AMOS 4 was employed for examining construct validity of each scale by assessing how well the individual item measured the scale (Ahire, Golhar & Walter, 1996). Specifically, confirmatory factor analysis was used to detect the unidimensionality of each construct. Unidimensionality is evidence that a single trait or construct underlie a set of measures (Hair et al., 1988). The measurement model for each construct was treated as a single factor congeneric model with error variances and estimated regression weights. According to Motwani et al. (1997), to establish the construct validity of the measure, it is crucial to determine (1) the extent to which the measure correlates with other measures designed to measure the same thing and (2) whether the measure behaves as expected. The goodness of fit indices (GDI) of the seven SCM constructs exceeded the 0.90 criterion suggested by Hair et al. (1998), hence, establishing the construct validity. CFA showed all the items were loaded highly on their corresponding constructs, which supported the independence of the constructs and provided strong empirical evidence of their validity. Divergent or discriminant validity was tested by analyzing bivariate correlations between each of the SCM scales and other variables such as demographic variables and company size etc. There were no significant correlations between the SCM variables and these variables, and thus the scales were not measuring other unintended constructs. Since data for this study was generated using scaled responses, it was deemed necessary to test for reliability (Frohlich & Westbrook, 2001).

Table 1. Descriptive Statistics of Critical Variables of SCM Programs.

Variable	Original items	Final items	Mean	Std. Dev.	Reliability
Strategic Supplier Partnership	8	8	5.247	0.871	0.801
Customer Relations Practices	7	7	5.704	0.836	0.826
Information Sharing	4	4	4.888	1.215	0.911
Quality Information Exchange	4	4	5.250	0.925	0.908
Lean System	6	6	5.329	0.905	0.808
Postponement Concept	6	6	5.346	0.824	0.822
Technology and Innovation	6	6	5.230	1.088	0.918

The reliability analysis was conducted by calculating the Cronbach's alpha for each construct. Items that did not significantly contribute to the reliability were eliminated for parsimony purpose. The result shows that the Cronbach's alpha measures for the seven constructs exceeds the threshold point of 0.70 suggested by Nunnally (1978). Alpha coefficients for SCM scales range between 0.801 and 0.918 after the alpha maximization process were carried out (Table 1). As a result, 41 items were retained for the seven constructs.

Dependent Construct Measurement

Several studies have identified performance improvement constructs that are commonly associated with SCM (Voss, 1988; Gunasekaran et al., 2003; Kuei et al., 2001; Cox, 1999). Voss (1988) classified performance measures into three groups: market place competitive advantage, productivity increases, and non-productivity benefits. Marketplace success involved longer-term competitive gains including increased sales. In this study, the performance variable, sales is determined from single measurement using 7-point interval scales.

Table 2. Descriptive Statistics of Performance Variable

Indicator	Mean	Std. Dev.	Reliability(Cronbach Alpha)
Sales	4.8257	1.246	Single measurement

Research Methodology

The instrument used in this study was a structured survey questionnaire, which was designed to assess the companies in term of the described dimensions. The instrument developed in this study consists of two major parts. The first part comprises several constructs measuring SCM practices, and the second part comprises performance (sales). To enable respondents to indicate their answers, seven–point interval scales were use for SCM variables. A total of seven constructs of SCM, which have been widely referred, were extracted. Similarly, the dependent variable namely sales also used a seven-point interval scale, representing a range

of agreement on statement whether over the past three years sales are high relative to competitors after implementing SCM practices.

Sample companies were randomly chosen from manufacturing companies in Klang Valley, Malaysia. Companies in Klang Valley were chosen because majority of these companies were situated in Klang Valley (mostly in Kuala Lumpur and Selangor). The reasons for focusing on this sector are twofold. First, manufacturing companies have emerged as leading sectors in Malaysia in terms of adopting new manufacturing and SCM programs and these practices are driven primarily by competitive rather than regulatory forces. Second, the industry is heterogeneous in terms of sub-sectors and product/process complexity. Hundred and ten (110) useable responses were received and were analyzed using the SPSS package. The primary purpose of the research was to measure senior quality managers' or production manager's perception of SCM variables and to gain insight into the benefits of implementing SCM in the manufacturing industry. The goal is to understand and determine determinants of SCM that can improve sales. Face to face interviews with SCM managers or production managers were carried out for checking the information accuracy, validating the outcome of analysis and developing an understanding of practical aspects of SCM principles adoption. Given the scarcity of OR research in Malaysia that examines associations between SCM and performance, the purpose of this paper is to enhance managerial understandings of SCM and sales by addressing the following questions:

Which SCM programs have significant impact on sales?

With regards to these questions, the main objectives of this paper are:

To empirically investigate correlates between SCM and sales.
To empirically assessing the importance of each SCM indicator on sales.

Study Findings

Discussion on the empirical findings will be based on several statistical analyses which include (a) Pearson correlation analyses, (b) Friedman's rank test and (c) Stepwise multiple regression analysis.

a. Pearson Correlation analyses between SCM programs and sales

Pearson correlation (Table 3) is conducted to investigate and describe relationships between SCM and sales. This result indeed confirms close associations between SCM programs and sales. Sales has positive and strong correlations with Technology and Innovation (r = 0.486), Customer Relations Practices (r = 0.464), Lean System (r = 0.449), and Strategic Supplier Partnership (r = 0.431). In addition, it also has significant correlations with Lean System (r = 0.449), Information Sharing (r = 0.423) and Postponement Concept (r = 0.422). These findings are consistent with several previous studies that proclaimed better organizational transformations as a result of SCM initiatives (Lee et al., 1997; Metters, 1997; Narasimhan & Jayaram, 1998; Lummus et al., 1998; Anderson & Katz, 1998). Fundamentally, to improve sales, a manufacturing company should implement SCM programs.

Table 3. Spearman's Correlations between Supply Chain Management Programs and Sales

Supply	Chain Management programs	Sales
1	Strategic Supplier Partnership	0.431(**)
2	Customer Relations Programs	0.464(**)
3	Information Sharing	0.423(**)
4	Quality Information Exchange	0.432(**)
5	Lean System	0.449(**)
6	Postponement Concept	0.422(**)
7	Technology and Innovation	0.486(**)

*P£0.05, **P£0.01 2. All t-tests are one-tailed

b. Cluster Analysis and Friedman's Test

Exploring further on the segmentation of manufacturing companies in this study, a cluster analysis was carried out. Since sales are a very importance bottom-line outcome, therefore the classification is based on sales clustering. The result from cluster analysis statistically segmented the manufacturing companies into two clusters based on sales namely "High sales-generated companies" and "Low sales-generated companies". Tables 4 highlights further information about the cluster. The first cluster ("High sales-generated companies") comprises of large-scaled companies with average employees of more than 1,000 people

and average approximated sales turnover of RM 1.5 billion. Mean while, the second cluster ("Low sales-generated companies") comprises of smaller companies with average employees of about 600 and average approximated sales turnover about RM 90 million. From the result, we can also infer that the higher level of SCM implementations are more realized in "High sales-generated companies" than "Low sales-generated companies". "High sales-generated companies" put high priorities on 'customer relations programs', 'technology and innovation', 'lean system' and 'strategic supplier partnership' followed by 'postponement concept', 'quality information exchange' and 'lastly information sharing'. On the other hand, the second cluster ("Low sales-generated companies") has high priorities on 'customer relations practices', 'postponement concept' and 'strategic supplier partnership'.

Table 4. Rankings of Supply Chain Management Programs Based on High and Low Sales-Generated Companies Using Friedman's Test

Supply Chain Management programs	High sales-generated companies (n=63, chi-square = 51.358, significant=0.000)				Low sales-generated companies (n=47, chi-square = 18.717, significant=0.005)			
	Friedman's Test	Rank	Mean	Std Dev	Friedman's Test	Rank	Mean	Std Dev
Strategic Supplier Partnership	4.22	3	5.644	1.0131	4.22	3	4.7805	1.12943
Customer Relations Programs	5.10	1	5.966	.87032	4.85	1	5.0976	1.06782
Information Sharing	2.81	7	4.924	1.4318	3.28	7	4.1951	1.29845
Quality Information Exchange	3.32	6	5.203	1.2633	3.52	6	4.5000	.96825
Lean System	4.19	4	5.525	1.2192	4.15	4	4.7317	1.02529
Postponement Concept	4.11	5	5.551	1.0115	4.34	2	4.8293	.89170
Technology and Innovation	4.24	2	5.559	1.3166	3.63	5	4.4390	1.07352

Determining the Relationship between SCM Practices and Sales: A Stepwise Multiple Linear Regression Analysis

In this study, a multiple regression analysis was used to investigate the relationship between a set of predictor variables and a dependent variable and to identify most contributing SCM programs determinants. The model developed represents an attempt to account for the contributions of critical determinants of SCM programs on sales.

Testing the Overall Regression Model

A regression forecasting model is generated as follows:

$$Y = Y_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \ldots\ldots \beta_t X_i + e,$$

where:

$x_1, x_2 \ldots\ldots x_i,$ – independent variables

$\beta_1, \beta_2, \beta_3,$ – regression coefficients for the respective independent variables, $x_1, x_2 \ldots\ldots x_i$

The overall significance of the multiple regression model is tested with the following hypotheses:

$$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_t = 0$$

H_a : At least one of the regession coefficients is $\neq 0$

A rejection of the null hypothesis indicates that at least one of the predictor variables is adding significant predictability for the overall sales. The multiple regression result using stepwise method (Table 5) indicates that a strong relationship existed as hypothesized. This model has a good fit and significantly high values of R (0.623) and (0.388). The value of represents the proportion of variation of the dependent variable, Y, accounted for by the independent variables in the regression model. Meanwhile, R value indicates strong association between the independent and dependent variable. The value of adjusted is 0.369 with standard

deviation of 0.9499 and a significant F-value of 20.117. The model exhibited a significant F value. The F test was used to determine if the research model was able to account for a significant amount of variation in the dependent variable (Black, 2001). The regression model suggests that SCM Programs are able to explain almost 40% of the variance in the dependent variable (sales). This value is considered quite high, given that a multitude of factors affecting sales.

Table 5. The Regression Model Summary

R	R^2	Adjusted R^2 (Adj. R^2)	Std Error (SE)	F	Sig
0.623	0.388	0.369	0.9499	20.117	0.000

Significance Tests of the Regression Coefficients

The significance of beta coefficients provides support for the alternative hypothesis in the regression model. The values of the standardized beta coefficients of the SCM programs determinants provide some indication to their comparative influences on sales. Individual significance tests for each regression coefficient are carried out by using a t test (Hair et al., 1995). The hypotheses for testing the regression coefficient of each independent variable take the following form:

$H_0 : \beta_i = 0$

$H_1 : \beta i \neq 0$ (i = 1, 2,...., k).

Table. 6 The relationship between SCM programs and Sales
(A Stepwise regression analysis)

SCM programs	Unstd. Coeff.		Std.	t	Sig.
	Beta	S. Error	Beta		
Constant	.792	.561		1.412	.161
Customer Relations Programs	.349	.104	.303	3.363	.001
Technology & innovation	.249	.081	.280	3.074	.003
Information sharing between supply chain partners	.194	.075	.231	2.593	.011

Dependent variable = sales.

Testing the regression coefficients not only gives researchers some insight into the fit of the regression model, but it also helps in assessing the strength of individual predictor variables in estimating Y (Black, 2001). The result (Table 6) indicates that regression coefficients or slopes of 'Customer Relations Programs', 'Technology & Innovation' and 'Information Sharing between Supply Chain Partners' have significant impact on sales. This indicates the importance of combined efforts from management, employee, suppliers and customers. Managers of manufacturing companies are responsible for synthesizing all of the different SCM processes and programs in the business into a cohesive system focused on a common set of goals. To reduce the concern for data multicollinearity that maybe due to highly correlated variables, the study further determines VIF (variance inflation factor) values of the predictor variables. However, it is safe to conclude at this point that the overall regression model has a good fit.

In this study, the regression model was tested in order to explore the relationship of the seven critical factors of SCM practices and sales. The results of the initial multiple regression analysis was expected to provide insights into those SCM critical variables thought to be most important in upgrading the level of sales of manufacturing companies. However, future researchers should be aware of possible problems that may be encountered during regression analysis or discriminant analysis: (a) First, the problem of multicollinearity and (b) Second, the presence of outliers. Fortunately, we do not detect any outliers from the scatter diagram.

Table 7. Collinearity Statistics

SCM Practices	Tolerance	VIF
Strategic Supplier Partnership	0.635	1.574
Customer Relations Practices	0.793	1.260
Information sharing	0.880	1.137
Quality Information Exchange	0.851	1.175
Lean System	0.744	1.344
Postponement Concept	0.781	1.280
Technology & innovation	0.838	1.193

As stated earlier, one problem that can arise in multiple regression analysis is multicollinearity. One of the basic assumptions in regression

modeling is that the independent variables in the model are not linearly related. Multicolliearity is when two or more of the independent variables of a multiple regression model are highly correlated (Black, 2001; Wang, 1996). Multicollinearity affects the stability of the parameter estimates calculated in multiple regression and discriminant analysis models. Technically, multicollinearity could lead to improper variable estimations and ultimately unstable regression models formation. The result may suggest a misleading conclusion because when independent variables are highly correlated, the t-values exhibited are insignificant. This is because when independent variables are correlated the estimated standard error of the coefficients will be large and independent variables that should be significant predictors of a dependent variable are insignificant (Agus, 2000; Wang, 1996). The t values test the strength of the predictor given the other variables in the model. If a predictor is highly correlated with other independent variables, it will appear not to add much to the explanation of Y and produce a low t value. However, had the predictor not been in the presence of these other variables, the predictor might have explained a high proportion of variation of Y (Black, 2001).

Several procedures have been suggested in the literature for detecting the presence of multicollinearity among variables (Wang, 1996). In this study, VIF_j (variance inflation factor) associated with each predictor variable X_j were determined. If one or more of these variance inflation factors are large, we can conclude that multicollinearity exist among independent variables. It has been suggested, as a rule of thumb, that values of VIF_j greater than 10.00 may be considered large enough for us to suspect serious multicollinearity problem (Graybill & Iyer, 1994). Since none of the SCM variables exhibit values of VIF_j greater than 2.00, (Table 7) it is suggested that the presence of multicollinearity in this study is not severe. On the whole, the result exhibited a significant overall F test for the model, and also significance t values for predictor variables such as 'Customer Relations Programs', 'Technology and Innovation' and 'Information Sharing between Supply Chain Partners'.

Conclusion and Implications

The purpose of this paper is to empirically test the impact of supply chain management practices on sales so as to determine to what degree SCM issues influence sales in manufacturing companies in Malaysia. In summary, the findings of the empirical study are clear, and suggest several

things. Firstly, there is significant impact of SCM practices on sales of the Malaysian manufacturing companies. The findings suggest that supply chain management programs have significant correlations with sales. "High sales-generated companies" gives high emphasis on customer relations practices, technology and innovation, lean system, strategic supplier partnership followed by postponement concept, quality information exchange and lastly information sharing. Further, the findings from stepwise regression stress the importance of 'Customer Relations Programs', 'Technology & Innovation' and 'Information Sharing between Supply Chain Partners' on sales. Since customers are very important in any business, manufacturing companies need to translate customer requirements into product designs such as using a method called quality function deployment (QFD). It uses inter-functional teams to study and listen to customers to determine characteristics of superior products. In addition, advances in technology and innovation such as robotics and automation, are affecting every aspect of business which change the way manufacturing operations are being designed and managed. Lastly, successful SCM requires the sharing of information between suppliers. This information sharing can include everything from new product design specifications to capacity planning, scheduling and database in order to enhance the manufacturing process (Davis & Heineke, 2005, pp 149-150, 78, 117).

The results of this study suggest that superior adoption in SCM does have an impact on sales. The findings show that SCM is positively related to sales, which reinforces several empirical studies in the supply chain (Vickery et al. 1999; Lee et al., 1997; Frohlich & Westbrook, 2001; Gunasekaran et al., 2003; Kuei et al., 2001; & Cox, 1999).

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