The Structural Influence of Supply Chain Management on Product Quality and Business Performance

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***Abstract*—Supply chain management (SCM) has been increasingly recognized as a critical factor in improving bottom-line performances. In addition, more and more firms are making use of SCM to improve their performance. The study aims to understand and determine critical variables of SCM that would be able to enhance product quality and business performance in manufacturing companies in Malaysia. The study measures senior production or SCM managers' perceptions regarding SCM and level of performances in their companies. Two hundred and fifty responses are received and data are analyzed using SPSS. The study specifically investigates relationships between SCM, product quality and business performance and these associations are investigated utilizing parametric statistical analyses such as Pearson's correlations and structural equation modeling (SEM). The SEM result demonstrates that SCM dimensions namely 'lean production', 'new technology and innovation', 'strategic supplier partnership' and 'postponement concept' appear to be of primary importance and exhibit significant effects on product quality and business performance. Findings of the study provide a striking demonstration of the importance of SCM in enhancing bottom line performances of Malaysian manufacturing companies. The result indicates that manufacturing companies should emphasize greater attention to the waste elimination program through lean production as well as the technological aspects of SCM and a greater degree of management support for SCM implementation initiatives.**

***Index Terms*—Supply chain management, product quality, business performance, Pearson's correlations, structural equation modeling.**

I. Introduction

As global competition increases, manufacturing companies should be more involved in how their suppliers and customers conduct their businesses. To compete successfully in today challenging business environment, manufacturing companies should effectively integrate the internal functions within their companies and effectively linking them with the external operations of suppliers, supply chain members and final consumers. They need to focus on supply chain management practices that have impact on enhancing SCM activities and ultimately performances.

The process of making and distributing products and services to customers is becoming the most critical effort for companies to stay successful and is pertinent to the practice of SCM. Despite variable evidence regarding performance improvements related to SCM, relatively few empirical studies exist to measure the extent of performance improvements resulted from the SCM programs especially in the Malaysian context. This study seeks to address this apparent gap in literature by examining the performance implications of implementing SCM in the context of Malaysian manufacturing industry.

Empirically, the purpose of this study is to highlight an explicit result on the relationship between SCM and performances where other researchers have perhaps known or describe them only implicitly. There are studies which suggest that SCM improves performances but, with a few exceptions, rarely support their propositions with statistical evidences. This study is one of few attempts to estimate the structural effect of implementing SCM programs on product quality and business performance. It fills a gap that exists in the literature on SCM in the manufacturing industry in Malaysia. The main objectives of this study are:

a) To empirically assess the importance of each SCM dimension on performance.
b) To empirically determine whether SCM has significant influence on product quality.
c) To empirically investigate whether SCM has significant impact on business performance.
d) To empirically discover whether product quality has significant effect on business performance.
e) To empirically test whether there is a mediating effect of product quality in the linkage between SCM and business performance.

This study explores the possibility of adopting SCM as the basis for enhancing product quality and business performance in Malaysian manufacturing companies. First, this study proceeds with a brief explanation on the SCM principles and literature review; second, it discusses the methodology adopted. Third, it presents the result of the structural equation modeling (SEM). Finally, the overall results are then discussed and implications highlighted.

II. Supply Chain Management (Literature Review)

Supply chain management includes managing supply and demand, sourcing raw materials, manufacturing and assembly, warehousing and inventory tracking, order management, distribution across all channels, and delivery to the customer. The term SCM was first used in the 1980s and as such is a relatively new discipline within management theory with tools and concepts still being developed. As with most management subject areas, many definitions have been used to explain the term SCM. The frequency with which the term "supply chain management" (SCM) is used in today's environment would suggest that it is a well understood concept accompanied by an accepted set of managerial

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practices. However, definitions of and approaches to SCM vary substantially from organization to organization. Tan, et. al. [1] defines SCM as the simultaneous integration of customer requirements, internal and external requirements; and upstream supplier performance. Ellram and Cooper [2] identify SCM as an integrating philosophy to manage the total flow of a distribution channel from supplier to the final customer. Robinson and Kalakota [3] view the supply chain quite simply as a "process umbrella" under which products are developed and delivered to customers. From a structural viewpoint, they suggest, the supply chain refers to the complex network of relationships that organizations maintain with trading partners to source, manufacture and deliver products.

Basically, SCM involves integration, co-ordination and collaboration across organizations and throughout the supply chain. SCM has the potential to assist the organization in achieving both cost and a value advantage. To improve performance, organizations have to adopt SCM approach and consider the supply chain as a whole. Several researchers claim that SCM can result in better supply chain performance and bottom line results [4] [5]. In this study, in order to determine the domain that encompasses SCM practices, exhaustive theoretical, empirical and practitioner literature are reviewed. The supply chain management (SCM) dimensions included in the study are:

a) *Strategic Supplier Partnership* (MB1SSP): Developing trust and collaboration among supply chain partners as well as customers [6] [7].

b) Lean *Production* (MNB5LP): Lean production is associated with continuous pursuit of improving the processes, a philosophy of eliminating all non-value adding activities and reducing waste within an organization [8] [7].

c) *Postponement Concept* (MNB6PC): Postponement involves the process of delaying final product configuration until the actual order requirement is specified by the customer. Keeping products in semi-finished would allow more flexibility and customization in completing the final products and also enables a company to respond more quickly to market demand [9] [7].

d) *New Technology and Innovation* (MB7TECH): New technology and innovation refers to the application of the latest scientific or engineering discoveries to the design of operations and production processes in SCM [7].

Meanwhile, product quality performances (PQUAL) are derived from three pertinent product quality dimensions namely:

a) *Product Conformance* (CONFORM): Conformance quality is the degree to which a product's design and operating characteristics meet established standards. It reflects whether the various produced units are identically made and meet the specifications [10] [11].

b) *Product Performance* (PPERFORM): Performance quality refers to the levels at which the product's primary characteristics operate established initially at one of four performance levels: low, average, high and superior [10][11].

c) *Product* Reliability (RELIABLE): Reliability is a measure of the probability that a product will not malfunction or will operate properly within a specified time period or the consistency of performance over time during which it is subjected to a given set of environment (temperature, humidity, corrosive agents, etc) and/or mechanical (shock, abrasion etc) stress [12] [11].

d) *Product Durability* (DURABLE): Durability is a measure of the product's expected operating life before it physically deteriorates or until replacement is preferable. Buyers will pay more for a more durable product but this is subject to some qualifications [13] [11].

On the other hand, business performance is operationalised by items namely [14] [7]:

a) *Return on Sales* (ROS): A measure of a company's profitability, equal to a fiscal year's pre-tax income divided by total sales.

b) *Return on Assets* (ROA): A measure of a company's profitability, equal to a fiscal year's earning divided by its total assets, expressed as a percentage.

c) *Market share* (MKTSH): Market share refers to a brand's share of the total sales of all products within the product category in which the brand competes. Market share is determined by dividing a brand's sales volume by the total category sales volume.

III. The Conceptual Framework – The Conceptual Model And Hypotheses

A. The Conceptual Model

This section explores the linkages between supply chain management, product quality and business performance constructs and variables within the context of the Malaysian manufacturing industry. The proposed conceptual model, as depicted in Figure 1, is based on three main constructs—(i) Supply chain management (SCM); (ii) Product quality (PQUAL); and (iii) Business performance (BUSPERF).

B. Hypotheses

The researcher proposes that supply chain management (SCM) has an important influence on product quality and business performance results. A structural equation model is used in this study to analyze the structural effect of SCM on these performance results. In this study, firstly, the study aims to test the fitness of the overall SEM model based on the main null hypothesis:

H_0 : The overall hypothesized model has a good fit.

Then secondly, the study looks at the main research hypotheses of the study regarding the relationships between SCM and product quality and business performance. The first hypothesis states that implementing effective SCM enhances product quality. The second hypothesis proposes that implementing SCM improves business performance. In addition, this study also attempts to test the third hypothesis suggesting that product quality has a positive structural effect on business performance within the context of Malaysian manufacturing companies. Lastly, it is interesting to investigate whether product quality mediates the linkage between SCM and business performance (fourth hypothesis). Therefore, the following main research hypotheses are proposed:

H_1 : Supply chain management has a positive structural effect on product quality.

H_2 : Supply chain management has a positive structural effect on business performance.

H_3 : Product quality has a positive structural effect on business performance.

H_4 : Product quality mediates the linkage between supply chain management and business performance.

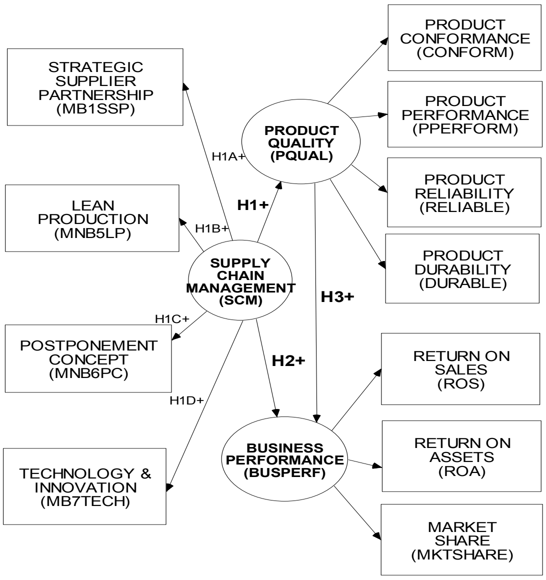

Fig. 1. The Conceptual Framework Linking Supply Chain Management, Product Quality and Business Performance

IV. Research Methodology

The unit of analysis chosen for this study was company level and each company was represented by either production or SCM manager (respondent). The sampling frame was derived from the Federation of Malaysian Manufacturing Companies Directory (FMM). The primary purpose of the research was to measure production manager's or SCM manager's perception of supply chain management initiatives and to gain insight into the benefits of adopting supply chain management in the manufacturing industry. The goal was to understand and determine critical variables of SCM that would be able to better enhance product quality and business performance. Face to face interviews with these managers were conducted for checking the information accuracy, validating the outcome of analysis and developing an understanding of practical aspects of SCM. Two hundred and fifty responses were received and analyzed using SPSS. 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 consisted of two major parts. The first part comprised several constructs measuring SCM, and the second part comprised several performance measurements. To enable respondents to indicate their answers, seven–point interval scales were use for the questionnaire regarding the level of SCM dimensions and implementations (7-strongly agree and 1-strongly disagree). The performance measures namely product quality and business performance also used a seven-point interval scale, representing a range of agreement on statements whether over the past three years these performances were high relative to competitors after implementing SCM. Before creating the final scales, the data were checked for normality and outliers.

V. Independent and Dependent Constructs' Measurement: Factor Analysis and Reliability Test

TABLE 1: Descriptive Statistics and Factor Analysis

Exploratory Factor Analysis (Varimax Rotation)					
Supply chain management (SCM):	Mean	Std Dev.	Factor Loadings 1 (SCM)	Factor Loadings 2 (PQUAL)	Factor Loadings 3 (BUSPERF)
Strategic Supplier Partnership (MB1SSP)	5.18	.975	**0.743**	0.282	0.251
Lean Production (MNB5LP)	5.21	1.08	**0.779**	0.374	0.132
Postponement Concept (MNB6PC)	5.32	0.97	**0.787**	0.249	0.200
New Technology and Innovation (MB7TECH)	4.94	1.26	**0.697**	0.157	0.495
Product Quality (PQUAL):					
Product Conformance (CONFORM)	5.49	1.09	0.276	**0.861**	0.254
Product Performance (PPERFORM)	5.56	1.03	0.271	**0.848**	0.304
Product Reliability (RELIABLE)	5.60	1.06	0.284	**0.840**	0.261
Product Durability (DURABLE)	5.48	1.09	0.294	**0.832**	0.249
Business performance (BUSPERF):					
Return on Sales (ROS)	4.96	1.21	0.227	0.342	**0.819**
Return on Assets (ROA)	4.94	1.16	0.209	0.311	**0.853**
Market Share (MKTSH)	4.76	1.49	0.292	0.210	**0.824**

As the initial data analysis, SCM, product quality and business performance dimensions or proxies were subjected to factor analysis and reliability test. These tests were computed to select and assess the final items of the constructs that would be utilized for further statistical and hypotheses testing. Exploratory factor analysis (EFA) was conducted to investigate whether the factors derived from the exploratory factor analysis fitted the constructs as described theoretically in the literature (Table 1). Results from the EFA indicated that all items had significant loadings on their respective factors with eigen values exceeded 2, and the values of cumulative variance explained ranged from 27.539 to 79.476 (Table 2). In addition, the KMO (Kaiser-Meyer-Olkin) measure was 0.903 with significant chi-square value (Barlett's Test of Sphericity = 1801). The value of KMO in this analysis surpassed the threshold value of 0.50 as recommended by Hair, Anderson, Tatham, & Black [15]. All constructs exhibited high factor loadings and fell into the designated factors. The result provided evidence to support the theoretical conceptualization of the three constructs. Observing the descriptive statistics in Table 1, the result demonstrated that among SCM dimensions, postponement concept had the highest mean (5.317), followed by lean production (5.214), strategic supplier partnership (5.183) and lastly new technology and innovation (4.941). The result suggested that the adoption of new technology and innovation should be enhanced to keep abreast with global manufacturing practices. On the other hand, for Product

Quality variables; product reliability demonstrated the highest mean (5.600) followed by product performance (5.562), product conformance (5.488) and product durability (5.476). Finally, among business performance measures; 'return on sales' (4.964) exhibited the highest mean followed by 'return on assets' (4.936) and 'market share' (4.764).

Since data for the study were generated using multi-scaled responses, it was deemed necessary to test for reliability [16] [11]. The internal consistency of each factor was examined using Cronbach Alpha. The reliability analysis was conducted by calculating the Cronbach's alphas for the main constructs in the study. Items that did not significantly contribute to the reliability were eliminated for parsimony purpose. The result indicated that the Cronbach's alpha measures for the three main constructs exceeded the threshold point of 0.70 suggested by Nunnally (1978). Alpha coefficients for SCM, product quality and business performance ranged between 0.854 and 0.915 after the alpha maximization process were carried out, indicating internal consistency (Table 2). As a result, 11 items of the three constructs were retained for the confirmatory phase.

TABLE 2: STATISTICAL RESULTS

	Exploratory Factor Analysis –EFA (Varimax Rotation)			Confirmatory Factor Analysis (CFA)		Reliability
CONSTRUCT	Eigen value	% of Variance Explained	Cumm. Variance Explained	GFI	CFI	Cronbach Alpha
Supply chain management	2.75	27.54	27.54	0.99	0.99	0.854
Product Quality	2.66	26.57	54.11	0.99	0.99	0.915
Business performance	2.54	25.37	79.48	0.99	0.99	0.898

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization (KMO= 0. 903), Bartlett's Test of Sphericity (chi-sq= 1801.124, sig = 0.000)

The confirmatory factor analysis (CFA) or a measurement model using AMOS 5 was employed for examining construct validity of each scale by assessing how well the individual item measured the scale [17] [18]. Specifically, the confirmatory factor analysis was used to detect the unidimensionality of each construct. The goodness of fit index (GFI) and comparative fit index (CFI) of the three constructs computed from the confirmatory factor analysis (CFA) exceeded the 0.90 criterion suggested by Hair et al. [15], 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.

VI. FINDINGS

A. Pearson's Correlations between SCM, Product Quality and Business Performance

The study also examined Pearson's correlations between SCM and product quality (Table 3). The result suggested that the first product quality dimension namely product conformance had high correlations with SCM dimensions especially with 'lean production' (r = 0.593) and 'strategic supplier partnership' (r = 0.530) and 'new technology and innovation' (r = 0.516). Product conformance, product reliability and product durability had high correlations with all SCM dimensions especially with 'lean production', and 'new technology and innovation'. The findings suggested that to enhance product quality, a manufacturing company should invest its resources in incorporating lean production and technology and innovation in SCM to ensure that production runs effectively and efficiently resulting in high quality products.

TABLE 3: PEARSON'S CORRELATION BETWEEN SCM AND PRODUCT QUALITY DIMENSIONS

	Product Quality			
Supply chain management (SCM)	Product Conformance (CONFORM)	Product Performance (PPERFORM)	Product Reliability (RELIABLE)	Product Durability (DURABLE)
Strategic supplier partnership (MB1SSP)	0.530 (**)	0.506 (**)	0.489 (**)	0.523 (**)
Lean production (MNB5LP)	0.593 (**)	0.576 (**)	0.593 (**)	0.568 (**)
Postponement Concept (MNB6PC)	0.487 (**)	0.481 (**)	0.516 (**)	0.507 (**)
New Technology and Innovation (MB7TECH)	0.516 (**)	0.523 (**)	0.548 (**)	0.513 (**)

1. † if p < 0.10, * if p < 0.05; ** if p < 0.01; *** if p < 0.001 2. All t-tests are two-tailed

TABLE 4: PEARSON'S CORRELATION BETWEEN SUPPLY CHAIN MANAGEMENT AND BUSINESS PERFORMANCE

	Business Performance		
Supply chain management (SCM)	Return on Sales (ROS)	Return on Assets (ROA)	Market Share (MKTSH)
Strategic supplier partnership (MB1SSP)	.460 (**)	.479 (**)	.441 (**)
Lean production (MNB5LP)	.481 (**)	.483 (**)	.387 (**)
Postponement Concept (MNB6PC)	.400 (**)	.366 (**)	.299 (**)
New Technology and Innovation (MB7TECH)	.535 (**)	.541 (**)	.465 (**)

1. † if p < 0.10, * if p < 0.05; ** if p < 0.01; *** if p < 0.001 2. All t-tests are two-tailed

Business performance indicators also exhibited positive correlations with SCM dimensions (Table 4). Specifically, 'Return on Sales' had high correlations with new technology and innovation (r = 0.535), lean production (r = 0.481) and strategic supplier partnership (r = 0.460). Meanwhile 'return on assets' had high correlations with new technology and innovation (r = 0.541), lean production (r = 0.483) and strategic supplier partnership (r = 0.479). Market share also demonstrated strong correlations with new technology and innovation (r = 0.465), strategic supplier partnership (r = 0.441) and lean production (r = 0.387). Hence, the result suggested that investment in new technology and innovation in SCM and adoption of lean production would be able to improve 'return on sales', 'return on assets', 'market share' and ultimately overall business performance. [7] [11]

B. Structural Equation Modelling (SEM)

The findings of the SEM model indicated that the resulting Chi-square value was 52.30 with 41 degrees of freedom and probability value of 0.111 (Fig. 2). The result supported the main null hypothesis that the SEM model had a good fit (H_0). The p-value was considerably substantial (probability value > 0.05), in supporting the proposition that the overall model fitted the data. Furthermore, other statistical structural indices such as goodness of fit index (GFI = 0.964), Bentler comparative fit index (CFI = 0.995), Bollen incremental fit index (IFI = 0.995) and Tucker and Lewis index (TLI = 0.993) also provided strong evidence that the SEM model had a satisfactory fit (Table 5). Since the probability value and structural modeling indices were well above the recommended level, the model was considered to be a reasonable representation of the data [17] [18] [7].

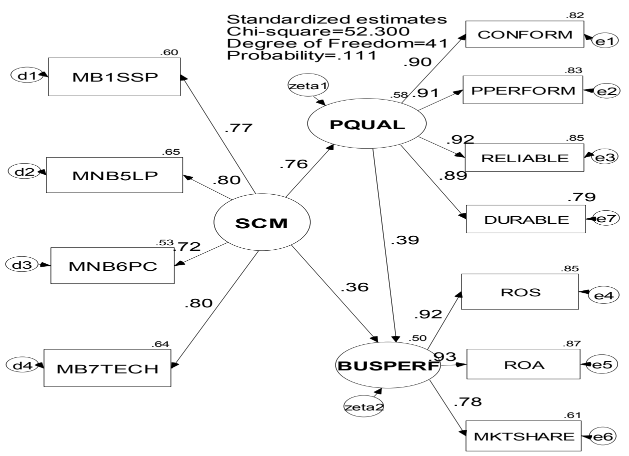

Fig. 2: The Structural Linkage between SCM, Product quality and Business Performance

TABLE 5: RESULTS OF THE OVERALL MODEL FIT

Statistics	Model Values	Recommended values for good fit
Chi square	53.300	-
Probability Level	0.111	≥ 0.05
Degree of Freedom	41	-
χ^2 /df	1.227	≤ 3.00
Bollen (1989) Incremental Fit Index (IFI)	0.995	≥ 0.90
Tucker & Lewis (1973) (TLI)	0.993	≥ 0.90
Bentler (1988) comparative fit model (CFI)	0.995	≥ 0.90
Normed fit index (NFI)	0.977	≥ 0.90
Goodness of fit index (GFI)	0.964	≥ 0.90

*Chau (1997)

The direct structural effect of SCM on product quality was high with a structural effect value of 0.760. The standardized structural coefficient of SCM on product quality was associated with a low standard error (0.095) and a non-zero critical ratio (10.582), which indicated that the structural effect between these two constructs, was positive and the relationship was significant.

TABLE 6: STRUCTURAL AND MEASUREMENT RESULTS OF THE SEM MODEL

(i) Constructs and indicators	Std. Loadings	Std. errors	Critical Ratio	Probability
a. Supply chain management (SCM):				
Strategic supplier partnership (MB1SSP)	0.772	0.092	11.466	0.000
Lean production (MNB5LP)	0.804	0.103	11.913	0.000
Postponement Concept (MNB6PC)	0.725	0.083	11.462	0.000
New Technology and Innovation (MB7TECH)	0.798	0.120	11.835	0.000
b. Product Quality (PQUAL):				
Product Conformance (CONFORM)	0.904	0.045	23.213	0.000
Product Performance (PPERFORM)	0.913	0.053	19.405	0.000
Product Reliability (RELIABLE)	0.921	0.043	24.458	0.000
Product Durability (DURABLE)	0.887	0.047	22.065	0.000
c. Business performance (BUSPERF) :				
Return on Sales (ROS)	0.915	0.078	13.894	0.000
Return on Assets (ROA)	0.939	0.042	23.199	0.000
Market share (MKTSH)	0.779	0.064	16.417	0.000
(ii) Exogenous/ endogenous Path				
a. SCM→ PQUAL [H_1 is supported]	0.760	0.095	10.582	0.000
b. SCM → BUSPERF [H_2 is supported]	0.360	0.149	3.849	0.000
c. PQUAL→BUSPERF [H_3 is supported]	0.390	0.106	4.340	0.000
d. SCM → PQUAL →BUSPERF [H_4 is supported]	Indirect effect (.759*.387) = 0.263 (sig.) Total Effect (.365+ .263) = 0.628 (sig.)			

The direct structural effect of SCM on business performance was also high and significant with a structural effect value of 0.360, a low standard error (0.149) and a non-zero critical ratio (3.849). In addition, product quality also exhibited a substantial and positive structural effect on business performance with a structural effect value of 0.390 (standard error = 0.106 and critical ratio = 4.340). Therefore, there were enough evidences to accept the first three hypotheses. Firstly, SCM had a positive effect on product quality (H_1). Secondly, SCM had a positive structural effect on business performance (H_2). Thirdly, product quality had a positive structural effect on business performance (H_3). The result also indicated that there was a mediating effect of product quality in the linkage between SCM and business performance. The calculated indirect effect was 0.263 and the total effect was 0.628. Since the initial structural direct effect of SCM on business performance was also significant (0.360), therefore it was concluded that product quality had a partial mediating effect in the linkage between SCM and business performance (H_4). Hence, all the four main hypotheses were supported (H_1, H_2 , H_3 and H_4 were supported). Overall, it was essential to reaffirm that SCM can ultimately improve business performance of manufacturing companies in Malaysia mediated by product quality performance.

Investigating the structural loadings of each SCM determinants (Fig. 2 and Table 6) on the main construct, the result demonstrated that 'lean production' (structural loading = 0.804), had the highest contribution toward SCM implementation. It was followed by 'new technology and innovation' (structural loading = 0.798), 'strategic supplier partnership' (structural loading = 0.772), and lastly 'postponement concept' (structural loading = 0.725). All of these indicators had significant probability values (critical values ≥ 2.00), giving statistical evidences that the contributions of these determinants toward overall SCM implementations were significant and positive. The SEM result also demonstrated the SCM dimensions had significant contributions toward business performance indicators namely 'return on assets' (structural loading = 0.93), 'return on sales' (structural loading = 0.92), and 'market share' (structural loading = 0.78).

VII. Conclusion And Implications

To meet the increasing demands of high-quality and technological goods from sophisticated local and overseas markets, manufacturing companies must continuously improve their efforts in technological and quality operations. SCM provides a vision that focuses everyone in an organization on product, production and quality improvements. The pursuit of these improvements is not only requested by the market but also driven by the need to survive. The importance of critical dimensions of SCM is highlighted by utilizing SEM. The results of the study assist in the understandings of how SCM determinants influence product quality and business performance.

The result indicates that manufacturing companies should emphasize greater attention to the technology and lean production aspects of SCM and a greater degree of management support for SCM implementations. New technology and innovation in SCM would enhance product quality and product offerings in catering the changing customers' needs and customization. This subsequently would lead to better sales and market share. Achievement of these benefits requires changes in the way companies design and develop products; and production processes using new technological tools. Using the latest design technology, the manufacturing companies may save huge amounts of time and money in bringing new products to market faster with better quality and innovation [19] [11]. On the other hand, lean production has the potential of eliminating unnecessary waste and also enabled companies to identify waste more aggressively especially in the area of raw materials scheduling and manpower utilization. A lean production system has the characteristic of being able to adapt quickly to small variations in demand and trying to reduce process variance [20]. These SCM initiatives together with cooperation between supply chain partners and customization process under postponement program would result in better quality and customized offerings which ultimately improve products sales of the manufacturing companies.

The conclusion emerging from this study is that SCM would ultimately result in positive gains. The results validate some of the key linkages and support beliefs and evidences by researchers regarding the relationships between SCM, product quality and business performance. It is also important to note that this study attempts to enrich the literature review and make a contribution in supply chain management-related studies. This study to some extent helps in resolving controversy about the magnitude and measurements of performance gains from adopting SCM. By strengthening SCM, improved performance will likely to occur. In short, the findings of this study suggest that SCM enhances product quality and has a positive effect on business performance.

References

[1] K.C. Tan, S.B. Lyman, and J.D. Wisner. Supply chain management: a strategic perspective, *International Journal of Operations and Production Management.*, vol. 22 no.6, pp. 614-31, 2002.

[2] L.M. Ellram, and M.C. Cooper. Supply chain management, partnerships and the shipper third party relationship, *The International Journal of Logistic Management*, vol. 1, no. 2, pp.1-10, 1990.

[3] M. Robinson and R. Kalakota. E-Business Road-map for Success, Wokingham: Addison-Wesley, 2000.

[4] M. Christopher. Logistics and supply chain management: Strategies for reducing cost and improving service, *Financial Times.* Pitman Publishing, 1998.

[5] S. Bhasin. Lean and performance measurement, *Journal of manufacturing technology Management. Vol.* 19, no. 5, pp. 670-684, 2008

[6] S. Li, B. Ragu-Nathan, T.S. Ragu-Nathan, and S.S Rao, The impact of supply chain management practices on competitive advantage and organizational performance. *Omega*, vol. 34. No. 1, pp. 107-124, 2006

[7] A. Agus. Supply chain management, supply chain flexibility and business performance. *Journal of Global Strategic Management.* 2011, vol. 5, no. 1, pp. 134-145, 2011.

[8] J. P. Womack and T.D. Jones. *Lean Thinking*. Free Press. 2003, pp. 352

[9] R. I. Van Hoek, The rediscovery of postponement: a literature review and directions for research, *Journal of Operations Management,* vol. 19, pp.161-84, 2001

[10] P. Kotler, Marketing Management Analysis, Planning, Implementation and Control. Eight Edn. Prentice Hall. New Jersey, 2004.

[11] A. Agus, 2010, the importance of new technology and innovation in SCM in enhancing production performance and product quality performance: an investigation on mediating effect. *Global Review of Business and Economic Research*, vol. 6, no. 2, pp.19-38, 2010.

[12] N. McGaughey, Building competitive strength: Lessons from the chemicals industry. *Industrial Management*. vol. 29, no. 3, pp. 36-41, 1991

[13] D. Pascucci, Up to date communications a must for keeping pace in the service business. *Air condition, Heating and Refrigeration News*. vol. 205, no. 16, pp. 5-6. 1998.

[14] Investorwords, 2010. [http://www.investorwords.com /5775/ ROS .html. Accessed 06 September 2010]

[15] J.F. Hair, R.E. Anderson, R.L. Tatham, and W.C Black, *Multivariate Data Analysis,* Englewood Cliffs, NJ: Prentice-Hall, 1998.

[16] M. T. Frohlich, & R. Westbrook, (2001). Arcs of integration: An international study of supply chain strategies, *Journal of Operations Management*, vol. 19, 185-200, 2001.

[17] S. L. Ahire, D.Y. Golhar, & M. A. Waller, (1996). Development and validation of QM implementation constructs, *Decision Sciences.,* vol. 27, no. 1, pp. 23-55, 1996

[18] A. Agus. A linear structural modelling of total quality management practices in manufacturing companies in Malaysia. *Total Quality Management,* vol. 12, no.5, pp. 561-573, 2001

[19] N. Gaither, and G. Frazier, *Operations Management*, 9rd Cincinnati,Ohio: South-Western, 2002.

[20] A.S. Sohal, and A. Egglestone, Lean production: Experience among australian organizations. *International Journal of Operations & Production Management, vol.* 14, no. 11, pp. 35 -51, 1994

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