

A Model for Supply Chain Performance of Electronics Industry in Malaysia

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Abstract—During the last decades supply chain issues have attracted researchers and industrialists' attention especially in manufacturing-based industries. Enhancing supply chain performance can significantly affect firm's competitive position within competitive markets and provide the enterprise with competitive advantage over its rivals. Based on the existing literature in the context of supply chain, this study tries to present a model for supply chain performance. The conceptual model presented in this study consists of supply chain design, information sharing, flexibility, delivery and supply chain performance and the electronics industry in Malaysia is selected as the population of this study in order to test the model by using the data collected from the industry. The model is investigated through path analysis and then by using factor analysis, Friedman test and paired sign test the variables are identified and the priority of each variable is investigated. The model presented by this study can be employed as a platform by Malaysian electronics manufacturing companies in order to improve their supply chain performance and obtain competitive advantage within local and foreign markets.

Keywords: *supply chain performance, supply chain design, information sharing, flexibility, delivery, Electronics industry, Malaysia*

I. INTRODUCTION

In today's highly unsteady and competitive markets, rivalry among companies is transformed from competing on the basis of own capabilities to competing with the whole supply chain [18]. Supply chain consists of the whole activities associated with products and services movement from raw material stage to final products which are consumable by customers. This movement includes financial and information flow as well as material flow. In other words, supply chain is a network consisting of downstream and upstream organizations which are involved in different processes and activities that create value for end customers in the form of products or services [8]. This definition emphasizes on satisfying customer's needs through all the activity levels of supply chain. The performance of the supply chain is affected by different factors. One of the most important factors influencing the performance of supply chain is supply chain design [31]. In fact design of the supply chain can affect its efficiency and effectiveness. Moreover, a

properly designed supply chain can help the firms cooperating within supply chain to achieve competitive advantage over rivals [31]. Today's success stories clearly depicts that taking advantage of an innovative design of supply chain is essential to firms in order to obtain higher levels of supply chain performance and consequently achieving competitive advantage over competitors. Besides supply chain design, information sharing is also one of the most important capabilities which can improve supply chain performance and consequently enhance its competitiveness. Information sharing in a supply chain is the ability of the firm in effectively and efficiently sharing information among its partners all along the supply chain [4]. Indeed, effective information sharing can be taken into account as one of the most significant abilities of supply chain process [32] by which efficient operation of the firm as a single partner of supply chain is considerably affected and more importantly firm does not need to possess other parts of the supply chain in order to operate more efficiently. Furthermore, integration and coordination across supply chain can be well provided through information sharing [40]. Failures can occur in case of information delays, shortage or distortion across the supply chain [4, 25]. Shorter order cycle time and lower total cost can be provided through applying higher level of information sharing by firms operating within the supply chain [21]. It is imperative to mention that in any supply chain, what information is shared, with whom it is shared and how it is shared can influence the impact of information sharing on supply chain performance [3, 20, 15]. As these issues should be initially considered in the supply chain design process, the impact of information sharing on supply chain performance must be evaluated together with the design considerations. Therefore, the design of the supply chain can affect its performance through influencing information sharing within the supply chain. In other words, supply chain's performance and competitiveness depends on its design which determines its information sharing as well. Another important factor that can influence supply chain performance is flexibility. In the context of supply chain literature flexibility is generally referred to as firm's response to uncertainties. In fact as long as a manufacturing system obtains the ability of dealing with environmental instabilities and variations the system possesses flexibility [23]. According to [38] a manufacturing system is said to have flexibility, when it achieves the ability of reacting to

environmental changes faster and in a less costly manner in a way that system effectiveness will be less influenced. As a consequence of today's competitive pressure within markets, lots of firms are forced to enhance their supply chain flexibility in order to rapidly adapt to environmental variations [34]. [7] argued that when it comes to the whole supply chain which comprises supply network, production firms and delivering enterprises, flexibility is taken especially in to account as an important and relevant factor. Supply chain flexibility is defined as supply chain's rapidity capabilities and swiftness, destinations and volume in line adaptabilities with changes in customer requirements [22] which is indeed, an extension of the definition of manufacturing flexibility to the entire supply chain. According to [39] firm's efficiency can be improved through supply chain's flexibility which ultimately enhances the performance of supply chain. Moreover, flexibility of the supply chain is itself affected by the way supply chain is designed. Indeed supply chain flexibility is one of the most important considerations in designing the supply chain [2]. Many studies have also investigated the impacts of flexibility together with information sharing e.g. [26,43&39]. Flexibility may contribute to delivery as well. Firm's ability in changing delivery dates is a consequence of its flexibility [1]. Delivery is referred to as the extent to which a company's promise about delivery of products is reliable for customers, while providing customers with more speedy and on time delivery comparing to its rivals [28,24]. Therefore delivery can be taken into account as a critical factor affecting the performance of the supply chain. The higher the delivery performance, the higher the performance of the supply chain [9].

II. SUPPLY CHAIN DESIGN

Supply chain design involves making decision about number of suppliers participating in supply chain, selecting and evaluating suppliers, proximity to suppliers, planned capacities in each facility, definition of contractual terms, and reactions to the possible disagreements between channel members [5]. A properly designed supply chain is a crucial factor in providing competitive advantage for the firms within that particular supply chain [31].

III. SUPPLY CHAIN INFORMATION SHARING

Information sharing is the ability of the firm in sharing knowledge with supply chain partners in an effective and efficient approach [4]. Effective information sharing is considered as one of the most important abilities of supply chain process [32]. Information sharing is one of the most important tools for achieving an integrated and coordinated supply chain [40]. In this study supply chain information sharing is associated with the amount of information shared among supply chain partners in downstream and upstream side of the supply chain and also the information intensity.

IV. FLEXIBILITY

In this study flexibility is associated with firm's ability in changing its production volume and /or capacity [27,29,42],

firm's capability to produce a broad range of products[10], firm's capacity to match the products' features considering the customer's desires and needs promptly[11,42], firm's capacity in delivery handlings for customers[16] and the firm's ability to perform products customization on the basis of customer attributes [17].

V. DELIVERY

Prior studies describe delivery as reliability of firm's promises to deliver the product more promptly and on time to their customers in comparison to competitors [28, 24]. However, delivery can be described in two categories as delivery reliability and delivery speed [14]. Therefore, delivery reliability is explained as Firm's capability to fulfill its commitments to delivery and delivery speed is described as firm's ability to rapidly deliver its products to customers faster than competitors. [13], suggests that the issue about delivery reliability and delivery speed arises only when the time necessary to accumulate the order plus the necessary time to process the order completion exceeds the time of delivery which the customer expects. In this study delivery is associated with diminishing manufacturing lead time [13], controlling lead time of order [33], providing speedy deliveries [13] and meeting delivery dates [24].

VI. SUPPLY CHAIN PERFORMANCE

In this study supply chain performance is associated with manufacturing cycle time [34], delivery Cycle times [34] on time delivery performance [35], return on sales [12], ROA[36] profit margin[34], and sales over assets [12].

VII. STUDY HYPOTHESES

With regards to the purpose of this study which is identifying a comprehensive structure for supply chain performance and its components, as well as identifying the relationship between them, based on the theoretical review, the hypotheses for this study are developed as follows:

1-Supply chain performance is influenced by supply chain design, supply chain information sharing, flexibility and delivery.

2-Supply chain design affects information sharing and flexibility.

3-Information sharing and flexibility are correlated to each other.

4-Supply chain design components affecting supply chain performance consist of decision about number of suppliers participating in supply chain, selecting and evaluating suppliers, proximity to suppliers, planned capacities in each facility, definition of contractual terms, and reactions to the possible disagreements between channel members.

5-Information sharing components influencing supply chain performance consist of information shared among supply chain partners within upstream and downstream supply chain and information intensity.

6-Flexibility components affecting supply chain performance consist of firm's capability in changing its production volume and /or capacity, firm's capability to produce a broad range of products, firm's capacity to match

the products' features considering the customer's desires and needs promptly, firm's capacity in delivery handlings for customers and the firm's ability to perform products customization on the basis of customer attributes.

7-Delivary components influencing supply chain performance consist of diminishing manufacturing lead time, controlling lead time of order, providing speedy deliveries and meeting delivery dates.

The conceptual model for this study which is proposed based on the literature and the hypotheses is depicted in figure 1.

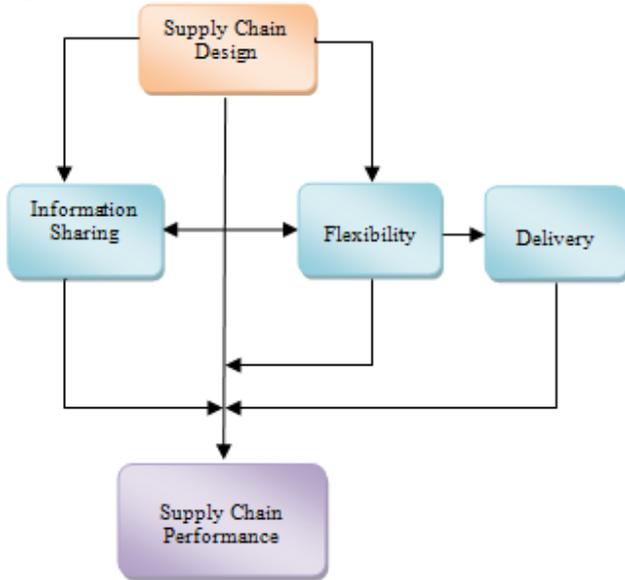


Figure 1. Conceptual Framework

VIII. METHODOLOGY

In this study the causal association of variables to each other is investigated. This study can be categorized as explanatory study in which the mechanism of the association of dependant and independent variables is examined. In order to collect primary data, questionnaire was utilized. The reliability of the questionnaire was also tested. The value of Cronbach's Alpha for the questionnaire was estimated 0.871 which shows a strong and acceptable value. Additionally, in order to ensure the validity of the questionnaire, the questionnaire was checked with two professors of operation management and one expert in supply chain management.

IX. POPULATION AND SAMPLE SIZE

The population of this study is electronic companies in three subsectors (industrial electronics, consumer electronics, and electronic components) located in Selangor state and Federal Territory. This population is an appropriate representative for Malaysia's electronic industry. Moreover, supply chain managers and operation managers are selected as the unit of this study. In order to collect primary data a sample size of 350 electronic companies was selected. The authors used e-directory.com.my, Malaysia INFO pages

Handbook¹ and Mechanical & Electrical Directory 2010 Handbook² in order to get contact information of the firms. All the questionnaires were sent to companies through e-mail and after one week reminder e-mails were sent. After that we started calling companies and eventually after five weeks 289 questioners were collected among which 251 questionnaire were answered completely.

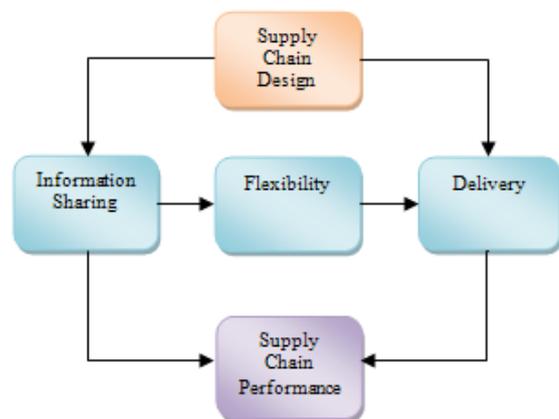
X. DATA ANALYSIS

In order to test the first three hypotheses, path analysis was employed using SPSS. The results for variables' path coefficient are illustrated in table 1.

TABLE 1.

Independent variable	Direct path Coefficient	Indirect path Coefficient	Total path coefficient
Delivery	0.418	N/A	0.418
Supply Chain Design	N/A	0.367	0.367
Information Sharing	0.232	0.109	0.341
Flexibility	N/A	0.143	0.143

According to the path analysis, the first three hypotheses were supported. The findings from data analysis depicted that supply chain design affects supply chain performance through delivery and information sharing. Moreover, information sharing and delivery have a direct impact on supply chain performance. The results also illustrated that flexibility affects supply chain performance through delivery. Information sharing affects supply chain performance directly and has also an indirect influence on supply chain performance through flexibility. These results confirm the study model as follows:



¹ Malaysia INFO pages Handbook (KDN PP14089/10/2010(025769))

² Mechanical & Electrical Directory 2010 Handbook (pp16674/11/2010)

The rest of the hypotheses were tested through factor analysis and were all supported. Furthermore, in order to identify each variable's priority based on its significance Friedman test and paired sign test were used. The results are depicted in table 2.

XI. CONCLUSION

This study intended to present a model for supply chain performance by employing supply chain design, supply chain information sharing, flexibility and delivery components as independent variables influencing supply chain performance. Malaysia Electronic Industry as the leading sector in Malaysia's manufacturing sector was selected as the population of this study. The results from this study depicted that supply chain design influences supply chain performance through delivery and information sharing. Furthermore, information sharing and delivery have a direct influence on supply chain performance. The findings also showed that flexibility influences supply chain performance through delivery. Information sharing affects supply chain performance directly and has also an indirect impact on supply chain performance through flexibility. This study elaborates the significant affect of the design of the supply chain on its performance while considering the impact of information sharing and the findings are in consistence with the results of the study by [31]. The findings also confirm the results of the study conducted by [9] which identifies delivery as a factor positively associated to performance of the supply chain. The current study highly contributes to operation and supply chain managers of electronic equipment manufacturing firms in Malaysia in order to improve their supply chain performance and achieve competitive edge over their competitors. Further studies are intended to investigate a similar model for other industries and geographic areas.

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TABLE 2. VARIABLES RANKING

Type of Variables	Independent Variables				Dependant Variable
List of Variables	Supply Chain Design	Flexibility	Information sharing	Delivery	Supply Chain Performance
Priority of Variables (Ranking)	1- Selecting and evaluating suppliers, decision about number of suppliers 2- Proximity to suppliers 3- Reactions to the possible disagreements between channel members 4- Planned capacities in each facility, definition of contractual terms	1- Firm's capability in changing its production volume and/or capacity, firm's capability in production of wide range of products 2- Ability of the firm in customizing products based on customer specifications, firm's ability in changing products features based on customer needs 3- Firm's ability in handling customer delivery requirements	1- information intensity 2- Information shared among supply chain partners within upstream and downstream supply chain	1- Providing speedy deliveries, meeting delivery dates 3- Diminishing manufacturing lead time, controlling lead time of order	1- Delivery Cycle times, on time delivery performance, missing/wrong/defective products shipped 2- Manufacturing cycle time 3- Return on sales, profit margin, ROA, sales over assets