# The Relationship between Supply Chain Integration, Just-In-Time and Logistics Performance: A Supplier's Perspective on the Automotive Industry in Malaysia

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***Abstract*—This paper examines whether the supply chain integration, just-in-time (JIT) purchasing and JIT manufacturing could impact on the logistics performance of suppliers in the automobile industry in Malaysia. An empirical study was conducted in the Malaysia Automobile Industry and the theoretical model was tested using regression analysis. Data were collected using mail questionnaires which were distributed to suppliers of Malaysian automotive manufacturers. The survey was administered to the management level identified from a list of executive personnel and to those who were actually in charge of logistics operations. Among one hundred respondents, 91 were considered as valid from those who practice supply chain integration for their business operations. The findings reveal supply chain integration, JIT purchasing and JIT manufacturing had direct and significant benefits to logistics performance. The scope of this study was by design limited to participants' responses within a particular time frame and they were only given a single opportunity to respond. The proposed framework provides a significant contribution to the performance of the logistics operations automotive manufacturing industry and furthermore enables logistics practitioners to gain a better understanding of these factors affecting logistics performance. In addition, to date, only a few studies have been conducted on the effect of supply chain integration and just-in-time towards logistics performance mainly in the automotive industry particularly in developing a county like Malaysia.**

***Keywords*—** *Supply chain integration, Just-in-time, Logistics performance*

## 1. Introduction

The automotive industry in Malaysia is growing rapidly, capturing the local and foreign market. Therefore, it is regarded as an essential sector in the Malaysian economy. The economic contribution of this sector is enormous, with significant contributions toward employment, investment and national income. Unfortunately, in recent years the automotive industry is facing significant challenges particularly from trade liberalization and increasing competition. As such, this phenomenon has resulted in a considerable amount of pressure on Malaysian manufacturers to improve productivity and performance in total in order to be more competitive locally and globally. In order to achieve these aims, improving logistics performance appears to be a necessity.

The majority of studies into the supplier integration phenomenon conclude that logistical concerns are the driving factor behind the success of the manufacturing industry. Therefore, the focus of this research is on the spectrum of supplier integration, just-in-time application and logistics cost performance. Up to now, there are neither detailed studies focusing on the identification of logistics cost performance in Malaysia environment nor studies that try to look at the impact of just-in time phenomena towards logistics performance in automobile industry in Malaysia. This paper provides a benchmark for both suppliers' and buyers' organizations assessing the opportunity to reduce logistics cost and helps identify opportunities for significant improvement. This is a novel approach to analyse logistics performance initiatives in a single model and its impact on

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cost reduction.

Therefore, the purpose of this paper is to explore whether there is a significant and direct influence among supply chain integration, JIT purchasing and JIT manufacturing and examine the explanatory powers and influences of supply chain integration, in comparison with JIT purchasing and JIT manufacturing, for suppliers' logistics performance. This paper refers to the conceptual framework (Figure 1) and respondents from logistics practitioners from automobile industry mainly in the production system suppliers in Malaysia in order to examine whether the extent of supply chain integration, just-in-time (JIT) purchasing and JIT manufacturing can directly benefit the logistics performance of suppliers in the automobile manufacturing company.

## 2. Literature Review

*Supply Chain Integration* - The integration of supply chain management systems has been the subject of significant debate and discussion [17]. As organizations seek to develop partnerships and more effective information links with trading partners [31,40], internal processes become interlinked and span the traditional boundaries of firms [15,39]. This section covers issues relating to integration of core processes across organizational boundaries through improved communication, partnerships, alliances and cooperation [23]. It also includes the application of new technologies to improve information flows and coordinate the flow of physical goods between trading partners [33]. Therefore, this paper is not aimed at discussing the importance of integration mechanisms but rather at investigating their relationship with the logistics strategy [5,28].

*JIT Purchasing*–Just-in-time (JIT) is a critical initiative to meet demand of customers on price, quality and lead times [29]. As cost becomes increasingly important in today's highly competitive international marketplace, it allows a few of these companies to compete solely on the basis of price [12]. To be successful, these companies must also achieve high levels of quality and be responsive to changing market needs. One approach that many companies in more developed countries have adopted in order to achieve these objectives is just-in-time (JIT) purchasing. With JIT purchasing, a company requires its suppliers to make frequent, reliable deliveries of small lots of very high quality parts and encourages its suppliers to participate in the purchasing plant's continuous improvement efforts [16].

The long-term relationship with the supplier encourages loyalty and reduces the risk of an interruption to supply [1,13,21]. The contract will usually be extended unless the supplier fails to keep the exacting standards set by the buyer, and, barring a complete relationship breakdown, the vendor will continue to supply the customer for future products [14]. The long-term contract eliminates the re-tendering costs, promotes reclaiming capital over an extended period, helps build the relationship and ensures that costs are reduced in the long-term through repetition. Suppliers help customers to grow and succeed in the marketplace in order that all members of the supply chain (including them) benefit. JIT purchasing is an important part of the overall JIT programme and can produce benefits of reduced lead times, reduced inventories, improved quality, improved lead time reliability, reduced material costs and improved flexibility [9].

*JIT Manufacturing* - Just-in-time (JIT) system has been a great force in the world of manufacturing since the early 1980s. Just-in-time (JIT) manufacturing has become synonymous with excellence in many discussions of manufacturing[18]. Sometimes called lean production, it is used in a wide variety of industries such as automobiles, consumer electronics, office equipment, and electrical equipment. Some of the main benefits of JIT such as inventory reduction, quick delivery, and cost reduction have been well documented [6,20]. Studies have found that JIT manufacturing can help reduce throughput time, inventory cost, delivery time, labour cost, and the cost of quality [35]. In fact, several studies have found that the greater use of JIT manufacturing by Japanese firms, or lean production as one of these studies calls it, explains most of the cost differential between Japanese and US automobile producers. The importance of JIT manufacturing is hypothesized to be a function of logistical complexity as the importance of the JIT techniques described above is a function of a product's logistical complexity [27]. These include revised layouts, reduced set-up times, simple production systems, and just-in time purchasing [10].

*Logistics Performance* - Logistics refers to the effective and efficient management of material flows within and between companies [25,36,37].A key determinant of business performance is the role of the logistics function in ensuring the smooth flow of materials, products and information throughout the company's supply chains [15,26]. Logistics performance can be lead time, on-time delivery, and service level[8]. Measuring logistics performance moves the focus from strategic, financial performance to operational performance enabled by information sharing between supply chain actors [22]. To complete effectively, companies must recognize the strategic importance of the logistics function. Malaysia has over the years built on its strength as a transportation and distribution hub to become one of the leading logistics centers in the world [30]. The strategic importance of the logistics function can be measured by the extent to which logistics executives participate in the overall strategic formulation and planning for the company [4,30,38].

## 3. Conceptual Framework and Hypotheses

This study examines the relationship between supply chain integration, JIT purchasing and JIT manufacturing so that management will be able to pursue better logistics performance applicable directly to their business environment. Figure 1, shows the conceptual and structural framework as stated by [24] and the following seven hypotheses will be tested:

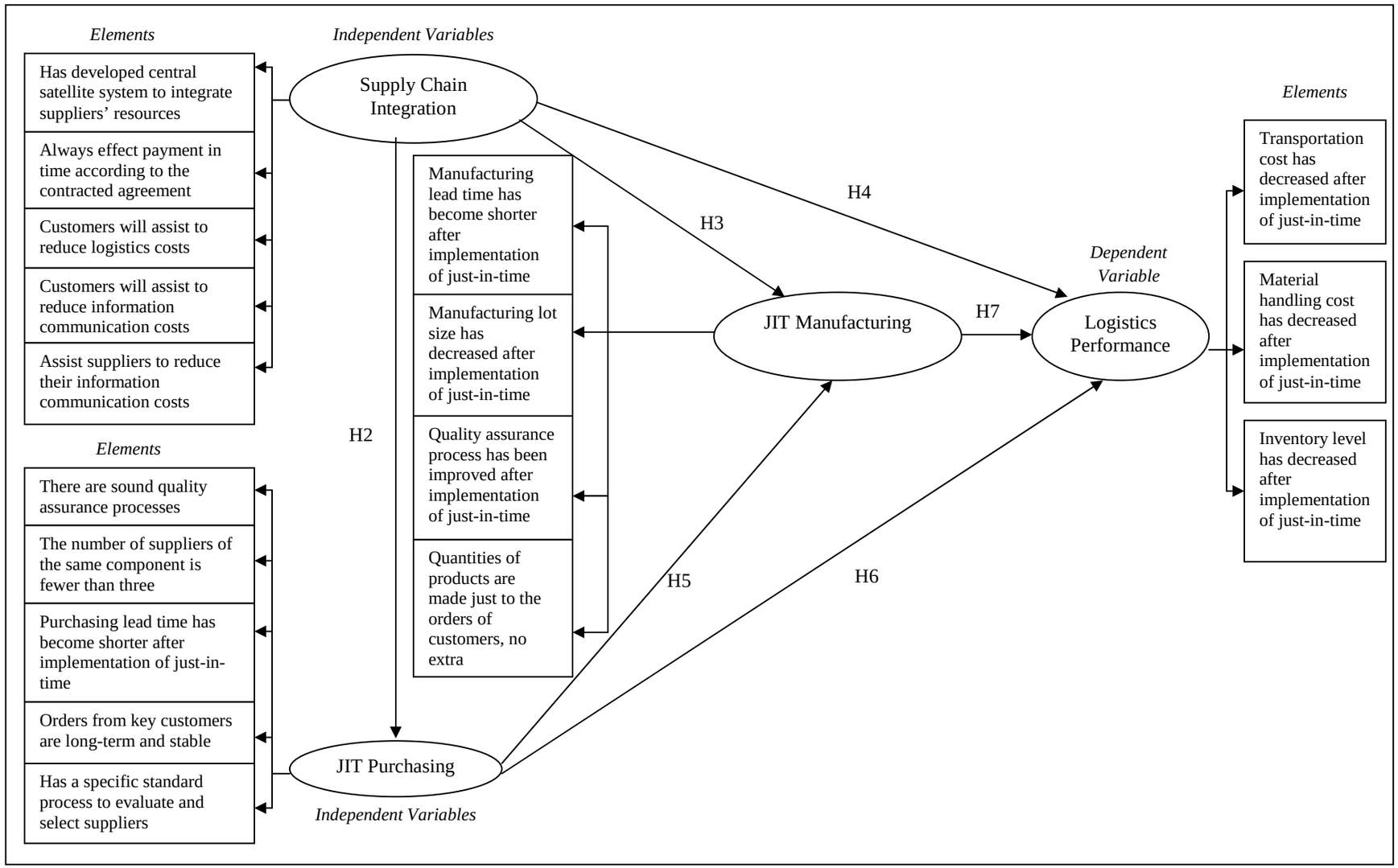



**Figure 1.** Conceptual Framework of the Study (adopted from [19])

*H1*. Each paired dimension supply chain integration, JIT purchasing, JIT manufacturing and logistics performance is significant correlated.
*H2*. Supply chain integration directly influences JIT purchasing.
*H3*. Supply chain integration directly influences JIT manufacturing.
*H4*. Supply chain integration directly influences logistics performance.
*H5*. JIT purchasing directly influences JIT manufacturing.
*H6*. JIT purchasing directly influences logistics performance.
*H7*. JIT manufacturing directly influences logistics performance.

## 4. Methodology – Instrument and Data Collection

A survey instrument was designed based on the constructs for the research model (a copy of the survey instrument is in appendix). Respondents are requested to indicate the performance of their firm compared to that of their competitors, the level of interaction with suppliers, the extent to which they used the internal process for process innovation, and the level of relationship with customers. The questionnaire was designed using a five point Likert scale from (1) strongly agrees to (5) strongly disagree and included typical demographic information of the company. The overall survey measurement items were adopted and adapted from [19]. The instrument was pre-tested at meetings with 20 managers of the key suppliers to reduce measurement errors. At the end of the pre-test, the questionnaire was modified to improve clarity. A series of panel specialists meetings consisting of two academic experts in the field of Proton production systems and two corporation managers in Indonesia helped establish the content of regression analysis.

The survey was administered to individuals identified from the list of executive officers, directors, presidents, vice presidents and to those who were actually in charge of JIT operations. Data were collected using mail questionnaires which were distributed to suppliers of Malaysian automotive manufacturers. A total of 1000 questionnaires with an introductory letter were distributed in the northern, central and southern region by regular mail, email, and fax. The survey was administered to the management level identified from a list of executive personnel and to those who were actually in charge of logistics operations. Among one hundred respondents, 91 were considered as valid from those who practice supply chain integration for their business operations. Table 1 summarizes the variables and number of measurement item.

**Table 1.** Variable Measurement

| Construct | Description | Numbers of items | Sample survey questions | Source |
|---|---|---|---|---|
| Supply Chain Integration | Partnerships with effective information links with trading partners | 5 | Has developed central satellite system to integrate suppliers' resources | [19] |
| JIT Purchasing | A timely product flow from supplier to buyer | 5 | There are sound quality assurance processes | [19] |
| JIT Manufacturing | Responsiveness of the entire supply channel to meet plant operational requirement | 4 | Manufacturing lead time has become shorter after implementation of just-in-time | [19] |
| Logistics Performance | Includes the cost reduction in logistics operations | 3 | Transportation cost has decreased after implementation of just-in-time | [19] |

## 5. Analysis of Data

Validity analysis – the general objectives of principal component analysis were data reduction and interpretation [2,34]. Therefore, the survey data were applied to principal component analysis to reduce the number of variables and to concentrate on a particular research dimension. The eigenvalue was set at greater than 1.0, the rotation was set in Varimax, and the loading factor was set greater than 0.5. Thus, KMO was within the range of 0.86 till 0.69; the accumulated explanatory power ($R^2$) was within the range 76% till 65%.

Reliability analysis – the Cronbach reliability test is summarized in the appendix. The total reliability coefficient α was 0.840 and all α values in each of the dimensions were higher than 0.7. Thus, the data of this opinion survey had a high degree of internal consistency [3,7,31,32].

Descriptive analysis- provides useful information as to the

mean value (trend of concentration) and standard deviations of the respondents' opinion. These are summarized in the Appendix.

Correlation analysis – the Pearson correlation coefficient was employed to check the correlation of each set of paired dimensions. The correlation coefficient is a measure of the closeness of the relationships or association between independent and dependent variables [11]. The results (see Table 2) indicates correlation coefficient of the following paired dimensions were larger than 0.6.

**Table 2.** Correlation Test Result

| | **SCI** | **JIT-P** | **JIT-M** | **LP** |
|---|---|---|---|---|
| **SCI** | 1.00 | | | |
| **JIT-P** | 0.76** | 1.00 | | |
| **JIT-M** | 0.63** | 0.60** | 1.00 | |
| **LP** | 0.84** | 0.81** | 0.68** | 1.00 |

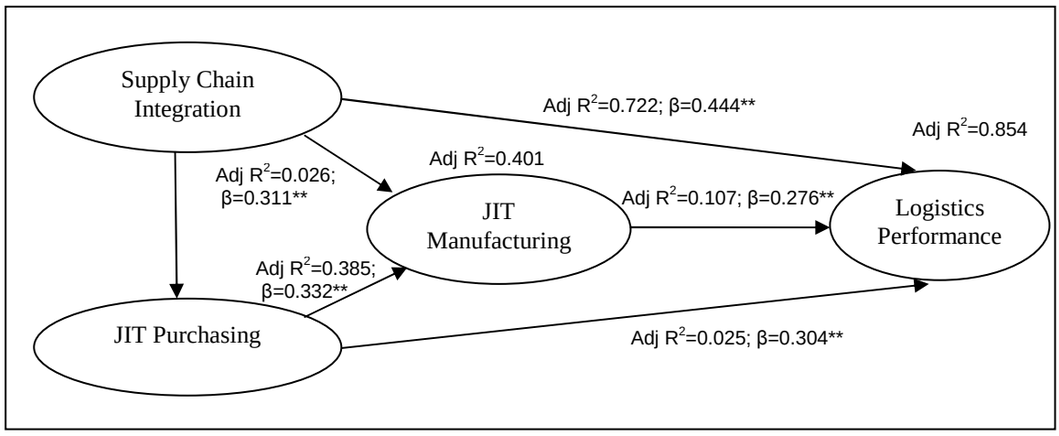
*Note: ** p < 0.01*

Regression analysis - The purpose of this test was to measure all dimensions and to examine the accumulated explanatory power ($R^2$) against the dimension of logistics performance. The results of the multiple regression analysis summarised in Table 3, show that supply chain integration, JIT purchasing and JIT manufacturing contribute significantly to logistics performance. As such, the crucial dimensions to build logistics performance were supply chain integration, JIT Manufacturing and JIT Purchasing. They also show a significant direct relationship between all dimensions. The explanatory power for JIT purchasing dimension for JIT manufacturing was 38.5% and the accumulated explanatory power for JIT purchasing and supply chain integration for JIT manufacturing was 40.1%. The explanatory power of supply chain integration for logistics performance was 72.2%; the accumulated explanatory power for supply chain integration and JIT manufacturing for logistics performance 82.9% and the accumulated explanatory power for supply chain integration, JIT manufacturing and JIT purchasing for logistics performance was 85.4%.

**Table 3.** Stepwise Linear Regression of JIT manufacturing and Logistics Performance

| **IDV** | **DV** | **$R^2$** | **Adj. $R^2$** | **Sig.** | **Std. Beta** |
|---|---|---|---|---|---|
| JIT P | JIT M | *0.389* | *0.385* | *0.008* | *0.576* |
| JIT P & SCI | JIT M | *0.405* | *0.401* | *0.016* | *0.332 & 0.311* |
| SCI | LP | *0.726* | *0.722* | *0.000* | *0.854* |
| SCI & JIT M | LP | *0.835* | *0.829* | *0.000* | *0.668 & 0.348* |
| SCI, JIT M & JIT P | LP | *0.850* | *0.854* | *0.000* | *0.444, 0.276 & 0.304* |

Path analysis – The model depicting path analysis was built for the purposes of delineating the relationship between all significant correlated variables and their influence, as shown in Figure 2. The path analysis shows that supply chain integration is the crucial factor effecting the JIT purchasing. In addition, supply chain integration and JIT purchasing significant influence JIT manufacturing. Thus, Hypothesis H2, H3 and H5 are all supported, and JIT purchasing has greater explanatory power (Adj $R^2$=0.385) and influence (β=0.332) that supply chain integration (Adj $R^2$=0.026; β=0.311) on JIT manufacturing. Besides, supply chain integration, JIT purchasing and JIT manufacturing are essential factor in effecting logistics performance in the automobile industry in Malaysia. Therefore, Hypothesis H4, H6 and H7 are all supported. Importantly, supply chain integration in comparison to JIT purchasing and JIT manufacturing, the highest explanatory power (Adj $R^2$=0.722) and influence (β=0.444) on logistics performance.




*Note: ** p < 0.01*

**Figure 2.** Path analysis for the logistics performance model

## 6. Conclusion

The local automobile industry has been a successful venture in that it has met the objectives set for it when it was conceived. It is clear that the National Car Project has been a success. However, local industry needs a period of development at least as demanding in the next few years if it is to continue to succeed in the global market it intends to enter with the construction of its new factory. From the conceptual frameworks noted here it is clear that JIT purchasing is practised at automotive industry and that certain technical improvements will be possible internally. However, these are easy things to achieve. There is more difficult work to do in terms of the integration of suppliers into an overall chain to achieve strategic JIT manufacturing and gain competitive advantage.

Nevertheless, the use of JIT as a means of national strategy is impressive. Perhaps the point is that local automotive industry has the flexibility to use JIT purchasing to achieve the desired national policy – be it increasing the number of component manufacturers and suppliers, increasing Bumiputera participation, reducing costs, carrying out technology transfer, competing globally and so on. It is clear from this case study that these multiple objectives have been met and it is debatable whether they would have been achieved using strategic JIT.

## Appendix

**Table 4.** Descriptive analysis and Reliability test

| Construct | Mean | S.D | Reliability |
|---|---|---|---|
| *Total reliability* | | | *0.840* |
| Supply Chain Integration | 3.523 | 0.715 | 0.819 |
| JIT Purchasing | 3.688 | 0.662 | 0.785 |
| JIT Manufacturing | 4.124 | 0.772 | 0.753 |
| Logistics Performance | 3.932 | 0.639 | 0.717 |

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