

## **The Role of Supply Chain Integration in Supply Chain Performance** *(An Empirical Study on Chinese Tropical Fruits and Vegetable Industry)*

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### **Abstract**

The core objective of this paper is to test the impact of supply chain integration on supply chain performance in Chinese tropical food industry. Data were collected with the help of structured questionnaire and SmartPLS software was utilized to run the PLS SEM Technique. The results showed that supply chain integration has a significant impact on supply chain performance.

**Keywords:** Supply chain Integration, Supply chain performance, PLS SEM. China, Tropical Fruits.

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### **INTRODUCTION**

In the global economy of the modern world the competition is increasing and so is the effort level of finding ways to keep pace and cope with the competition. For this reason supply chain managers and professionals are compelled to focus on integration to create strategic partnerships to achieve cost reduction and reduced lead time and for improvement in supply chain performance (Pearcy, Parker, & Giunipero, 2008).

In the past many models of manufacturing organizations were usually vertical with the firm in focus regarding suppliers of raw material fully or partially. Yet, the rigidity and inefficiency caused by the model to their supply chains was realized by the firms. This forced the firms to switch their models to a horizontal one that creates a high value chain and integrates with other companies (Pearcy et al., 2008). Therefore within a supply chain, the design and interaction

of elements is a significant part (Samaranayake, 2005).

“The major characteristic of supply chain integration (SCI) is that when members work together for better performance and profitability while meeting the demands of the customer and collaborate along the supply chain. The integrating information and flow of material of firms will manage the supply chain more efficiently” (Stank, Keller, & Closs, 2001).

For overall performance across the supply chain for all partners, “the alignment of business functions internally within a firm and with its supply chain partners is involved so as to reduce costs and increase customer value” (Stank et al., 2001). A good deal of the benefits of SCI have been discussed as revealed the literature review but the key design elements that would lead to improved performance have not been given the due coverage. Moreover, many inconsistencies in the results are found regarding the role of integration in supply chain performance betterment.

The present study aims to define key indicators of performance to measure supply chain integration and thus contribute in the knowledge related to this field. The strategies and practices employed by the firms to provide maximum services to the customers is the main characteristic of customer integration (Stank et al., 2001). The procedures involved in sharing of information and mutual planning to achieve goals of the firm with benefits of reduced cost, customer’s satisfaction and improved work timing collectively constitute supplier integration.

The strategic connection of departments in an organization to improve performance is defined as internal integration which has been considered as the foundation of other kinds of integration. The key information data shared through IT system among supply chain partners for maximum mutual benefits makes up information integration (Quesada, Rachamadugu, Gonzalez, & Luis Martinez, 2008).

The current study attempts to develop a model for food manufacturers in the China to check whether integrated design can help to achieve better supply chain performance. The outcomes will help organizers of supply chain and experts who invest hugely to obtain advantage over competitors. The food manufacturing industries is focussed because this industry is a vital operator of the Chinese economy. Therefore, present study aims find to answer to the research question, ‘Is there any impact of Integration on supply chain performance?’

## **LITERAURE REVIEW**

### **Supply Chain Integration**

The key elements of supply chain integration are outlined and reviewed in the following section. The impact of supply chain integration towards the performance of supply chain is discussed in depth. Through focus on development of various constructs, framework of supply chain integration and the relevant definitions, supply chain integration review will be synthesized more effectively.

Flynn, Huo, & Zhao, (2010) defined integration as combining something in such a way that it becomes a whole. Since supply chain management coordinates, (Lummus & Vokurka, 1999) considered “the integration behaviour important in supply chain management to view the entire process as one system. The decisions of all supply chain members geared towards one goal of maximizing total chain profits are assured by coordination and as several studies” (Jayaram & Tan, 2010; Vokurka, Zank, & Lund, 2002) found that it integrates all activities in fulfilling the customer request as well.

Many studies (Jayaram, Tan, & Nachiappan, 2010) has defined supply chain integration as to what degree all functional activities within an organization and outside the organization (the

functional activities of its suppliers, customers, and other supply chain partners) are integrated together. Flynn, et al., 2010; S. Gunasekaran & Ngai, 2004 stated that supply chain integration is network link of an organization or firm with its business partners integrating their relationships and functions.

Two perspectives of supply chain integration were outlined by Stevens, (1989), which consists of internal integration and external integration. Frohlich & Westbrook, (2001), explained the aspect of internal integration as establishing a close relationships between various functions in a business organization. In other words a firm develops close relationship between material management, order management, warehouse management and inventory. The external integration includes further two aspects: 1. resource flow from ultimate supplier towards manufacturer and later to the customer is forward integration and 2. (Gimenez & Ventura, 2005) illustrated, backward integration of information from ultimate customers, to manufacturers, and ultimately to suppliers.

“Through strategic partnership and effective knowledge sharing practices among trading partners in a supply chain” Byrne and Markham (1991), were of the opinion that “supply chain integration can be achieved”. In order to ensure successful supply chain integration, Hewitt, (1994) and Stevens, (1989) suggested that “the development of internal supply chain integration should precede the external integration with suppliers and customers”. Moreover as supported by many scholars like (Feng, Sun, Zhu, & Sohal, 2012), organizational performance in terms of diversity, capabilities and productivity would be enhanced due to successful and well integrated supply chain.

## **Supply Chain Performance**

According to Chia, Goh, & Hum, (2009) depending on the purpose and the way it is performed, performance can be measured in many different ways. Performance measure can be carried out by continuously improving the processes, setting performance expectations and comparing actual performance with benchmarking data. Atilgan & McCullen, (2011) defined performance measurement as a process of quantifying several activities effectively and efficiently or a single task. More specifically, measuring performance can also means interpreting the performance outcome into communicated and reported information (Trkman, Indihar Štemberger, Jaklič, & Groznik, 2007).

In the competitive business environment, even supply chains needs monitoring mechanisms for their performance, owing to its importance in present competition (Bititci, Mendibil, Martinez, & Albores, 2005). To be dynamic a performance measurement system should possess properties that match the dynamic environment as recommended by (Kim, Kumar, & Kumar, 2010). Such properties are considered to be sensitive to changes in the external and internal environment of an organization by (Bititci et al., 2005).

The supply chain performance according to Brewer & Speh, (2000), is a process of quantifying the performance of the total supply chain operations of an organisation in terms of capital utilization, customer service and cost efficiency. Besides, the activities or tasks pertaining to customer service, corrective actions and preventive action are also reflected by supply chain performance as found and presented by Gunasekaran, Patel, & McGaughey, (2004). Through corrective action such as production, overtime, emergency or rush order, an effective customer service can be developed in a supply chain. Certain preventive action like safety stock and plant extra capacity is related to supply chain capital management and cost operation. The corrective and preventive action could deliver excellent customer service together.

(Atilgan & McCullen, 2011) stated that purpose of supply chain performance is to achieve its short-term and long-term objectives. For the supply chain performance, measures adopted to improve productivity of the total supply chain through inventory reduction and shorter lead time measures are short-term objectives. While measures purported to 1. to increase market share and 2. integrate with all trading partners in the total supply chain are the long-term objectives of the supply chain performance (Li, Ragu-Nathan, Ragu-Nathan, & Rao, 2006).

## **Supply Chain Integration and Supply Chain Performance**

The review of literature revealed that many studies have been focussing the vitality of the integrated supply chain strategy as reported by Kim, (2006a), and are still continued. Tan, Kannan, & Handfield, (1998), found that this strategy values customers and keeps both suppliers and customers involved in the value creation process. (Birou, Fawcett, & Magnan, 1998) recognized the integrated supply chain vital to stay in competition in the market. Theoretically it is well-known that strategic advantages are created by the supply chain integration. However, (Lambert, Cooper, & Pagh, 1998), found that to measure total integration reality and connect it to performance parameters practically in supply chain strategy situations has been left behind by researchers. Davis, (1993), for example, suggested that a well-joined business process increase performance of supply chain management through certain measures. These measures include, improving reliability, less delivery time, suitable feedback, sustained low inventory levels, and lowering cost. With the findings of their study, (Frohlich & Westbrook, 2001) strongly favoured the argument that the company with the huge circle of supplier and customer integration improves performance at a higher rate.

### *Internal Integration and Supply Chain Performance*

The sequence of processes that provides with a product from the company to the customer is referred to as internal supply chain. Many processes are involved to perform multiple functions such as sales, production, and distribution. In order to provide good customer service these functions need to be integrated because a well-integrated internal supply chain would produce best company performance and excellent customer service. In other words, internal integration can be described as the collaboration among departments to achieve unified effort as per the environment requirement stated Ellinger, Daugherty, & Keller, (2000).

According to (Ellinger, Daugherty, & Keller, 2000) several studies related examined inter-functional integration in the company, the interaction and collaboration between different departments of the firm being the central focus.

Scholars like (Alam, Wang, Waheed, Khan, & Farrukh, 2019; Levi, Kaminsky, & Levi, 2003) stated that if divisions or departments of a firm are not integrated and have their own information system independently, is un-integrated company. In such firms, systems are highly inefficient, the flow of information is slow and the same information is stored in different departments. (Levi et al., 2003) described that through a connection and integration of different information systems into a single point, a firm may become internally integrated so that members from the different departments can access all data from one point. Internal integration is said to be present if specialized departments are interdependent and cooperation is required while carrying operational procedures.

Contrary to traditional solo functions it emphasizes better coordination in functions. Bowersox, Closs, & Stank, (1999) concluded that minimum two or more complementary functions act as a whole even though not integrated into a single unit. Some studies found in literature, have

given the name of an interaction or communication activity to all inter-functional integrations.

### *Supply Chain Performance and External Integration with Suppliers*

To make a sustainable competency of the supply chain possible, (Cao & Zhang, 2011) considered external integration a vital driver. Therefore, linkages with suppliers are considered as a critical issue in effective supply chain which aims at coordinating information in upward and material flows along the supply chain in management in downward direction (Danese, Romano, & Formentini, 2013). For best external integration, internal integration is a precondition. That's why the efficiency of external integration is found better if internal integration is successfully employed.

A firm develops its integration with its suppliers because of a strategic collaboration with them. Strategic collaboration according to (Vickery, Jayaram, Droge, & Calantone, 2003) involves mutual trustworthy relationship, commitment over time, joint conflict resolution, long-term contracts, and the sharing of risks and rewards. For sharing benefits, two sides collaborate to enhance quality and lower the cost of product. Stroecken, (2000), suggested that agreements made by the larger firms with smaller companies are usually reliable agreements, that's enable them to function as main suppliers.

Various enterprise bodies such as Electronic Data Interchange (EDI), Product Data Interchange (PDI) and Enterprise Resource Planning (ERP), strengthen and facilitate the relationships and constitute the second level of supply chain integration. According to (Levi et al., 2003) , this partnership decrease inventory and improves the communications due to correct information about materials. Vickery, Jayaram, Droge, & Calantone, (2003), added that it may enhance firms 'competition capabilities and as per statement of Stroecken, (2000), also deter new entrants. A firm can reduce supply-side risks by its effective external integration with suppliers as suggested by Lin and Zhou, (2011). In the same context Flynn et al., (2010), argued that this can be brought about by the information sharing, alignment of business processes between suppliers and customers, and joint planning of both. To have collaborative approach the establishment of mutual understanding is essential and helps to understand needs of customers. Stank et al., 1999 suggested that to enable suppliers to guess and respond customer needs accordingly and thus for enhanced delivery performance, timely sharing of market and operational information is essential.

The materials and information may have no coordination without sharing of accurate information, and can result in poor management of inventory. The task coordination and resolution of conflicts can better be achieved by supplier-customer collaboration. Swink et al., (2007), supported this concept by saying that better coordinated and aligned objectives helps to reduce wastage and useless efforts to manage supply chain procedures. In addition to this problem solving routine can be developed by integration with customers and suppliers, stated Flynn and Flynn, 1999; Narasimhan and Jayaram, (1998) that made mutual efforts to reduce cost and develop product, possible. Rosenzweig et al., (2003), stated that such collective endeavors are vital to achieve time saving performance, innovation and standard of product as well as. In Chinese tropical fruits and vegetable industry, the supply chain integration has a positive significant impact on firms' supply chain performance.

*Hypothesis: Supply chain integration has significant impact on supply chain performance*

## **METHOD AND MEASURES**

### *Data Collection Procedure*

Bryman, 1988 and Bickman & Rog, (1998), described data collection as collecting data

from the right target population at the right time to answer the research questions and to meet the objectives of research thus an important part of research. For the current study the target population encompasses top ten Chinese fruits and vegetable firms located in china. Since the establishment and continued existence of such companies centre on their supply chain performance therefore Chinese fruits and vegetable industry was selected for the present study. Additionally, this industry has always been the most open sector and the Chinese products have a competitive strength in the global market.

For representative sample from the population of these companies, the companies registered with International Trade Centre, (2017), were selected from the list. The local organizations are assisted by these agencies to compete in international markets. Therefore this database is often used for sampling for Chinese studies such as linked with United Nation Global Goals for sustainability, ITC primarily work with a mission “trade impact for good” and World Trade Organization (WTO). China is the world’s top fruit producer in terms of market size and structure, its yield in 2016 was 192,202,000 tons of fruits. In comparison with 2008, its import increased both in volume and value up to 37% in 2017, by importing 2,309,000 tons of fruit, of worth US\$ 1.63 billion. Per capita annual fruit and vegetable consumption in China is twice as much the global average consumption stated the United Nations Food and Agriculture Organization (FAO), in a report. The estimate provided by the Chinese Ministry of Agriculture, the tropical fruits and vegetables account for over 20 million tons or 25% of China’s total fruit planting area. While the China Fruit Marketing Association estimated that in fruits consumption in China, consumption of tropical fruit accounts for 10%. China’s domestic vegetable output equals to 49% of the global output thus a huge yield that is 602 million tons per year. On the other hand the quantity of vegetables imported into China is small weighing 88,000 tons only.

### ***Instrument***

#### *Supply Chain integration*

Several researchers (Stock and Tatikonda, 2000; Narasimhan and Jayaram, 1998; Wood, 1997; Li, 2002; Marquez et. al., 2004), reported that “the extent to which all activities within an organization, and the activities of its suppliers, customers, and other supply chain members, are integrated together is assessed by Supply chain integration”. In the present study Supply chain integration was measure by using Romano (2003)’s four (04) items.

#### *Supply chain performances*

The extent to which a firm’s performance is measured in terms flexibility performance, resource performance and output performance is assessed by supply chain performances. Beamon, 1999; Sezen, (2008), measured it.

## **DATA ANALYSIS**

Structural equation modeling (SEM) was utilized as a primary data analysis technique. Differs from other multivariate techniques, SEM is capable in testing the entire model simultaneously and assessing measurement errors. These capacities are pertinent with the sizeable errors (Byrne & Heavey, 2001). As an alternative to covariance-based SEM (CBSEM), in which the method is focusing on estimating a set of model parameters, this study relied on variance-based SEM, using partial least square (PLS). This technique has become popular in management and business studies field and has been used by some prior studies (Anjum, Nazar, Sharifi, & Farrukh, 2018; Ansari, Siddiqui, & Farrukh, 2018; Farrukh, Alzubi, Shahzad, Waheed, & Kanwal, 2018; Farrukh, Chong, Mansori, & Ravan Ramzani, 2017; Farrukh, Khan, Shahid Khan, Ravan Ramzani, & Soladoye, 2017; Farrukh, Lee, Sajid, & Waheed, 2019a, 2019b; Farrukh, Lee, &



Shahzad, 2019; Farrukh, Sajid, Lee, & Shahzad, n.d.; Farrukh, Sajid, Zreen, & Khalid, 2019; Farrukh, Ting, Shahzad, & Hua, 2018; Farrukh, Ying, & Mansori, 2017; Shahzad, Farrukh, Ahmed, Lin, & Kanwal, 2018; Zreen, Farrukh, Nazar, & Khalid, 2019)

PLS model is generally analyzed and interpreted in two phases; first measuring the outer model for validity and reliability and second, analyzing the structure model for R square, and checking significance of path coefficients (hypothesis testing).

### Measurement Model

Before testing the hypothesis, measurement model was assessed for its validity and reliability. Following section explain the process in detail

#### *The Convergent Validity Analysis*

According to Hair et al. (2010), convergent validity refers to the degree to which a group of variables converge in measuring a particular concept. They suggested that convergent validity can be established through the simultaneous testing of three criteria; factor loadings, composite reliability (CR) and average variance extracted (AVE). As such, the entire items loadings were examined and confirmed to be above 0.70 (the acceptable level recommended by Hair et al., 2010).

Next, we investigated composite reliability – a test that refers to the level to which the items set indicate the latent construct in a consistent manner (Hair et al., 2010). For this study, the Composite Reliability values are listed in Table 1. From the table 1, the values composite reliability values fall between 0.881-0.956 indicating that the latter values exceeded the recommended value of 0.70 (Fornell & Larcker, 1981; Hair et al., 2010). Hence, the results confirm the outer model’s convergent validity.

In addition to the above, the average variance extracted (AVE) values were tested to further confirm the outer model’s convergent validity. AVE shows the group of items average variance extracted in relation to the variance shared with measurement errors. Specifically, AVE gauges the variance encapsulated by indicators that relate to the assignable variance to the measurement errors. If the AVE value is 0.5, the set of items is deemed to have sufficient convergence in measuring the construct (Barclay, Higgins, & Thompson, 1995). In the present study, the values of AVE fall in the range of 0.622-0.686 indicating good construct validity of measures as recommended by Barclay et al. (1995).

**Table 1: Measurement Model Evaluation**

Construct	Items	Loading	Cronbach's Alpha	CR	AVE
Supply chain integration	SCI1	0.819	<b>0.883</b>	<b>0.914</b>	<b>0.681</b>
	SCI2	0.777			
	SCI3	0.823			
	SCI4	0.827			
Supply chain performance	SCP1	0.807	<b>0.82</b>	<b>0.881</b>	<b>0.649</b>
	SCP2	0.83			
	SCP3	0.794			
	SCP4	0.792			
	SCP5	0.837			

SCP6	0.811
SCP7	0.801
SCP8	0.769
SCP9	0.812
SCP10	0.907
SCP11	0.891
SCP12	0.813
SCP13	0.73
SCP14	0.888
SCP15	0.621
SCP16	0.859
SCP17	0.901

#### *The Discriminant Validity (DV) Analysis*

Next, the discriminant validity of the measurement model was checked with the help of Fornell and Larcker's (1981) criterion. DV is an extent to which constructs can be differentiated from other constructs. Table 2 shows that there was not any issue in regard to discriminant validity.

**Table 2: The Discriminant Validity Analysis by Fornell & Larcker Method**

	<b>SCI</b>	<b>SCP</b>
SCI	<b>0.825</b>	
SCP	0.324	<b>0.805</b>

#### **The Hypotheses Testing Procedures**

After checking the validity and reliability of measurement model, next step in PLS SEM is to evaluate the hypothesis through bootstrapping function of SmartPLS software.

**Table 3: Hypothesis Testing through bootstrapping**

<b>Hypothesis No.</b>	<b>Hypothesis</b>	<b>Path Coefficient</b>	<b>Standard Error</b>	<b>T-Value</b>	<b>P-Value</b>	<b>Decision</b>
H3	<b>SCI -&gt; SCP</b>	0.169**	0.085	2.987	0.004	Supported

The path coefficients statistical significance can be determined via bootstrapping methods in SmartPLS 3.0. In this regard, the T-values of each path coefficient were produced through such method and P-values were eventually obtained. Based on the results, the hypothesis was supported.



## DISCUSSION

Nowadays the business competition among organizations has been expanded to competition between supply chains partners. Therefore, use of supply chain by organizations integration is increasing, so that S.C response and advantage over competitors of the firm could be achieved. Many research findings indicated that various aspects of supply chain integration are practiced by all the state corporations. The results show supply chain integration is a advantageous method of competition. For the firm, the utilization of supply chain integration does have a powerful influence on supply chain performance and edge over competitors. For a company's supply chain and performance, the integrated supply chain has been proved to be an essential factor. The efficiency of supply chain and performances of companies will improve considerably if strategy and practice are combined accurately. The findings revealed that integration influence supply chain performance positively. The ability of the supply chain to diminish waste and enhanced leanness of their own operations can be improved by establishing longer lasting relationship with suppliers and consequently improving the supply chain performance. With appropriate strategic supplier partnership practice lean supply chain can be executed and is expected to be cost efficient. It shows that the cooperation form strategic partners facilitates and enables to adopt feasible production concepts to be successfully applied, information sharing should improve effectively, so that higher performance could be generated and supply chain responsiveness could be increased.

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