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Information Technology Factors Affecting Supply Chain Collaboration in Automotive Component Manufacturing in Indonesia

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Abstract. There is a growing need for collaborative supply chain management. This collaboration has been attracting the researchers due to their critical impact to improve business value. The use of information technology (IT) which is presently widely used in almost areas of business and engineering is considered prerequisites of today's complex supply chain. Current study shows that a broad array of references in supply chain collaboration especially in identifying influencing factors on Information Technology are partial and limited. This study was aimed at reviewing a comprehensive understanding of dominant IT factors that influence successful supply chain management. Based on thorough analysis on the state of the art literature review, a proposed construct of influencing IT factors in supply chain collaboration is offered. Multiple linear regression technique is used to model the proposed construct. The result of analysis suggests that a further research on identifying factors and determining samples is required to model accuracy.

Keywords: Supply Chain Management, Supply Chain Collaboration, Multiple Linear Regression, Information Technology

1. Introduction

In recent years business environments have been identified as unpredictable and volatile demands due to dynamic nature of relationships and faster changes on consumers' behavior (Montoya-Torres and Ortiz-Vargas, 2014). This primary source of environmental uncertainty facing manufacturers tends to be distorted and amplified along supply chain (Hadaya and Cassivi, 2007). The main concern of supply chain management is how to coordinate the independent participating companies, so that they work together as an integrated unit, in the pursuit of the common goal in changing market conditions. Further, as global markets grow increasingly efficient, competition no longer takes place between individual businesses, but between entire supply chains. Therefore, collaboration can provide the competitive edge that enables all the business partners in supply chain to prevail and grow (Sahay, 2003). Hence, in order companies to survive and to grow in unpredictable and volatile business environment, they should collaborate with their participating chains such as customers and suppliers.

In general, Simatupang *et al.* (2002) define collaboration as an act of properly relating, harmonizing, adjusting and aligning a number of objects i.e., actions, objectives, decisions, information, knowledge, and funds for the achievement of the chain goal. Previous studies of the literature have highlighted many benefits for collaboration in supply chains, for decreasing costs, inventory levels and lead time,

and to increase service levels, product quality, and income (Birendra *et al*. 2007; Bowersox, 1990; Corbett *et al*. 1999; Huang *et al*. 2003; Simatupang *et al*, 2002). Previous studies have highlighted various benefits of supply chain collaboration, however other studies in literature have reported some difficulties and barriers for implementation such strategies (Green and Inman, 2005; Holweg *et al*. 2005; Simatupang and Sridharan, 2008; Spekman *et al*., 1998). The advantages and benefits of the supply chain are coupled with barriers of supply chain collaboration implementation, hence to ensure successful supply chain collaboration implementation, a thorough study of the effective supply chain collaboration is required.

In practice collaboration of multiple participating companies can become a complex process that is difficult to manage. Hence to support this process, information technology (IT) can provide a number of tools to facilitate, streamline, and increase the reliability of communication and exchange of information between organizations (Debarros *et al*. 2015). The integrative role of IT shows in information availability, visibility, and management; efficient transaction management and execution; decision making and planning; and cooperation and collaboration (Auramo *et al*., 2005; Simchi-Levi *et al*., 2003). Supply chain leaders like Amazon, Dell, Honda, Procter & Gamble, and Wal-Mart use IT to share real-time information regarding inventory levels and flow relationships, which promote the ideation and exploitation of unique forms of supply chain collaboration (Tippins and Sohi 2003; Leem 2004; Liker and Choi, 2004). Indeed, it is often difficult to accurately capture and describe the business value of IT in supply chain and there are a number of factors that we accept as important and necessary conditions in the process of value co-creation. Hence, the intensified complicated business environment requires the implementation of information technology to enable the effective and successful supply chain collaboration implementation. However, information technology itself could not contribute benefits for the companies, unless the information technology solution is properly used.

The objective of this paper is to investigate the information technology factors that affect successful supply chain collaboration. This review aims at answering research questions: Do the independent variables reliably predict the dependent variable? Does back-end application affect supply chain collaboration? Does front-end application affect supply chain collaboration? Does technology use affect supply chain collaboration? Hence, the contribution of this paper is to expose and model the information technology factors in supply chain collaboration.

The paper is organized as follows. First, a brief discussion about concept of collaboration and information technology in supply chains is presented. Second, the research methodology employed for searching and the framework used for classifying the papers is presented. Third, the principal findings about IT-based supply chain collaboration are discussed. Next, an in depth analysis of IT-based supply chain collaboration is presented, highlighting the type of collaboration and IT role. From these findings, some areas for further research are suggested and conclusions are finally drawn based on the result of the study.

2. Concept On Information Technology In Supply Chain Management

2.1 Information Technology

Information technology is defined as to include the set of non-human resources dedicated to the processing, storage and communication of information and the way in which these resources are organized into a system capable of performing a set of tasks (Bakopoulos, 1985). IT in general, and IT in SCM, is argued to enable great opportunities, ranging from direct operational benefits to the creation of strategic advantage (Auramo *et al*., 2005). Unfortunately, many companies failed to grasp his emphasis on how IT is used rather than on IT itself (Fawcet *et al*., 2011). As a result, they had failed to implement IT to leverage complementary competencies that reside across the supply chain to gain competitive advantage (Dyer and Singh, 1998; Frohlich, 2002).

Auramo *et al.* (2005), classify functional roles of information technology in supply chains into three categories i.e., transaction processing; planning and collaboration; and order tracking and delivery coordination. Hence, these IT classifications are used to review the selected papers. Soh and Markus

(1995) provide the logical processes of how IT creates value shown in Figure 1. They analyze the sequence of activity to determine whether causal elements of necessary and sufficient conditions are present, or causal elements in which conditions are necessary but not sufficient to lead a favorable outcome. IT expenditure is necessary to create IT value in firms, but IT expenditure is not sufficient to create usable IT assets addressing the needs of the firm's business processes. Next, appropriate usage of the firm's IT assets leads to the creation IT impacts and business value. Favorable IT impacts resulting from appropriate usage should lead to improved organization performance. However, favorable IT impacts are not a necessary and sufficient condition of improved organization performance. Other factors influence organization performance such organization and competitive factors.

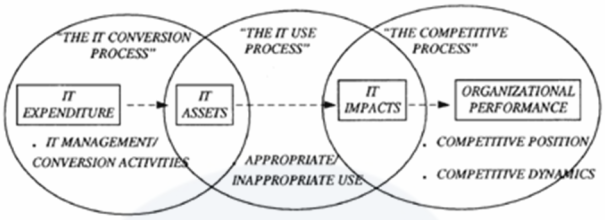

Figure 1. How IT creates business value: a process theory (Soh and Markus, 1995)

2.2 Supply Chain Collaboration

A supply chain can be defined as an integrated process wherein a number of various business entities (i.e., suppliers, manufacturers, distributors, and retailers) work together in an effort to: (1) acquire raw materials, (2) convert these raw materials into specified final products or services, and (3) deliver these final products or services to retailers. The objective of any supply chain should be to maximize the overall value generated (Chopra and Meindl, 2013). Further, Chopra and Meindl (2013) emphasize the important on long-term collaboration amongst all the participating parties so that total benefits and profits of the supply chains can be assured.

Supply chain collaboration has become an integral part of supply chain management. Hence, for implementing successful supply chain collaboration a set of guidance is required for all participating companies. In addition, an integrative framework for supply chain collaboration consists of five features, namely a collaborative performance system (CPS), information sharing, decision synchronization, incentive alignment, and integrated supply chain process (Simatupang and Sridharan, 2005). There are three perspectives of collaboration type taken in reviewing the selected papers, i.e., collaboration type I, II, and III (Lambert *et al*. 1996). Type I collaboration focuses on short-term relationships and deals with only one division or function. Type II collaboration focuses on long-term relationships and deals with multiple divisions or functions. Type III collaboration has no end date expiration relationships. This type of partnership views the other parties as an extension of its firms and organizations share a significant level of integration.

2.3 Factors Affecting Supply Chain Collaboration

To discuss IT-based value co-creation in supply chain collaboration, the fundamental concept of supply chain collaboration, the role of information technology, value co-creation are combined. Selected literature is classified based on the particular content coverage and focus of each paper, i.e., the collaboration type, the role of information technology, the value co-creation, and methodology taken. Moreover, collaboration is analyzed by identifying the collaboration type among the participating companies referring to Lambert *at al*. (1996). Information technology in supply chain collaboration is classified based on roles and impacts of information technology application in supporting supply chains processes (Auramo *et al*. 2005). The holistic context for supply chain collaboration can be seen in Figure 2.

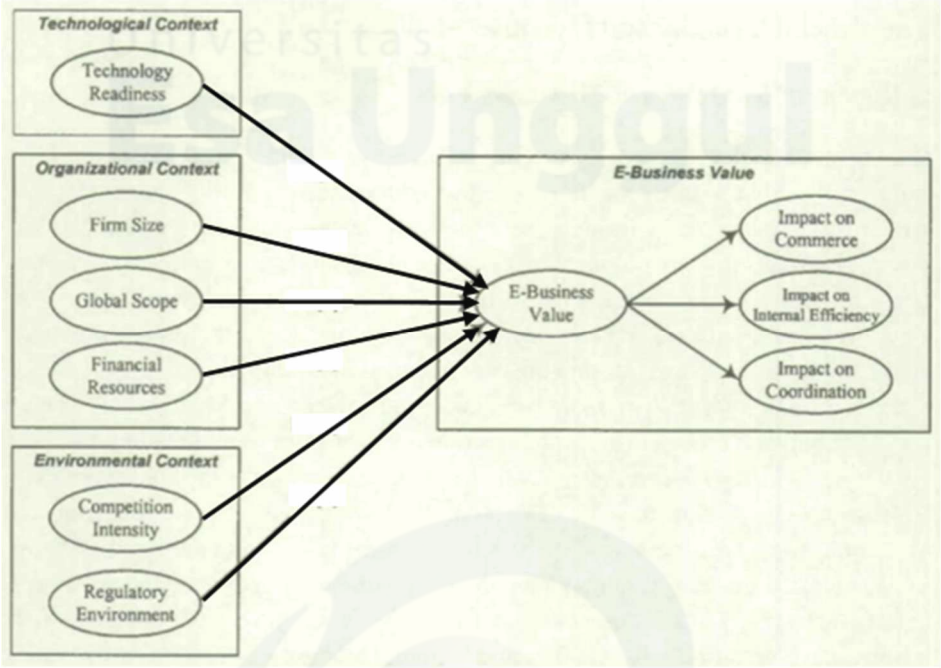

Figure 2. Supply Chain Collaboration Context

3. Methodology

3.1 Data Collection

Data were collected within 2 weeks in April 2016 using a survey methodology. Online questionnaires were distributed to respondents. The respondents were composed from person in charge (PIC) related to logistic functions in automotive industries, such as production & material planning, procurement & purchasing, sales & marketing, and finance. The respondents were limited to PIC in some automotive components manufacturing in Jababeka areas. Supply chain collaboration is assessed through 2 statements: 1. I will collaborate with our suppliers and/or customers, 2. Supply chain collaboration can improve company performances. Back-end application is assessed through 2 statements: 1. Back-end application can improve supply chain collaboration, 2. Back-end application can improve company performances. Front-end application is assessed through 2 statements: 1. Front-end application can improve supply chain collaboration, 2. Front-end application can improve company performances. Technology use is assessed through 2 statements: 1. Technology use can improve supply chain collaboration, 2. Technology use can improve company performances. Furthermore, the respondents were asked to choose their agreement or disagreement using 4-point likert scale where 1 is “strongly disagree’, 2 is “disagree”, 3 is “agree”, and 4 is “strongly agree”.

3.2 Proposed Constructs

This research identified four constructs namely supply chain collaboration, back-end application, front-end application, and technology use. The proposed construct relation is depicted in Figure 3. The front-end is defined as everything involved with what the user sees. A common front-end application is web site that can be seen and accessed by user. On the other hand, back-end application is basically how the web site works, updates, and changes. This refers to everything the users can not see in the browser, like database, ERP (enterprise resource planning) system such as SAP, Oracle, etc. Technology use occurs when people and organizational units use IT assets (technology and skills) appropriately, a process affected by organizational structures, processes, and culture.

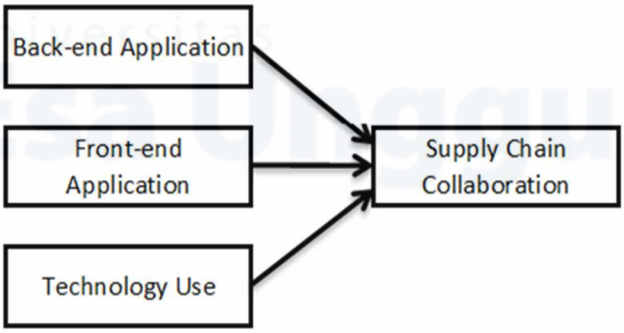

Figure 3. Proposed Constructs

3.3 Propositions

Based on the study, three propositions are developed on factors that affecting successful implementation of supply chain collaboration. The content of the propositions can be summarized as follows:

P1: Back-end application is positively influence supply chain collaboration. Successful implementation of supply chain collaboration has implemented back-end application.

P2: Front-end application is positively influence supply chain collaboration. Successful implementation of supply chain collaboration has implemented front-end application.

P3: Technology use is positively influence supply chain collaboration. Successful implementation of supply chain collaboration has implemented and used appropriate information technology solutions.

4. Results And Data Analysis

From sample size n = 45 respondents and 4 variables (3 independent variables namely back-end application, front-end application, technology use, and 1 dependent variable namely supply chain collaboration), the data were analyzed using SPSS Multiple Linear Regression technique. The results are shown in Table 1, 2, and 3.

Table 1. Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.887[a]	.787	.771	.2276

a. Predictors: (Constant), Back End Application, Technology Use, Front End Application

From the R Square (0.787) in Table 1, it indicates that 78.7% of the variance in supply chain collaboration can be predicted from the variables back-end application, front-end application, and technology use.

Table 2. ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.841	3	2.614	50.439	.000[b]
	Residual	2.125	41	.052		
	Total	9.965	44			

a. Dependent Variable: SC Collaboration

b. Predictors: (Constant), Back End Application, Technology Use, Front End Application

The F value (50.439) and the associated p-value (0.000) < 0.05 in Table 2, are used to answer the question “Do the independent variables (back-end application, front-end application, and technology

use) reliably predict the dependent variable (supply chain collaboration)?" These values conclude that group of variables back-end application, front-end application, and technology use can be used to reliably predict supply chain collaboration.

Table 3. Multiple Linear Regression Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.598	.284		-2.102	.042
	Technology Use	.444	.113	.433	3.946	.000
	Front End Application	.314	.134	.266	2.352	.024
	Back End Application	.479	.114	.352	4.191	.000

a. Dependent Variable: SC Collaboration

From table 3, it can be shown the coefficient for multiple linear regression for the proposed constructs. Hence, the regression equation for this constructs can be presented as:

Supply chain collaboration Predicted = 0.444 x technology use + 0.314 x front-end application + 0.479 x back-end application – 0.598

From t values and their associated p-values using Alpha = 0.05, it can be concluded that:

- The intercept (-0.598) is statistically significant (p-values = 0.042 < 0.05)
- The coefficient for back-end application (0.479) is statistically significant (p-values = 0 < 0.05). Therefore, the first proposition is satisfied that back-end application is positively influence supply chain collaboration.
- The coefficient for front-end application (0.314) is statistically significant (p-values = 0.024 < 0.05). Therefore, the second proposition is satisfied that front-end application is positively influence supply chain collaboration.
- The coefficient for technology use (0.444) is statistically significant (p-values = 0 < 0.05). Therefore, the third proposition is satisfied that technology use is positively influence supply chain collaboration.
- The most influencing factor among those three factors is back-end application, the second one is technology use, and the least one is front-end application

5. Conclusions

The purpose of this study is to examine the relationship and affect of back-end application, front-end application, and technology use on supply chain collaboration. The finding of this study presents that group of variables back-end application, front-end application, and technology use can be used to reliably predict supply chain collaboration. Furthermore, back-end application, front-end application, and technology have positive impacts on supply chain collaboration. Among those independent variables, back-end application has the largest impact on supply chain collaboration, whereas technology use and front-end application have the second and the third impact respectively.

6. Limitation And Future Research

The limitation of this study, first only employ three independent variables back-end application, front-end application, and technology which categorized from similar technological context. For the future research may employ more independent variable categorizes such as organizational and environmental contexts. Second, this study collects data from 45 respondents from an automotive industry with its suppliers and customers in Jababeka. For the future research, researcher can conduct the survey with larger samples from various areas that represent major automotive industries areas in Indonesia.

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