Supply Chain Integration: Its Antecedents and Impact on Firm's Operational Performance

by

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Dissertation Abstract

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1. Outline

Supply chain integration (SCI) is considered to be a core concept of supply chain management (Pagell 2004) and it has become one of the most popular concepts discussed by researchers and practitioners from diverse fields of management as logistics, operations, information systems and organizational behavior. The existing literature suggests that SCI is a key factor in achieving improvements and competitive advantage (Van der Vaart and van Donk 2008). And it is often believed that the higher the integration level the better for firm's and supply chain performance (Droge, Jayaram, and Vickery 2004, Frohlich and Westbrook 2001, Gimenez and Ventura 2005) by practitioners and researchers.

On the other hand, researchers conducted enormous amount of study in an attempt to explore the factors (antecedents) that facilitate SCI. Among these factors are information and communication technologies (Bharadwaj 2000, Grover and Malhotra 1999, Kearns and Lederer 2003, Sanders 2007), and environmental factors such as uncertainty, market volatility and competition (Paulraj and Chen 2007). Specifically, the literature reports different and opposing results about the impact of ICT and SCI on performance (Wognum, Fisscher, and Weenink 2002). Moreover, most of the past studies and their results are representative of US manufacturing organizations, rather companies from Asian countries, especially from Japan.

The findings from the existing literature on the relationship between SCI and performance, and the relationship between above-stated SCI antecedents and SCI report inconsistent conclusions, calling for further empirical evidence. Possible reasons for these inconsistencies can be lack of clear definitions and/or understanding of concepts, and use of different instruments for measuring constructs.

2. Research objective and questions

In an attempt to address the above-mentioned issues of inconsistent findings and gaps in the literature and to contribute to the knowledge base this dissertation utilized two types of methodology: empirical study and meta-analysis. Firstly, drawing on operations management and organizational theories of *resource based view* (Barney 1991), *relational view* (Dyer and Singh 1998), and *resource dependence theory* (Pfeffer and Salancik 1978) and findings from the previous literature in the areas supply chain management, operations management and information and communication technology (ICT), this dissertation aims to determine diverse dimensions for SCI, firm's operational performance, IT capability, environmental uncertainty based on the previous literature, and to empirically examine the relationship between multiple dimensions of SCI, information technology (IT) capability, environmental uncertainty, and firm's operational performance in the context of manufacturing firms in Japan. Secondly, the dissertation aims to comprehensively and quantitatively review empirical studies on the relationship between ICT and SCI in the supply chain management discipline through meta-analysis.

In doing so, this dissertation contributes to the existing theory and practice and attempts to answer the following research questions through *empirical study*: (1) How three distinct types of supply chain integration (internal, supplier and customer integration) can be enabled by three dimensions of IT capabilities (cross-functional applications, supply chain applications, and data consistency capability)? (2) How these technological (IT capability) and relationship (SCI) factors can mitigate or reduce three distinct sources of environmental uncertainty (demand, supply, and

technology uncertainties) in the context of supply chain? (3) How these SCI types can improve the above-mentioned six dimensions of firm's operational performance?

And the following questions through a *meta-analysis procedure*: (1) Is there any proof of a positive correlation between ICT and SCI? (2) Does the correlation between ICT and SCI vary across different dimensions and instruments of ICT? And (3) Does the correlation between ICT and SCI vary across different dimensions and instruments of SCI?

3. Research design and methodology

Research design: As stated above, the research employs two types of methodology. Firstly, an empirical study is conducted using path analysis in order to test four analytical frameworks and their hypotheses, which are developed based on theories and previous literature. Secondly, a meta-analysis is used in order to examine the relationship between two constructs (information and communication technology and supply chain integration) of the dissertation through comprehensive and quantitative reviewing of past empirical studies.

Empirical study sample: Data for the empirical research for this dissertation were collected through a survey of manufacturing firms in Japan during September through October in 2013. The survey instrument was mailed to 815 large manufacturing companies, which are listed in the First Section of the Tokyo Stock Exchange. This resulted in total of 117 responses yielding a response rate of 14.36%, of which 108 samples were used in data analysis.

Meta-analysis study sample: The dissertation sample was collected through a literature search using the EBSCO Academic and Business Source database. Out of 1009 peer-reviewed journal papers that the initial search provided, 201 papers were

chosen in the first screening, and the second screening resulted in 27 papers in the final sample for meta-analysis.

Empirical study measurement items test: The measurement items for four research models are extracted from the previous literature, which has extensively exploited these items and confirmed their content validity (Chen et al. 2004). A critical literature review allowed determining dimensions for each study construct. Supply chain integration (SCI) consists of three dimensions: internal integration (II), customer integration (CI), supplier integration (SI). Next, information technology (IT) capability is classified into data consistency (DC), cross-functional applications (CFA), and supply chain applications (SCA) types. Further, environmental uncertainty (EU) comprises three dimensions in terms of its sources: demand uncertainty (DU), supply uncertainty (SU), technology uncertainty (TU). Last, firm's operational performance (FOP) is measured in term of product-mix flexibility (PMF), delivery (D), production cost (PC), quality (Q), inventory level (IL), customer service (CS) dimensions. Further, reliability, unidimensionality, convergent and discriminant validity of the measurement items were established.

Empirical study structural equation model test: The four research models were tested using PLS method with Smart PLS 3.1.3 software. Three research models tested the relationships between SCI and FOP (Chapter 4), IT capability and SCI (Chapter 6), EU and SCI (Chapter 7) separately, and the fourth model examined the relationship between these constructs in a combined way (Chapter 8).

4. Research findings

Empirical study findings: In an attempt to understand relationships between environmental uncertainty, IT capabilities, SCI, and operational performance dimensions, this dissertation developed three research models comprising the

following pairs of research constructs: (1) supply chain integration and firm's operational performance dimensions, (2) IT capabilities and supply chain integration dimensions, (3) environmental uncertainty and supply chain integration dimensions, and one research model consisting of all research constructs considered in the dissertation study: supply chain integration, IT capabilities, environmental uncertainty and firm's operational performance dimensions, and empirically tested all four models based on the sample of 108 Japanese manufacturing organizations.

Hypotheses comprising the research model were developed based on the findings from the past literature on operations management and organizational structure study and on the theories of resource-based view (Barney 1991), relational view (Dyer and Singh 1998), resource dependence theory (Pfeffer and Salancik 1978). The findings of this dissertation support the hypotheses developed in respective chapters and contribute to the existing literature on SCI, IT and organizational theory in several major ways.

In a combined research model of all study constructs, 26 specified paths out of 47 paths between constructs show significant path coefficients, supporting their corresponding hypotheses. It was found that firm's operational performance dimensions are improved when the focal firm has better integration with their customers. However, internal integration and supplier integration were found to improve operational performance partly. Our expectations for IT capabilities to facilitate supply chain integration was partly proven by the positive and significant impact of supply chain applications capability on external integration, and by the positive and significant impact of cross-functional applications capability on internal and supplier integration. Although, surprisingly, data consistency construct of IT capability was found to negatively impact internal integration, but positively influence

customer integration. Our findings also suggest that Japanese manufacturing firms are likely to highly integrate with their suppliers via technological factors (IT capabilities). On the other hand, these organizations are likely to achieve higher customer integration through higher internal integration. Further, with regard to managing environmental uncertainties, our empirical results show that Japanese manufacturing organizations are likely to deal with demand uncertainties through tighter integration and collaboration with their suppliers. As for the supply side uncertainty, the firms are likely to tackle with them with the support of not only technical factors (all three IT capabilities), but also with the relational factors of increased customer and internal integration. Last, but not least, technology uncertainty is found to be reduced through higher data consistency and supply chain applications capabilities.

Meta-analysis study findings: Nine out of 12 testable relationships showed support for their respective hypotheses. With regard to our supply chain integration variables of interest – internal integration, customer integration, and supplier integration, - supplier integration is found to be improved by supplier integration related information and communication technologies (supplier ICT). Against our expectations, both internal integration and customer integration were found not to be improved by internal ICT and customer ICT.