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Do arcs of integration differ across industries? Methodology extension and empirical evidence from Thailand

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ABSTRACT

This paper verifies the argument that arcs of integration or supply chain integration (SCI) configurations differ across different industries. It further develops statistical methods to compare 'balanced' and 'unbalanced' arcs of integrations and determines performance outcomes of different arcs of integration in three Thai industries. Survey data collected from 151 automotive, 82 electronics and 115 food manufacturers in Thailand are examined using cluster analysis, analysis of variance (ANOVA) and novel approaches to statistically differentiate balanced and unbalanced SCI configurations and their performance implications. The analyses conclude the existence of balanced arcs of integration with uniform levels of supplier integration (SI), internal integration (II), and customer integration (CI), as well as unbalanced arcs of integration with an emphasis on CI in the automotive and electronics industries. The food industry has no balanced arc of integration; some food manufacturers emphasize SI and II. These findings confirm differences across industries and add further insights in terms of how arcs of integration with different SCI strengths and emphases could lead to differences in delivery, quality, cost, flexibility, and innovation performance. Based on the data from these Thai industries, the findings from the different industries allow practitioners to benchmark SCI implementation and identify suitable arcs of integration for achieving desirable performance outcomes. In addition to statistically validating the differences amongst the SCI configurations and providing crucial empirical evidence to verify industrial differences, the paper demonstrates the benefit of analysing SCI configurations based on separate industrial samples and provides empirical evidence to drive new theoretical development.

1. Introduction

The extant research on supply chain integration (SCI) has identified various arcs of integration or SCI configurations based on three dimensions of SCI: supplier integration (SI), internal integration (II) and customer integration (CI). Explaining different arcs of integration is important because previous studies found links between different arcs and performance. While some manufacturers strive to achieve balanced levels of SI, II and CI others may emphasize individual SCI dimensions (Flynn et al., 2010). Evidence shows that both 'balanced' ('uniform') and 'unbalanced' arcs of integration with high SCI strengths result in better performance. Manufacturers with balanced arcs of integration (Flynn et al., 2010) e.g., 'high-uniform' (high SI, II and CI), 'unbalanced' arcs of integration (Flynn et al., 2010) e.g., 'outward-facing' (high SI and CI), and 'forward-facing' or 'customer-leaning' (high CI) have achieved superior performance (Flynn et al., 2010; Frohlich and Westbrook, 2001; Schoenherr and Swink, 2012).

However, there are inadequate theories to explain why different arcs of integration are being adopted by different industries and how they lead to better performance. Some argue that the adoption of different arcs of integration is due to differences in industrial and environmental characteristics but no concrete evidence has been reported (Flynn et al., 2010). To extend the work of SCI (e.g., Flynn et al., 2010), this paper aims to: (1) empirically verify differences in arcs of integration across industries; (2) develop methods for comparing uniform and unbalanced arcs of integration; (3) extend the understanding of the performance influence of different arcs of integration. It advances SCI theory in four ways.

First, this paper provides crucial empirical evidence for testing the industrial differences theory by cross-examining large samples from three Thai industries, namely automotive, electronics and food. This attempt is valuable because prior studies tend to mix samples from different industries (and countries) into a single analysis and, therefore, could not reveal industrial differences (e.g. Flynn et al., 2010;

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Frohlich and Westbrook, 2001; Schoenherr and Swink, 2012; Thun, 2010). We also specifically include a combination of suppliers and original equipment manufacturers (OEMs) into each industry sample to improve the validity of our findings. Furthermore, by separately examining three industries from an emerging market such as Thailand, instead of analyses based on mixed industries from multiple countries (e.g., Flynn et al., 2010; Frohlich and Westbrook, 2001), this paper extends the generalizability of the argument for industrial differences.

Second, the identification of different arcs of integration adopted by different industries provides the field with new clues for explaining industrial differences. So far, industrial differences have been partly explained by two theories. From a contingency perspective, manufacturers adopt a particular arc of integration due to the need for aligning individual SCI dimensions and the environment (Flynn et al., 2010; Wiengarten et al., 2016). Alternately, from a configuration perspective performance comes from 'gestalts' or configuration of SCI that are consistent with each other (and the environment) to achieve desirable performance outcomes (Flynn et al., 2010). However, the field has not been able to test these theories. Using an exploratory approach, this paper provides new insights into the possible links between the industrial characteristics (environments), performance and fit, gestalt and configuration among SCI dimensions crucial for advancing the contingency and configuration theories (Flynn et al., 2010).

Third, the paper develops and applies novel approaches for statistically differentiating balanced and unbalanced SCI configurations and understands their performance influence. In the past, SCI configurations were largely identified based on arbitrary thresholds of 'low' and 'high' SCI dimensions using the quartiles method (e.g., Frohlich and Westbrook, 2001; Thun, 2010; Schoenherr and Swink, 2012), which cannot classify firms into mutually exclusive groups. A more robust clustering method such as discriminant analysis is used (e.g., Flynn et al., 2010) for identifying different types of firms (Punj and Stewart, 1983). While these analyses are able to identify mutually exclusive arcs of integration, the literature still lacks methods to statically differentiate balanced from unbalanced arcs of integration. To address these limitations, we statistically verify if the levels of SI, II and CI are truly balanced or unbalanced which, in the past, has been determined arbitrarily (Flynn et al., 2010).

Fourth, this paper provides additional analyses to explain the performance influence of different arcs of integration. In addition to quality, cost, delivery and flexibility being previously studied (Frohlich and Westbrook, 2001; Schoenherr and Swink, 2012), this paper adds a new performance dimension – product innovation. Since innovation is a crucial competitive weapon in the current century, discovering arcs of integration that drive product innovation is paramount to advancing SCI theory (Wong et al., 2013). Furthermore, the use ANOVA (Frohlich and Westbrook, 2001; Flynn et al., 2010) or ANCOVA analyses (Schoenherr and Swink, 2012) helps to identify statistical differences of performance outcome across different arcs of integration but is still unable to ascertain statistical differences among performance outcomes across the same arc of integration. This paper develops and applies a new approach so that it is possible to determine which performance outcomes are significantly higher than others within an arc of integration and across similar or different arcs of integration within and across industries.

2. Theoretical background and extension

2.1. Existing arcs of integration

Supply chain integration (SCI) can be broadly defined as the strategic collaboration in both intra-organizational and inter-organizational processes (Jacobs et al., 2016; Alfalla-Luque et al., 2015; Flynn et al., 2010; Pagell, 2004). SCI is widely recognized as a multidimensional variable (Flynn et al., 2010) because it involves information sharing, cooperation, partnership, and collaboration across functions, suppliers and customers. SCI is further divided into three dimensions: internal integration (II), supplier integration (SI), and customer integration (CI). II involves collaboration across the product design, procurement, production, sales, and distribution functions to meet customer requirements at lower total system cost (Morash et al., 1997). SI and CI involve collaboration in information sharing, strategic partnership, planning, and joint product development with suppliers and customers, respectively (Lai et al., 2010; Ragatz et al., 2002).

The three SCI dimensions (i.e., SI, II, and CI) together form different arcs of integration or configurations of SCI. The arcs of integration proposed by Frohlich and Westbrook (2001) represent the very first attempt to classify SCI configurations using these dimensions. Table 1 summarizes two major arcs of integration found by prior studies. The first type of SCI configuration has 'balanced' or 'uniform' SCI dimensions (Flynn et al., 2010), each having similar levels of SI, II, and CI. The remaining configurations have different levels of SI, II and CI; they are called 'unbalanced' SCI configurations (Flynn et al., 2010, Scheonherr and Swink, 2012). So far, prior studies have focused on finding reliable methods to classify different SCI configurations and examining their performance impacts using contingency theory, configuration theory, strategic alignment theory, resource-based view, relational-view and information process theory, based on mix-industry (and countries) datasets (e.g. Frohlich and Westbrook, 2001; Flynn et al., 2010; Thun, 2010; Schoenherr and Swink, 2012).

2.2. Theories explaining arcs of integration

There are some 'theories' for explaining why different arcs of integration or SCI configurations may exist in different industries. Currently, a concept called 'point of equilibrium' is used to speculate why a large number of firms with 'periphery-facing' arc were found by Frohlich and Westbrook (2001). The popularity of this configuration is cross-validated by recent evidence provided by Schoenherr and Swink (2012). Still, it is unclear why different 'equilibriums' or arcs of integration exist and what 'equilibrium' means. However, this use of these concepts highlights the need to understand the 'fit' or 'alignment' between SI and CI to further apply configuration theory (Miller, 1986) to develop the concepts of 'SCI strength' and 'SCI balance' for supporting the finding of balanced and unbalanced SCI configurations. In line with this view, Flynn et al. (2010) suggest some SCI configurations are determined by fits among 'organizational elements,' but no research has yet identified such elements.

The existing SCI configuration theory can be extended to explain industrial differences. Configuration theory suggests the need for achieving fit for better performance (Miller, 1990; Doty et al., 1993). A configuration is a bundle of characteristics that, together, lead to high performance and each configuration is composed of tight constellations of mutually supportive elements (Miller, 1986), or fits (Miller, 1990). In other words, SCI dimensions and the external environment can be seen as the bundles of characteristics that are mutually supportive, leading to specific arcs of integration. Industrial differences may be explained by the fact that external environments such as supply market, customer demand, and industrial norms may create different dominant coalitions in an industry. These dominant coalitions are responsible for "partitioning the environment and assigning its components to various organizational subunits such that resources are allocated to these subunits according to their strategic importance" (Miles and Snow, 1978).

Taking the matured automotive industry as an example, influential focal firms in such an industry can create two dominant coalitions: integrated and non-integrated suppliers (Waters-Fuller, 1995; Dyer et al., 1998). Such exogenous structural constraints may reduce the range of feasible configurations (Whittington, 1988). Thus, firms being asked to operate in just-in-time (JIT) supply environments where planning of supply delivery has to be undertaken in an integrative manner require SCI configurations with relatively high levels of SI, II