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Information sharing across multiple supply chain tiers: A Delphi study on antecedents

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ABSTRACT

The purpose of this paper is to empirically explore antecedents associated with information sharing across multiple supply chain tiers. We conduct a Delphi study with 29 supply chain experts to collect qualitative and quantitative data, and identify a total of 22 factors that are grouped into six categories: information utilization, technology utilization, power structures, culture, business process, and legal. All 22 factors pose challenges to information sharing beyond the dyadic relationships, and certain factors such as trust are regarded as barriers, i.e. too difficult to resolve for implementing multi-tier information sharing. With respect to the many antecedents that are identified, the study highlights several difficulties for companies to achieve seamless information flows across multi-tier supply chains. These difficulties concern relational, behavioral, and structural issues in networks of multiple companies. For instance, there is a lack of an overarching purpose and process so that all partners work toward the same goal, and an increased number of relationships make it difficult to build strong relationships and to formalize contracts. The multiple links and exchanges also make it difficult to forecast, aggregate, and share accurate and timely information in a secure manner. This research study is one of the few that empirically explores information sharing across multi-tier supply chains and, as such, provides new insights to why the challenges may be difficult to resolve in a multi-tier setting.

1. Introduction

The Absolut Company shares demand-related information with their immediate suppliers and customers only, but not beyond that, even though they have experienced stable demand for long time-periods (Kembro and Selviaridis, 2015). Kembro and Selviaridis (2015) studied information sharing along a seven-tier supply chain – the Absolut Company and three tiers upstream as well as downstream – and concluded that despite potential benefits, the companies refrained from sharing information beyond the dyadic ties. They found that there are challenges related to misinterpreted and incomplete information, which are particularly difficult to resolve in multi-tier supply chains. This case provides empirical support to previous research that suggests that companies struggle with and avoid demand-related information sharing across their supply chain; see e.g. Moberg et al. (2002), Angulo et al. (2004), Taylor and Fearne (2006), and Fawcett et al. (2009). Angulo et al. (2004) indicated that there may be several barriers to the implementation of multi-tier information sharing. Fawcett et al. (2007), for example, submitted that information systems fall short of enabling the seamless connectivity supply chain managers want, and that the connectivity challenge is worsened by organizational cultures and structures that reduce companies' willingness to share the information needed to improve overall supply chain performance.

At the same time, there are proponents of information sharing along the supply chain, that highlight potential benefits such as improved allocation and utilization of logistics resources, improved production planning, lower inventory costs, increased customer service, and reduced lead times through the supply chain, see e.g. Angulo et al. (2004), Zhou and Benton (2007), Prajogo and Olhager (2012), and Hill et al. (2012). Several authors have also emphasized the need for increased information sharing across the supply chain (see e.g. Ogden et al., 2005; Caridi et al., 2010). Mason-Jones and Towill (1999), for instance, argue that unmodified customer demand data should be shared as far upstream in the supply chain as possible. Melnyk et al. (2009) urge managers to ensure seamless information sharing by involving the entire supply chain and working together collaboratively with secure and timely information flows between the parties. Similarly, Autry et al. (2014) argue that the effort to connect the triad and perhaps the broader supply chain at

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further tiers is worthwhile to achieve higher effectiveness and efficiency in the supply chain.

Hence, there are two different views. One group claims that it is difficult, if not impossible, to implement multi-tier information sharing whereas the other group argues that information sharing across multiple tiers can be done, should be done, and is being done in industry. Reviews of extant literature applying an empirical research method (see e.g. Kembro and Näslund, 2014) suggest that this disagreement to some extent can be explained by a difference in reported unit of analysis and studied unit of analysis. While results are often reported on the supply chain level, research has predominantly focused on dyadic buyer-supplier relationships (Autry et al., 2014; Caridi et al., 2014). As argued by, for example, Mena et al. (2013) and Kembro and Näslund (2014), this dyadic approach to researching supply chains is problematic bearing in mind that the complexity and dynamics across multi-tier supply chains are different than in a buyer-supplier relationship. Moving beyond the dyadic relationships implies different competitive dynamics, increased relational and behavioral issues as well as structural issues of networks including multiple links and exchanges (Kembro and Selviaridis, 2015).

In the future, companies are expected to intensify their efforts to establish relationships and share information across networks to strengthen their cost, quality, and sustainability performance (Mena et al., 2013). As argued by several authors (see e.g. Moberg et al., 2002; Li and Lin, 2006; Bailey and Francis, 2008; and Vijayasarathy, 2010), researchers should further investigate the challenges that companies need to overcome to implement and unlock the claimed benefits of multi-tier information sharing. The purpose of this study is therefore to identify and explore antecedents to multi-tier information sharing. We formulate the following research question:

RQ. *How do factors relevant to multi-tier information sharing act as barriers or challenges?*

The unit of analysis is the supply chain (Mentzer et al., 2001) representing three or more tiers, which could involve networks of multiple suppliers, manufacturers and/or customers. Moreover, we define a *barrier* as a factor, which likely is too difficult to overcome or solve in order to implement information sharing across three or more tiers, whereas a *challenge* represents a complicating factor, which likely can be overcome or solved in order to implement information sharing across three or more tiers.

We employ an extensive Delphi study with 29 panel experts including industry professionals, academic scholars, and senior consultants. We identify 22 factors that must be addressed to enable information sharing in multi-tier supply chains, and group these factors into six categories. The paper is organized as follows. First, we review the related literature on information sharing in supply chains. Second, we present the Delphi study methodology. We then present the results including a qualitative and quantitative assessment. Finally, we discuss implications for practice and research, as well as limitations and opportunities for future research.

2. Related literature

2.1. Information sharing in supply chains

Companies share demand-related information with their upstream and downstream partners with the purpose to improve planning and coordination of logistics and production related activities (Cooper et al., 1997; Fawcett et al., 2009). Inter-organizational information sharing involves two or more organizations from different tiers of the supply chains. Information sharing can be categorized based on the intended decision time horizon: (i) operational level: companies share sales and order information to facilitate customer orders, reduce information distortion, and lower stock levels (Patnayakuni et al., 2006; Klein and Rai, 2009); (ii) tactical level: involves monthly and quarterly forecasts and plans to help partners reserve adequate capacities for production and logistics activities (Patnayakuni et al., 2006; Klein and Rai, 2009; Yigitbasioglu, 2010); (iii) strategic level: organizations share annual demand and promotion plans as well as marketing strategies to enable planning of future purchases and growth within the alliance (Mentzer et al., 2001).

2.2. Antecedents to information sharing in supply chains

Considering the purpose of the paper, we built on previous literature reviews in the area (Sahin and Robinson, 2005; Huang et al., 2003) and conducted a systematic review of literature to identify factors that must be addressed to enable information sharing in supply chains. We adopted guidelines provided by e.g. Tranfield et al. (2003) and focused our search on papers applying an empirical research method (Wacker, 1998) or conceptual papers that are based on empirical results. We first conducted a scoping study to define relevant keywords, which were then used to search for literature in two recognized databases: Thomson Reuters (formerly ISI) Web of Knowledge and SciVerse Scopus. We used a data extraction sheet to identify and map various factors and classifications, and reached the final list of factors by following two steps. First, we created a long list of all factors mentioned in literature. Here, we noted that literature to a certain extent mixes pre-requisites, antecedents, challenges and barriers (and even drivers) to information sharing in supply chains. Second, we identified common themes across the factors and grouped factors that were similar together. In this process, we concluded that there is a lack of a clear and systematic classification of the various factors, which is one of the gaps that the manuscript addresses.

The systematic review revealed that previous literature predominantly focuses on the dyadic buyer-supplier relationships, and there is a lack of research applying the multi-tier supply chain as unit of analysis (Moberg et al., 2002; Barratt, 2004; Autry et al., 2014; Kembro and Näslund, 2014). We found nine factors that must be addressed to enable dyadic information sharing: (i) low information quality, (ii) costly and inadequate information systems, (iii) power asymmetry, (iv) lack of governance, (v) lack of trust, (vi) unfair allocation of benefits, (vii) lack of common performance indicators, (viii) lack of common goals, and (ix) confidential information. These are displayed in Table 1, with the respective sources. Further, the review showed that related literature has discussed one or a few of these nine factors at a time, and a large number of the sources (15 out of 28 in Table 1) deal with only a single factor. Among the few examples that empirically investigate information sharing across three or more supply chain tiers, Kembro and Selviaridis (2015) highlight issues related to low information quality. Capo-Vicedo et al. (2011) investigate socio-technical factors such as trust and shared vision. Bailey and Francis (2008) also discuss aligned performance measures and benefit allocation among companies. Finally, Holweg and Pil (2008, p. 401) argue that power dynamics determine the directionality of information flows, where the dominant actor "will favor local optimization of their respective processes over a solution that marks a compromise derived from a systemic perspective." Next, we discuss the various factors (Table 1) and related concerns.

Companies are often embedded in several networks (cf. Choi and Hong, 2002) where each firm may have multiple suppliers and customers. Connecting supply chain partners and their different information systems can therefore be difficult, time-consuming and expensive (Lee and Whang, 2000; Childerhouse et al., 2003) often resulting in low information quality regarding accuracy, timeliness and proper formatting (Moberg et al., 2002; Angulo et al., 2004; Li and Lin, 2006; Forslund and Jonsson, 2007). Inaccurate and obsolete information has no value for decision-making, and could even create a number of problems for upstream supply chain partners including process inefficiencies and excess cost in production and transportation (Monczka et al., 1998; Lee and Whang, 2000; Li et al., 2006).

Another concern relates to power. Power asymmetry represents an imbalance in power and dependence between companies (e.g. Mason-Jones and Towill, 1999). On the one hand, firms may refrain from

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