USING KEY SUPPLIER RELATIONSHIP MANAGEMENT TO ENABLE SUPPLY CHAIN RISK MANAGEMENT IN THE AUTOMOTIVE INDUSTRY

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ABSTRACT

This paper investigates whether manufacturers using key supplier relationship management as a strategic tool will enable supply chain risk management to reduce or mitigate risks. An exploratory qualitative study conducted interviews with five auto manufacturers and five original equipment manufacturers or first-tier suppliers. Analysis found both groups are interested in doing so but that the practice is not wide-spread. Inhibitors include a continuing emphasis on cost, quality and supplier capacity, issues regarding new and smaller supply chain actors, sudden process and production changes impacting suppliers, and lack of auto manufacturer communication and information sharing. Suggestions to address these inhibitors include closer collaborative involvement between auto manufacturers and their original equipment manufacturers in a key supplier relationship management approach.

***Key words**: Supplier relationship management, supply chain risk management, original equipment manufacturers, automotive industry*

บทคัดย่อ

บทความนี้มีวัตถุประสงค์ เพื่อสืบค้นว่าผู้ผลิตมีการใช้การบริหารความสัมพันธ์กับซัพพลายเออร์หลักเป็นเครื่องมือในเชิงกลยุทธ์ เพื่อลดหรือบรรเทาความเสี่ยงในโซ่อุปทานหรือไม่ ซึ่งเป็นงานวิจัยเชิงคุณภาพเพื่อการสำรวจ โดยการสัมภาษณ์ผู้ผลิตยานยนต์ 5 ราย และผู้ประกอบยานยนต์ หรือ ผู้ผลิตชิ้นส่วน 5 ราย จากการวิเคราะห์ข้อมูลพบว่า ทั้งสองกลุ่มสนใจที่จะใช้การบริหารความสัมพันธ์เพื่อลดหรือบรรเทาความเสี่ยงในโซ่อุปทาน แต่ยังไม่ได้มีการนำมาปฏิบัติในวงกว้าง อุปสรรคเกิดจากการให้ความสำคัญกับการบริหารต้นทุน คุณภาพ และความสามารถของผู้ผลิตชิ้นส่วนเป็นหลัก นอกจากนี้ยังมีประเด็นในเรื่องสมาชิกโซ่อุปทานรายใหม่ที่มีขนาดเล็กกว่า การเปลี่ยนแปลงกระบวนการ และการผลิตอย่างกระทันหันที่ส่งผลกระทบต่อผู้ผลิตชิ้นส่วน การขาดการสื่อสารและแลกเปลี่ยนข้อมูลกับผู้ผลิต ข้อเสนอแนะในการแก้ปัญหารวมถึงความร่วมมือกันอย่างใกล้ชิดระหว่างผู้ผลิตยานยนต์และผู้ประกอบยานยนต์โดยการใช้วิธีบริหารความสัมพันธ์กับซัพพลายเออร์หลักเป็นเครื่องมือ

คำสำคัญ: การบริหารความสัมพันธ์กับซัพพลายเออร์ การจัดการความเสี่ยงในโซ่อุปทาน ผู้ประกอบยานยนต์ อุตสาหกรรมยานยนต์

Received: April 11, 2019; Revised: May 15, 2019; Accepted: May 21, 2019

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INTRODUCTION

It is argued that the cost of inputs for the automotive manufacturing sector is around two-thirds of the final product cost. Further, a failure of any one node in a supply chain might lead to a failure of the entire supply chain network or the auto manufacturer having to stop production, which might have an impact of having an impact of around USD 1.25 million per hour for an auto manufacturer unless it carries safety stock (Bakshi & Kleindorfer, 2009).

Modern automotive supply chains have become more complicated than even two decades ago with JIT production and globalized supply with multiple tiers of actors (JLT, 2019). Trends such as outsourcing, off-shore manufacturing, globalisation, improved infrastructure and information technology have extended supply chains into longer and complex networks which increase risk substantially (Manuj & Mentzer, 2008; Grant, 2014). Such increased complications and risk in the automotive manufacturing sector is manifested in publicly well-known major production and recall situations such as airbags produced by Takata and brake master cylinders produced for Toyota.

Supply chain risk refers to the disruption of flows between organisations, which could relate to information, materials, products or money, and extends beyond the boundary of a single firm where the boundary-spanning flows themselves can present a source of risk (Peck, 2006). Further, the concept of supply chain risk management (SCRM) was considered by Rafi-Ul-Shan et al. to be *"the management of supply chain risk through coordination or collaboration among the supply chain partners so as to ensure profitability and continuity"* (2018:475).

The automotive manufacturing sector was the most disrupted sector in 2017 with over 1,700 'events' (JLT, 2019). Auto manufacturers rely mainly on small- to medium-sized enterprises (i.e. 60-70 percent of their supplier base), who may be less prepared to respond to disruptions than larger firms. We argue it is paramount for auto manufacturers to properly manage their first-tier suppliers in terms of ensuring that not only will they always deliver the right amount of inputs just in time but that they also are resilient in the face of increased risks and can transmit these values to their own suppliers, who are tier two for the manufacturers. This is often referred to as key supplier relationship management (KSRM).

KSRM is defined by Teller et al. *"as the management of familiar relationships between a company and a supplier, in which the two parties share a significant level of business process integration and view themselves as an extension of their firms"* (2016:110) and has the potential to improve performance and create value. Therefore, a coherent KSRM strategy appears to also be anappropriate solution to reduce or manage supply chain network risk.

Previous studies have stressed the importance of supplier relationship in the implementation of SCRM but have focussed mostly on supply chain integration or collaboration and its relationship with performance across industries, e.g. Kauppi et al. (2016). In this paper we draw on the literature on KSRM as a collaborative strategy to achieve more supply chain visibility to better manage supply chain risk. Therefore, this paper's objective is to investigate whether KSRM is a relevant strategic tool to mitigate SCRM in the automotive manufacturing industry in a western context, i.e. North America and Europe.

The remainder of this paper is organized as follows. The next section overviews the literature and theory behind both SCRM and KSRM. Then, in the two following sections the research

methodology and design are explained before results are presented. Finally, we conclude the paper with some remarks and avenues for further research.

SUPPLY CHAIN RISK MANAGEMENT

Over the past years, the unpredictability of the business environment and various industrial trends as noted above have caused companies to be exposed to supply chain risks, making SCRM a key area of interest for practitioners and academics (Colicchia & Strozzi, 2012; Fan & Stevenson, 2018). Several definitions and approaches to SCRM exist, focusing on pathway and objectives (Norrman & Jansson, 2004), stages (Wieland & Wallenburg, 2012) or a sub-process (Lavastre et al., 2012), without having a real consensus. In an attempt to build a comprehensive definition, Fan and Stevenson, build on Rafi-Ul-Shan et al.'s (2018) consideration define SCRM as *"the identification, assessment, treatment, and monitoring of supply chain risks, with the aid of the internal implementation of tools, techniques and strategies and of external coordination and collaboration with supply chain members so as to reduce vulnerability and ensure continuity coupled with profitability, leading to competitive advantage"* (2018:210).

Regardless of definition or approach, supply chain risks are what drive companies to develop SCRM strategies, as these create negative impact in a firm's continuity and overall performance (Hendricks & Singhal, 2005). Research on supply chain risks has categorized risks based on different criteria, ranging from source (Kleindofer & Saad, 2005), type (Peck, 2006; Manuj & Mentzer, 2008), and influences (Trkman & McCormack, 2009).

Internal Risks: Supply and Demand

Peck (2006) suggests that risk can impact companies in three ways: internal to the company, external to the company and internal to the supply chain, and external to the supply chain. Thun and Hoenig argue that "*internal supply chain risks have a higher likelihood to occur than external supply chain risks since the majority of the latter are predominantly exceptional (e.g. war or terrorist attacks), whereas internal supply chain risks such as supplier problems or a change in customer demand cannot be regarded as uncommon incidents"* (2011:244). Thus, we consider it important not to focus on risks internal to the company but rather to the internal supply chain, i.e. demand and supply risks. Demand risks relate to actual or potential disruptions between the company's market and customers whereas supply risks relate to disruptions upstream of the firm.

With regards to demand risk, the main premise is that end-consumer demand is uncertain (Sohdi, 2005). A change of a plant's replenishment schedule or on a customer's forecast may cause that supply from the warehouse do not match consumer demand, resulting in delivery bottlenecks, high inventories, or inefficient capacity utilization (Cachon & Lariviere, 2001). Evidence shows that demand risk has a direct negative impact on a firm's operational performance (Chen et al., 2013), but given that supply risk has a bigger effect on process risk it also has a more severe impact on the company's production risk than demand risk. Supply risk is, in that sense, perceived by managers as higher than demand risk.

Supply characteristics such as capacity constraints (e.g. size of the plant, labour force, technology), supply availability or legal liabilities can have detrimental effects on profits (Zsidisin, 2003). In other cases, financial instability can become critical, particularly when alternative or new sources are hard to develop or find (Giunipero & Eltantawy, 2004), but also some purchasing practices such as single sourcing, JIT deliveries and reduced supplier

base can represent a threat to the supply chain. Nevertheless, evidence shows that external risks as globalization fosters risk on the supply chain since it can have an impact on both supply and demand (Thun & Hoenig, 2011). Lastly, there are also deliberate but company controllable managerial internal company risks, such as the recent Volkswagen scandal, however we leave such risks aside for the purposes of this paper.

External Risks: Environmental and Density

When studying external risks, Deane et al. (2009) differentiate between environmental and what they define as density risks. Environmental risk *"refers to risks associated with the economic, political, cultural, natural, and infrastructure aspects of various countries of the world"* while density *risk "refers to risks associated with the geographic proximity of the chosen suppliers"* (2009:862). From these two environmental risks, such as natural disasters including the 2011 Asian Tsunami and Japanese earthquake, are likely to have a higher impact as such incidents are commonly accompanied by grave consequences (Thun & Hoenig, 2011).

Over the past twenty years many environmental risk events have increased and have had a great impact on companies across several industrial sectors. Scholarly research (see for example Sheffi, 2001 and Kleindorfer & Saad, 2005) has studied disruptions from these events, analysed their impact, and proposed means to reduce impact or better respond to these risks. Among these, supply chain visibility and supplier collaboration are considered key strategies to reduce the impact of environmental risks.

KEY SUPPLIER RELATIONSHIP MANAGEMENT

Historically, KSRM has been studied under the buyer-supplier relationship umbrella and for some time research focused only on topics such as purchasing strategy, supplier selection, supplier collaboration, and supplier development; each one being widely studied but independently. Kraljic's (1983) seminal purchasing strategy model has served as a basis for many other researcher and companies aiming to reduce costs. Regarding supplier selection, two early approaches have also been studied, namely the identification of criteria considered in supplier assessment (Dickson, 1966) and the application of techniques for supplier evaluation (Schniederjans & Garvin, 1997). Supplier collaboration has mostly dealt with aspect of collaboration strategy and the techniques to implement it (Gunasekaran, 1999; Handfield et al., 1999). Finally, supplier development has studied a supplier's value by measuring its capabilities and performance over longer periods of time (Roodhooft & Konings, 1996).

Recently, the literature has put more attention into integrative approaches from method and process perspectives. On method, several studies (e.g. Lui & Wu, 2005; Lin et al., 2009) have integrated decision-making tools for solving the supplier selection problem. From a process perspective, Ting and Cho (2008) provide an integrated approach to supplier selection and purchasing decisions, Eroll and Ferrell (2009) use JIT and total quality to design purchasing strategies, Grant (2005) suggesteda longer-term relational strategy as opposed to transactional events, and Park et al. (2010) proposed a framework for supplier relationship integration.

Other studies have also demonstrated the importance of supplier relations to company performance for both customer and suppliers. For instance, Corsten and Kumar (2005) showed the benefits of cooperative relationships from a supplier perspective, Grant and Torgersen (2006) emphasised proper communication and information for suppliers, Hamister

(2012) demonstrated the positive impact of supplier partnerships on supplier performance, Forslund (2014) showed that logistics performance depends on the quality of buyer-supplier relationships, and Teller et al. (2016) demonstrated the potential of KSRM for enhancing the level of SCM execution and thus higher customer and shareholder value.

METHODOLOGY

We drew from the literature and theory discussed above about SCRM and KSRM to build our understanding of how the interaction between them and how KSRM may enable SCRM and mitigation in the automotive industry. We thus develop the concept rather than construct or test theory (Gioia et al., 2013). An inductive multiple case study approach (Yin, 2013) was chosen given the limited existence of empirical evidence about the relationship and interactions between SCRM and KSRM generally and this sector particularly. Case study research presents an opportunity to explore a complex or new phenomenon with unclear boundaries in the early stages of theory building and enables researchers to understand a holistic picture by answering how and why questions (Eisenhardt & Graebner, 2007; Yin, 2013) and thus we considered this approach appropriate for our empirical study.

We used qualitative methods to explore the relevance of KSRM as a strategy to enable supply chain risk in the automotive industry. For this, semi-structured interviews were conducted and analysed. The interview guide comprised three sections. After an opening to obtain an overview of the company and its supply chain structure, the first section addressed issues of SCRM such as risk differentiation, supply chain resilience, the tools used to manage risk, and corporate culture. The second section assessed each company's supplier management to understand all implications for KSRM; questions focussed on sourcing strategies, supplier selection and evaluation, contracts, as well as supplier development programs. Finally, the third and last section addressed continuous improvement and potential strategies that also contribute to SCRM.

Interviewees were selected using a purposive sampling method. Our criteria included working in SCM or logistics at a senior level for more than 5 years, working in the automotive sector, and being an auto manufacturer or first-tier OEM. A total of ten interviewees were obtained for our study and for confidentiality reasons only their generic demographic profiles are shown in Table 1. Data was collected from these informed respondents who possess tacit knowledge about their company's operations and procedures in a whole supply chain context. All interviews were recorded and transcribed for analysis.

Table 1: Interviewee Demographic Profiles

Company	Region	Position	Years' Experience
OEM 1	Europe	Logistics Director	20+
OEM 2	Asia	Purchasing Director	20+
OEM 3	Europe	Purchasing Manager	4
OEM 4	Europe & USA	Procurement Manager	8
OEM 5	USA	Logistics Director	15+
Auto Manufacturer 1	USA	SC Crisis Manger	4
Auto Manufacturer 2	USA	SCRM Director	20+
Auto Manufacturer 3	USA	Purchasing Director	20+
Auto Manufacturer 4	Europe & USA	Purchasing Manager	4
Auto Manufacturer 5	Europe	SC Crisis Manager	12+

Case data analysis was carried out using open and axial coding schemes to increase internal validity (Miles et al., 2014). These were reviewed and discussed among the researchers to identify, reorganise and eliminate discrepancies in the data, core categories and sub-categories to enhance inter-rater reliability and data credibility. Analysis was conducted by comparing similarities and differences and looking at patterns across the cases (Yin, 2013). To ensure research rigour, we used guidelines from Halldórsson and Aastrup (2003) to assess qualitative research quality measured through trustworthiness, which consists of the following aspects: credibility, transferability, dependability and confirmability.

Findings are presented next. The first two parts first reflect the first two sections of the interview guide. We then discuss KSRM as an enabler of SCRM from discussions emerging from the third section of the interview guide and our reflective analysis detailed in the above paragraph.

FINDINGS

Supply Chain Risk Management

The automotive industry has seen an evolution in the past decades from its two principal actors: auto manufacturers and OEMs. Both types of companies are exposed to supply chain risks and affected by the huge costs that these can represent. However, OEMs and their suppliers have also identified SCRM as an issue for them, but not as strategic a concern as it is for the auto manufacturers. All interviewees pointed out the importance of the auto manufacturer's production line and the necessity of continuity, regardless of the cost. For instance, OEM 3 (Purchasing Manager) explained that *"it is preferable to pay 3 to 4 thousand euros and send a piece by helicopter on a Sunday to the car maker than stop the production"*. The more critical parts, and therefore the more technology and complexity there is in a part, the more the company will be exposed to risk and to a position in which it wants to improve its SCRM strategy. This supports notions of Deane et al. (2009) related to environmental risk and Thun and Hoenig (2011) of both internal and external supply chain risk for this very globalized industry. On the other hand, interviewees argued that suppliers of other parts which are not as complex and with little or no technology do not see these issues as stringently as the auto manufacturers or OEMs. Thus, depending on the product managers may adopt a different approach to SCRM, supporting Peck (2006).

When it comes to risk differentiation, there were many differences and nomenclatures depending on the company. However, interviewees agreed on two main identification strategies used, namely causes of the disruption and consequences of the disruption. Regarding the cause, the idea of 'root cause' seemed to interest part of the respondents. Finding the root cause of the disruption will ultimately allow a company to deal with it anticipate a possible future reoccurrence and thus, the consequence of such disruption. This confirms the idea of SCRM being a learning process; companies use those methods to learn from their mistakes and take corrective actions, supporting Trkman and McCormack (2009).

When it comes to risks that have a lower probability of occurrence, but which may have a critical impact on supply chains, companies tend to have a more reactive approach. Such is the case of natural disasters, which are acknowledged and considered in SCRM strategies. As this is a new field of research for companies, it appears that some face those risks with mixed success. Therefore, companies tend to have a proactive and reactive approach depending on which type of risk they face, again providing further support for Deane et al. (2009) and Thun and Hoenig (2011).

There are limits to SCRM in a globalized world and those limits are even more striking in a complex supply chain such as the automotive industry. All auto manufacturers had a grasp of what happens a step further upstream, i.e. the first tier. After that, it depends on the company practices and their position in the supply chain. Compared to the OEMs, the auto manufacturers in our study seem to perform better in terms of visibility as in some cases they deal with tier-2 suppliers and mandate a tier-2 to provide certain parts to a tier-1 supplier they have agreed to source from, i.e. the tier-1 supplier must source a component from a supplier chosen by the auto manufacturer.

This practice may go a bit deeper to the tier-3 supplier, but only in very specific cases where a commodity is critical for the auto manufacturer and even in that case it is complicated to get the required information. Nonetheless, a difference was among automobile brands: some have in their processes a willingness to go deep in their supply chain to monitor risk. In fact, one of the companies of this study shows that they have a state-of-the-art approach here as they can analyse up to tier-5 or tier-6 without that being an exceptional circumstance.

When dealing with supply chain risks, OEMs have a softer stance on the subject. Like the auto manufacturers, OEMs also know their tier-1 suppliers. Nonetheless, there are limits to their strategy as most rely on their suppliers to do the same job as they did when dealing with their SCRM strategy. While one can expect that from a big supplier, it is not necessarily the case with smaller businesses as these may not have the means to develop and enforce such a strategy, thus putting their customers to risk.

Further, some OEMs also have different industrial strategies depending on what they are manufacturing, in-line with Gunasekaran (1999) and Handfield et al. (1999). Some of them do mass production of small components and parts, which are then sent to plants closer to their customer to manufacture their product and send it over to the client. This step-by-step approach may be a certain type of risk mitigation strategy. As they have several facilities, OEMs can soften a disruption within their own supply chain.

Key Supplier Relationship Management

In today's automotive industry, the buyer or more precisely the auto manufacturers have understood the importance of their major suppliers, and thus these are providing them with innovation and new technology. Supplier development and relationship management therefore become critical to attain competitive advantage. Regardless of their position or business, all interviewees agreed on this point, supporting Teller et al. (2016). Nevertheless, there were some differences. When talking to purchasing managers or supply chain risk managers, they agree that talking to their suppliers and dealing with supplier related issues take around most of their time to the point where they might suffer 'overcommunication'.

Conversely, while logistics managers do deal with suppliers it does not appear as important for them as it is for the purchasing department. As OEM 5 (Logistics Director) noted *"…in purchasing, my colleagues would definitely say yes, is 95% of their work. On my side (…) I would say is relative. We have a lot of standards and we use standard systems to communicate with them"*. This difference is also clear on the way both purchasers and supply chain managers deal with SRM strategies to cope with risk. Buyers are here to assess the risk that is involved with dealing with suppliers and making sure their company will be able to do business for a long time with their suppliers. Supply chain managers, on the other hand, have a more reactive approach and base their SRM on the day-to-day management of operations,

sharing KPIs with suppliers on a regular basis so to respond rapidly to any problem that may rise. This is a process issue in-line with Corsten and Kumar (2005).

As found in the interviews, SCRM is not yet involved at the product development stage. It starts at sourcing, when buyers look at financial statements, location, and capacity constraints among others. As contracts are usually set for the length of a program (five to eight years) with little chance of re-sourcing, from the beginning the buyer is encouraged to support the seller if need be. If the supplier is a big company with great standards, there is no need for this step.

However, if the supplier has standards that are below those of the customer, there may be a need for support. This step involves every supplier and is a moment when risk mitigation takes place if a disruption occurs. As both the buyer and the supplier are aware of the cost of stopping the production line, putting standard processes in place to avoid a major disruption is an easy task. As explained by OEM 1 (Logistics Director)*"…we have taxis, we make exceptional transportation, from time to time we 'run' to the constructor (…) we manage to not stop the production line which is the ultimate 'taboo' because it costs 1 million euros per day, so try to avoid this (…) we outsource, we find the production capacity, anyway we organise ourselves"*.

Sometimes both actors find a solution even though there is a disruption at the suppliers' plant. As explained by OEM 3 (Purchasing Manager) *"…together, we find a way to produce the part differently, we look for another factory that produces the same part for another client so that they produce a bit more and supply it in our behalf"*. Further, OEM 4 (Procurement Manager) noted *"…KSRM is effective between two parties when they will inform each other to find the best solution (…) we adapt the internal communication and with the client depending on the risk (…) even readjusting the production schedule if that is possible"*.

Supplier development mainly focused on two aspects, quality and capacity, helping suppliers to make sure they will be able to reach what their buyers ask from them, supporting Eroll and Ferrell (2009). The idea behind that practice is that by improving suppliers' standards to the company standards, it will reduce supply chain risks. Thus, contributing to suppliers' development in the long run was found to be a shared value among the interviewees. All companies in the study developed suppliers, but only very specific ones which had critical commodities. Given the effort and investment for supplier development, it usually involves a technologies and suppliers that companies expect to work with over a long period.

As explained by a few interviewees, the approach is based on value-added suppliers: *"…this is something that, for the moment, we reserve to some suppliers, but the trend is to develop it with other suppliers"* (OEM 1 Logistics Director). For this specific case, the process is not a key point in their strategy, but they are expanding it. For others however, it is the basis for the strategy. As explained by one manufacturer, they believe every supplier should set high goals and is very strict with its suppliers. That is why they go to every supplier with SPM (Supplier Preparation Management) to make sure they do what is necessary to help them perform: "*Every project (…) worldwide, has key people that go visit the suppliers and help them put in place the production process (…) and they audit it using preestablished criteria"* (OEM 3 Purchasing Manager).

Key Roles for Suppliers to Enable Risk Management

As noted above both the auto manufacturers and OEMs are the most important set of actors in

the automotive supply chain. These actors have the financial power and business savvy to move activities forward in the supply chain. However, despite many efforts from both sides, things do not always work as they should.

In many occasions there seem to be an incomprehension of each actor's constraints and goals. Almost every OEM in our interviewee set complained about the demands automotive manufacturers sometimes make, and the fact that they seem not to understand the time and energy it takes to achieve what they are asking. OEM 2 was asked by an auto manufacturer to make technical modifications to one of their parts. In the words of their Purchasing Director, *"the company is not in capacity to perform such modifications because our component supplier is not either capable of performing such modifications given that these are made either inadequately or in a very short delay"*. Such issues can lead to increased risks, in this case capacity risk, that have not been previously consideration. We suggest suppliers could enable this process by working more closely with auto manufacturers.

Another common issue is when the auto manufacturer has poor forecasting and communication and thus demand changes continuously and sometime immediately, as was found by Grant and Torgersen (2006). To avoid disruptions and shortages, auto manufacturers and OEMs must work closely to develop means of overcoming these risks before they occur potentially affecting other actors in the supply chain.

We argue auto manufacturers also need to be involved with the OEMs to develop solutions and to foster SCRM and KSRM practices all along the supply chain, again supporting Corsten and Kumar (2005). For example, Auto Manufacturer 2 (SCRM Director) stated "*…it goes back to the suppliers as you go down the chain, being comfortable and willing to provide that information, I think that's challenge #1 and then challenge #2 is, is the process to collect that information*". In some cases, small suppliers do not have automotive manufacturers or OEM as their first client and thus, they see very little interest in putting in place a security stock, a second set of tools or a second production line to reduce risk because is too expensive. According to Auto Manufacturer 3 (Purchasing Director) *"…this is when car manufacturers and OEMs must determine what to do (…) for this type of risk, we estimate that it is an important risk and thus, the contingency plan to put in place with supplier X is this"*.

There was also a common concern by auto manufacturers regarding third-party companies starting to enter the field and finding a solution to integrate such small suppliers. Auto Manufacturer 2 (Purchasing Director) estimates that *"…the first [third party company] that can get two or three or four automotive equipment manufacturers it is going start to have that economies of scale of information, where each one benefits out the other and then everybody will start joining"*. It is thus important for auto manufacturers and OEMs to be aware of all issues surrounding visibility through better or joint management of their supplier base to avoid potential risks, supporting Lui and Wu (2005) and Lin et al. (2009).

Finally, all interviewees agree that having a global view of the supply chain and sharing practices should make it able to respond quicker to any disruption and ensure processes run more smoothly (Hamister, 2012; Forslund, 2014), for instance in the case of standardization. In many automobiles there are important types of parts, the ones that the customer do not necessarily see, which are standardized for the entire industry. This strategy reduces the risk and allows companies to be more flexible. A step further on standardization is the fact that some auto manufacturers are building alliances that can, ultimately, mitigate risks. Although

not entirely widespread, this approach is being implemented between OEMs and it should reach further in the chain, as a collaborative strategy for SCRM. However, it will require auto manufacturers embracing KSRM to achieve these benefits.

CONCLUSIONS

We instigated whether auto manufacturers in a North American and European context could use KSRM as a strategic tool with their OEMs to enable SCRM across the entire automotive supply chain to reduce or mitigate risks. Findings from this exploratory research suggest it is indeed possible and will yield benefits to positively impact SCRM as well as improving processes and profitability of all actors in the supply chain.

However, only a limited number of companies in our interview set are doing so or planning to do so; i.e. such practices are not wide-spread. Issues inhibiting the take-up of these practices relate to process: sudden changes to production schedules and thus suppliers, lack of communication and information, what to do with new entrants and smaller suppliers, and a continuing emphasis on cost, quality and supplier capacity.

In other words, a holistic view to internal and external automotive supply chain in a globalized context is lacking despite interviewees have a global view of the supply chain and belief that sharing practices could provide a quicker response to disruptions. Our suggestions for addressing these issues include closer collaborative involvement by auto manufacturers with their OEMs using a KSRM approach, and vice versa, to develop solutions and foster SCRM practices all along the supply chain.

However, given the exploratory nature of this study we can only confirm our original research objective that KSRM is a relevant strategic tool to mitigate SCRM in the automotive manufacturing industry. As a result, there are some limitations to our study. First, our study was conducted with companies in a western context, i.e. North America and Europe. The so-called low-cost-countries (LCCs), located mostly in Asia, Central and South America, provide an interesting opportunity for companies in this global supply chain to achieve financial and other benefits. However, suppliers and OEMs in such countries are closely located due to resource sharing strategies and hence introduce density risk. If a disruption occurs, it will affect many if not all suppliers as these supply bases are prone to disruption intensity as they have close geographical proximity and represent complex systems.

This situation is very applicable to Thailand's automotive manufacturing sector, which employs almost 550,000 people and produced approximately 3.81 million vehicles in 2017 – almost 60 percent of which was exported and contributed about USD 25.2 billion to Thailand's gross domestic product (Yongplsanphob, 2018). Many of the world's major auto manufacturers operate out of Thailand and thus learnings from this research should be applicable for it in addition to the other LCC regions, including aspects of deeper collaboration (Jeenanunta et al., 2013). This will require research into how auto manufacturers and OEMs should normatively operate in LCC supply markets, versus what they currently do, to improve their activities in these markets including reducing risk.

Finally, the lack of consideration regarding demand risk also needs further study. Advances in automotive technology are making their way into the entire supply chain, including consumers. Shared mobility, connectivity services, electric vehicles, and autonomous vehicles could expand global revenues in the automotive industry by USD 1.5 trillion or a 30

percent increase (Gao et al., 2016), but in themselves are disruptive and engender increased risk. More downstream collaboration will be required to ensure these technological changes work properly and consider views of users, including consumers, transit companies and governments. Both auto manufacturers and OEMs are in the best position to develop and introduce such technologies, but they will have to expand their supply chain landscape to reach out to users. Future research here should investigate how best auto manufacturers and OEMs should engage with, and meet the needs of, various user groups.

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