
Information management and knowledge sharing in supply chains operating in Brazil

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Abstract: This article seeks to answer the following research question: how do enterprises within an automotive supply chain manage inter-organisational information and share knowledge? To this end, this study offers an analysis of the state of the inter-organisational information management and knowledge sharing in a supply chain in the Brazilian automotive sector. The research follows a qualitative approach. The study revisits models by Davenport (1997) and Dyer and Nobeoka (2000) aimed to incorporate particularities from the supply chain analysis by conducting a case study in the Brazilian automotive sector. Information exchanged and knowledge shared within the automotive chain is basically operational in nature and the phenomena occur at layers: unilaterally, bilaterally and multilaterally. Power and technology are elements that need to be balanced to achieve the effective management of inter-organisational information management and knowledge sharing. This paper highlights the relation between information management and knowledge sharing in an automotive supply chain.

Keywords: information management; knowledge sharing; automotive industry; supply chain; Brazil.

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1 Introduction

Today, there is a consensus among both academics and practitioners regarding the importance of supply chain management (SCM) (Mondragon et al., 2006; Brun and Castelli, 2009; Pereira, 2009; Chua et al., 2010). According to reports published in 2008 and 2009 by the international consultancy firms PwC, Deloitte, KPM and SBD, the main emerging markets, Brazil, Russia, India, and China (BRIC), represent the fastest growing automotive markets in the world, with increases in new car sales of up to 10% per year (Ilaese, 2010). This indicates the need to enhance the automotive SCM in emerging markets in order to meet this rate of growth.

Within this context, SCM has become a major component of the competitive strategies designed to enhance organisational productivity and profitability. Clark and Fujimoto (1991) point out the relevance of information for SCM. According to Lamming (1993), lean supply presupposes collaboration with suppliers and clients, which facilitates the information flow. The research carried out by Gunasekaran and Ngai (2005) and Gunasekaran et al. (2008) shows that SCM is a combination of several elements. The first article contains a thorough review of the literature on SCM, while the second goes on to suggest a model of a responsive SCM. These two studies highlight the importance of information management (IM), knowledge management (KM), and knowledge sharing (KS) as fundamental elements of SCM. [Kruiger and Johnson \(2010\)](#) point out that IM

enables KS, while KS is of vital importance within the supply chain as it enhances efficiency ([Myers and Cheung, 2008](#); [Lakshman and Parente, 2008](#)).

According to [Lewis and Talalayevsky \(2004, p.229\)](#), “supply chains are separated into two distinct substructures: physical and information”. Each element in the supply chain is affected by information. The present study investigates inter-organisational information management (IOIM) and KS, following the tendency of the most recent research on SCM ([Dyer and Nobeoka, 2000](#); [Samaddar et al., 2006](#); [Li et al., 2005](#); [Li and Lin, 2006](#); [Myers and Cheung, 2008](#); [Pereira, 2009](#)), within the context of part of an automotive supply chain in Brazil. [Sambasivan et al. \(2009\)](#) consolidate performance measures in a supply chain, and they found that measures related to intangible assets are underdeveloped.

Given the importance the IOIM and KS in SCM, this article seeks to answer the following research question: how do enterprises within an automotive supply chain in an emerging market manage inter-organisational information and share knowledge for improved efficiency? To answer this question, the present study offers an analysis of the state of the IOIM and KS in a supply chain in the Brazilian automotive sector, by carrying out a case study in which data were collected from five enterprises and examined using content analysis.

This paper revisits [Davenport’s \(1997\)](#) model presenting four main stages and considering definition (determination of requirements), acquisition, distribution, and usage, and [Dyer and Nobeoka’s \(2000\)](#) KS model aiming to incorporate particularities from the supply chain analysis. This research reports the findings on a case study addressing IM and KS in a specific setting: a Brazilian automotive supply chain.

The remainder of this paper is organised as follows. In the next section, we will situate our work within the broader literature on SCM, IOIM, KS, and the conceptual model adopted. Following this, we will describe our research method. After which, in the next section, we will discuss the empirical results. In the final section, we will present the conclusions and limitations.

2 Literature review

This section is organised as follows: IOIM in supply chains (2.1), IM process (2.2), inter-organisational KS (2.3), and research model (2.4).

2.1 IOIM in supply chains

According to [Zhao et al. \(2002\)](#) and [Jain et al. \(2009\)](#), SCM is a dynamic process that contemplates all activities associated with the transformation and the flow of goods and services from the companies supplying the raw-materials through to the end-user, including all the information that flows between the suppliers, manufacturers, distributors, retailers, and consumers involved in this process.

Studies into the flow of inter-organisational information and KS in SCM have increased in interdisciplinary areas such as IS and operations and logistics. IS-related research focuses mainly on the electronic flow of information, while the area of operations and logistics investigates the flow of inter-organisational information and KS ([Dyer and Nobeoka, 2000](#)).

Information is the key element facilitating the integration of supply chains, and its importance has been increasingly highlighted by several authors (Bowersox and Closs, 1996; Chopra and Meindl, 2001; Feldmann and Müller, 2003; Sohn and Lim, 2008). The information used and exchanged by enterprises within an SCM is known as inter-organisational information. The basic principle of SCM is founded on the understanding that efficiency can be enhanced through information sharing and joint planning (Bowersox and Closs, 1996; Sohn and Lim, 2008).

There are several advantages to sharing information, such as cost reduction in order processing, less uncertainty in operations planning, and the reduction of stock levels (Bowersox and Closs, 1996). Nevertheless, there are problems concerning the adherence to such sharing on the part of some enterprises within supply chains.

2.2 IM process

Information is data organised for a specific purpose, while knowledge is defined as “information combined with experience, context, interpretation, and reflection” [Davenport et al., (1998), p.43]. Information enables the modification or creation of knowledge (Nonaka, 1994).

McGee and Prusak (1993) and Davenport (1997) conceive of IM as a structured set of activities that includes the way enterprises define, acquire, distribute, and use information. Within the literature on information systems (IS), several IM models are put forward, such as those described in McGee and Prusak (1993), and Davenport (1993, 1997). These models are noticeably similar, with the sole difference being the number of stages contained in each one of them.

The *definition* stage consists of identifying the information needs and requirements. It represents a difficult problem, because it involves identifying information as perceived by end-users and is considered to be the most important stage in IM (McGee and Prusak, 1993). According to Davenport (1993), however, the definition of information needs is the aspect most frequently overlooked by the majority of enterprises.

After defining the information needs, we proceed on to the next stage, *information acquisition*. This stage consists of (Davenport, 1997):

- 1 exploring the information, that is, searching for the information that meets the needs predefined in the previous stage
- 2 classifying the information, and grouping it so as to meet those needs
- 3 formatting and structuring the information.

The *information distribution* stage concerns the means of conveying and divulging (sharing) the information. According to Davenport (1997), it is important to identify the most suitable means of distributing and sharing information in order to facilitate SCM.

The last stage, *information usage*, consists of interpreting and using information. It also involves information performance analysis tasks: whether the information is meeting the needs defined in the first stage (definition of information), and whether it is correct and adequate.

2.3 *Inter-organisational KS*

KS occurs between individuals or groups within organisations (intra-organisational) and between organisations (inter-organisational). [Gonçalves et al. \(2007, p.1\)](#) “presents the organisational framework implemented within the IT department of a French car manufacturer in order to acquire and share knowledge better”. Initiatives involving KM are expanding from the intra-organisational to the inter-organisational level, because the necessary knowledge is no longer only within the formal limits of the organisation (Yang and Kim, 2007; Ahmadjian, 2008). Such authors propose that individual and group attitudes toward KS and subjective norms play an important role in KS intentions (Bigliardi et al., 2010; Chen et al., 2010; Kolekofski and Heminger, 2003; Ryu et al., 2003).

Inter-organisational KS initially occurs between suppliers and the focal firm, and, at a later stage, suppliers extend their relations beyond the focal company to other suppliers ([Dyer and Nobeoka, 2000](#)). While studying an automotive supply chain, Lakshman and Parente (2008) identified evidence of the impact of KM on inter-organisational relationships in the search for competitive advantage. Thus, the organisations within a supply chain come to be seen as strategic partners, with KS being a determinant factor ([Smirnov et al., 2009](#)).

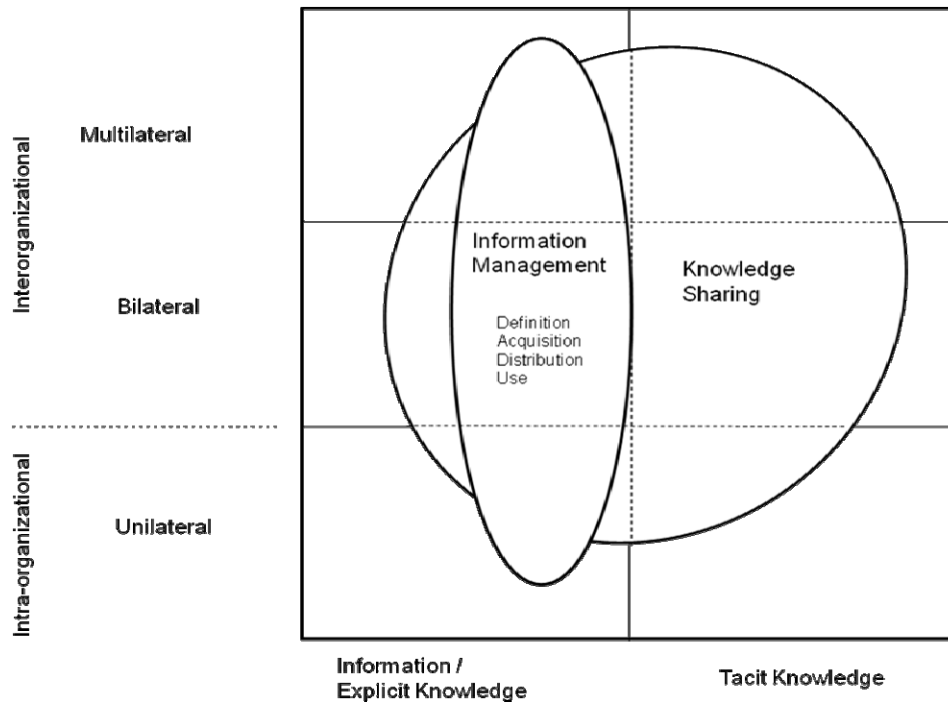
Knowledge can be classified into tacit and explicit (Nonaka, 1994). Tacit knowledge is very personal, subjective, and context specific, though its formalisation and communication are difficult (Takeuchi and Nonaka, 2008). Explicit knowledge, on the other hand, is very formal, objective, systematic, and easily transmitted (Takeuchi and Nonaka, 2008). Explicit knowledge can be shared by training, manuals, publications, and documents ([Volkoff et al., 2004; Ahmadjian, 2008](#)), while tacit knowledge is better shared through mechanisms such as stories, personnel transfers, plant visits, and interactions with suppliers and customers ([Volkoff et al., 2004; Ahmadjian, 2008](#)). Professional associations and trade unions can contribute to KS between organisations (Ahmadjian, 2008). Thus, according to [Dyer and Nobeoka \(2000\)](#), tacit and explicit knowledge can be shared through bilateral and multilateral level relationships with suppliers. Various mechanisms need to be adopted in order to share knowledge. In Toyota’s case, the mechanisms used were multilateral – supplier association committee meetings, and voluntary teams; and bilateral – supplier association general meetings, consulting problem solving team, and interfirm employee transfers (Dyer and Nobeoka, 2000).

2.4 *Research model*

This study combines Davenport’s (1997) IM model and Dyer and Nobeoka’s (2000) KS model. Davenport’s (1997) IM model has four main stages: information definition (determination of requirements), information acquisition, information distribution, and information usage. According to Dyer and Nobeoka’s (2000) KS model, tacit and explicit knowledge can be shared through bilateral and multilateral levels of relationships with suppliers. Various mechanisms need to be adopted in order to share knowledge. In Toyota’s case, the mechanisms used were meetings with supplier associations, the transfer of employees, the creation of a unit within the supply chain dedicated to KS, and a volunteer team ([Dyer and Nobeoka, 2000](#)).

IM and KS were adopted as dimensions in the conceptual model. In relation to IM, the variables were the stages (definition, acquisition, distribution and usage) at the unilateral, bilateral, and multilateral levels of relationship, while for KS, tacit and explicit knowledge within automotive the supply chain were considered (Figure 1).

Figure 1 Research model



A unilateral relationship is intra-organisational, as it considers the IM and KS that occurs within an organisation. The bilateral and multilateral levels are interrelated. The bilateral level involves the management of information and KS between two organisations, which may be companies within the chain or associations representing the sector. The multilateral relationship involves at least three organisations in the chain, which may be companies or associations representing the industry.

3 Research methodology

A qualitative, exploratory research methodology was adopted (Dubé and Paré, 2003). The research followed a case study approach addressing a set of enterprises within a supply chain belonging to the metal-manufacturing sector in Brazil, within the automotive industry, which is among the sectors that most use and invest in IT. The unit of analysis is information exchange and KS within the Brazilian automotive sector. The case was chosen based on three criteria: the relevance of the sample to the research question, the presence of the phenomena in the case, and the opportunity provided to produce believable descriptions (Miles and Huberman, 1994). The determinant factors for the

choice of a specific supply chain for this study were the scale and importance of the enterprise within the context of the automotive supply chain; its recognised capacity for innovation, the excellence of the products and services, and the long-standing nature of the relationships between enterprises; its pioneering initiatives in IOIM and KS; and the willingness of the enterprise to participate in the research at first contact. The single case study includes the following members of the SC: parts manufacturers (*Mahle* and *ThyssenKrupp*, *Sultécnica*), subset assembly (*International*), and final product assembly (*AGCO*).

In this automotive SC, the client-enterprises are *AGCO* and *International*, and the supplier-enterprises are *Mahle*, *ThyssenKrupp*, and *Sultécnica*. In this study, their roles as first level suppliers of *International* and second level suppliers of *AGCO* are analysed, but, due to the links in the chain and as they are auto-parts suppliers, they also directly supply *AGCO* and, in this case, represent first level suppliers as well. Table 1 shows information and characteristics these enterprises.

Table 1 Information about companies research

<i>Client-enterprises</i>	
<i>AGCO</i>	<i>AGCO</i> is a North American company, responsible for 25% of the world output of agricultural machinery. It is presently the leading manufacturer in Latin America and the largest Brazilian exporter of tractors. The subject of this research is a unit that produces agricultural machinery (tractors) and is a major world production centre of the group, since it supplies the markets in more than 90 countries. It manufactures, on average, 49.2% of the national tractor output.
<i>International</i>	<i>International</i> came to Brazil in 1959. The company is part of the <i>International Engine Group</i> , and has become the leading developer and exporter of diesel engines in Brazil and the Mercosul. With 47 years in activity, the company possesses a technology and business centre in São Bernardo do Campo (São Paulo), plus two industrial units, one located in Maria, Córdoba (Argentina), and another in Canoas, in the State of Rio Grande do Sul (Brazil), which was the unit selected for this research.
<i>Supplier-enterprises</i>	
<i>Mahle</i>	<i>Mahle</i> , a corporation of German origin, was founded in 1920. The group settled in Brazil in 1950, and today has six plants. It is currently the world leader in the production of engine components, and, according to data provided by the interviewees, 65% of its Brazilian production is exported. In this paper, the company's Mogi Guaçu unit, in the State of São Paulo, was studied.
<i>ThyssenKrupp</i>	<i>ThyssenKrupp</i> , a German corporation, is active in 17 countries and has almost 130 plants and around 184,000 employees. It owns four plants in Brazil. The unit selected for the research is <i>Campo Limpo Paulista</i> , which provides parts to the <i>International</i> .
<i>Sultécnica</i>	<i>Sultécnica Indústria Mecânica Ltda.</i> started its activities in 1988. Currently, the company is very active in the automotive, hydraulic systems, and agricultural markets, supplying its products to some of the world's most demanding, modern companies. It has been supplying <i>International</i> for over ten years, and it was one of the first companies to share information with <i>International</i> through the new, current information sharing system.

The protocol was as follows: data collection was conducted at the company offices in order to observe people working and understand the processes. Data was collected using semi-structured interviews, documental analysis, and observation of the working environment. The data from these sources was triangulated to achieve a common understanding (Yin, 2005).

The interview guide was validated using the content and face validation procedures as recommended by Yin (2005). The interviews were conducted by one of the authors and lasting two hours on average and four to five interviews were carried out for each SC member, totalling 23 interviews in the five different companies. The interviews were face-to-face with open-ended questions.

The SC members and the research team chose who would be interviewed, following the requirement that they should be staff directly involved in the IOIM and KS. This selection was made in close collaboration with the enterprises, because each SC member presents a specific structure and distributes internal responsibilities and tasks in a particular way. Table 2 shows the staff interviewed, by enterprise, and specifies their positions.

Table 2 Interviewees, classified by company

<i>Enterprise</i>	<i>Interviewee's position</i>
<i>AGCO</i>	Two logistics and materials managers, two supplies acquisition technicians and one EDI analyst
<i>International</i>	Two logistics and materials managers, one planning analyst and one supply analysts
<i>Mahle</i>	One e-business manager and three sales supervisors
<i>Thyssen Krupp</i>	One materials and planning division manager, three business and marketing analysts and two materials planners
<i>Sulténica</i>	One industrial director, one production planning manager and two control managers

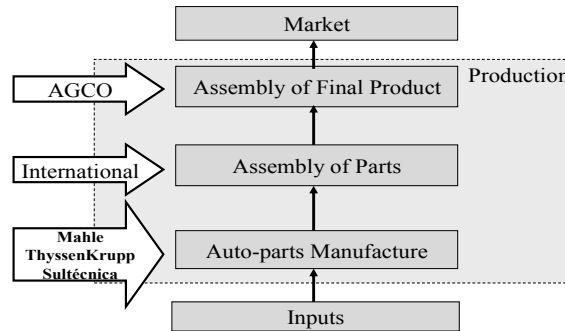
A literature review preceded the elaboration of the interview guide. The open-ended questions considered the following topics:

- a general information about enterprise
- b SCM relationships
- c IM process – phases
- d inter-organisational KS.

The documental research was carried out among documents of various types provided by the SC members upon request, such as annual reports, EDI documents, contracts, and order payments. The websites of the enterprises were also used as a source of documental evidence. The observations were made during the interviews and visits to the factories. Some of the interviewees proceeded with their working routines during the interviews, including answering phone calls, accessing information from other enterprises, using information, and exchanging reports with their customers and suppliers. This simultaneity made it possible to observe relevant research points. Figure 2 shows the members of the SC in the study and the physical flow of the production of auto-parts (*Mahle*,

ThyssenKrupp and *Sultécnica*), subset assembly (*International*) and the final product assembly (*AGCO*).

Figure 2 Studied automotive supply chain and companies



All interviews were tape-recorded and transcribed. The content analysis technique was used to address the information collected from the semi-structured interviews. According to Bardin (1977), content analysis is a set of communication techniques that seek, by means of objective, systematic message description procedures, to obtain indicators that allow the inference of knowledge relative to the production and reception of those messages.

In this study, thematic analysis was used with categories based on the above mentioned stages of IOIM, defining *a priori* and the KS associated with these stages. The interviews were split into initial categories (themes). Subsequently, they were grouped into intermediate categories and, lastly, into the final categories: definition of the information needs, acquisition, distribution, and usage and the unilateral, bilateral or multilateral sharing of explicit and tacit knowledge. During the data processing and interpretation stage, inferences were made with the aid of the other collected data, documents, and observations, which reinforced interviewees' statements.

The reliability of the research was checked using a combination of procedures, including tape-recording, transcription of all interviews, and triangulation of corroborative data from interviews, documents, and observations.

4 Case analysis

The inter-organisational information and KS among client-enterprises and supplier-enterprises within the SC follows the work flow. The results from the content analysis were categorised according to the IM stages defined by Davenport (1997):

- 1 definition of information needs
- 2 information acquisition
- 3 information distribution
- 4 information usage.

In each of these stages, evidence was found of unilateral, bilateral and multilateral actions, in terms of both IM and tacit KS.

4.1 Client-enterprises – AGCO/International

Before defining information needs, the client-enterprises (*AGCO/International*) carry out benchmarking and consult *Anfavea* in an attempt to achieve a more appropriate and acceptable guidelines for sharing information, which enables the sharing of tacit and explicit knowledge. *Anfavea* even has a list of recommended VANs and software-houses to meet the needs of the automotive supply chain, which demonstrates the power of representation of the sector, and highlights the sharing of explicit knowledge through these documents and which are available for consultation both by members and the stakeholders.

Defining information needs at *AGCO* in the SC was a unilateral process, that is, it was defined by *AGCO*, which has outsourced the entire process by hiring an IT company to do everything from the development and implementation to monitoring and interfacing with the supply-companies. However, this attitude has had an effect on the supply chain (200 direct suppliers at first level), for example in the *International* and *Mahle*.

4.1.1 Definition of the information needs

Defining the information needs of the *AGCO* in the SC was a unilateral process, as mentioned above, the entire process has been outsourced by hiring an IT company to cover all technology needs. However, this attitude has had an effect on the chain:

- a *Unilaterally*: *AGCO*'s decision to outsource the entire IM process.
- b *Bilaterally*: the supplier-enterprises are obliged to contract the same IT firm (hired by *AGCO*) in order to continue communicating and supplying *AGCO*. This situation has been widely questioned and disputed by the supplier-enterprises who have, to a certain extent, pressured *AGCO* to ease the decision.
- c *Multilaterally*: the decision by *AGCO* that the supplier-enterprises contract a certain IT company has been discussed in the automotive companies association, The Brazilian National Association of Vehicle Manufacturers (Portuguese, *Anfavea*), in an attempt to reach an agreement suitable to all the parties involved, which has allowed the sharing of tacit knowledge.

In *International*, the process of defining the information needs was a more comprehensive process:

- a *Unilaterally*: the company held three internal meetings to finalise the definition of information to be shared with suppliers, which facilitates the exchange of tacit knowledge.
- b *Bilaterally*: in order to define the inter-organisational information, a benchmarking process was undertaken with companies in the same sector, generating explicit knowledge.

- c *Multilaterally*: workshops were held at *International* with several companies (clients, suppliers and IT), which favoured the sharing of tacit knowledge in order to define the information. The *Anfavea* (Brazil's National Association of Vehicle Manufacturers) enabled the sharing of tacit knowledge through meetings and explicit knowledge based on documents generated by the EDI subcommittee that recommends and sets standards for companies within the sector.

4.1.2 Information acquisition

In *AGCO*, shared information is acquired:

- a *Bilaterally*: information is generated by *AGCO* and the supplier-enterprises automatically to confirm receipt of the order, and they later send out a dispatch notice, which is a pro-forma invoice, where the accuracy of the exchanged information can be checked. The information is obtained in the production sector of *AGCO* and also generated in the supply-company. The IT firm communicates between *AGCO* and each supplier enterprise, controlling all the information forwarded and received.
- b *Multilaterally*: the IT company, through its control of the forwarding and receipt of the information exchanged between *AGCO* and the supply-companies, generates spreadsheets for performance and errors in orders, which can be characterised as explicit knowledge provided by *AGCO*.

In *International*, information is obtained only unilaterally, because it generates the order and the system automatically gives notification when the supply-company has viewed the order.

4.1.3 Information distribution

The means of distributing the information to the supplier-enterprises was determined unilaterally by *AGCO*. The information received by the *AGCO*'s suppliers comes via VAN, in an EDI format, with the IT firm mediating the exchange. Therefore, the IT company does all the IOIM, as well as transmitting the data between *AGCO* and the supply-companies.

In the *International*, in contrast, the means of distributing the information to the supplier-enterprises was determined bilaterally. *International*'s tacit knowledge of each supplier-enterprise helped define that the information for the supplier-enterprises is sent via the web, through its portal, and also in the EDI format.

4.1.4 Information usage

At *AGCO* the information is used in the following way:

- a *Unilaterally*: through the purchasing sector in order to improve the supply of auto parts. The IT firm uses performance and error spreadsheets in order to improve the quality of inter-organisational IM.
- b *Bilaterally*: *AGCO* shares the problems relating to the management of inter-organisational information with the supplier-company.

International uses the information bilaterally:

- 1 after placing the order, it evaluates the performance of the supplier-enterprise, using a scoring system, which creates explicit knowledge that is passed to the supplier-company, which carries out the necessary improvements
- 2 *Sultécnica* actively participated in the validation phase of defining the information to be shared, upon implementation of the portal for the management of inter-organisational information.

In this stage, there was sharing of tacit knowledge. As a result of this validation, improvements have been made in the management of inter-organisational information at *International*.

4.2 Supplier-enterprises – Mahle/ThyssenKrupp/Sultécnica

Each client uses a different type of technology, with EDI currently being the most widely used. But there are still companies that place orders by fax and by e-mail. According to the interviewees, the majority of companies, especially large manufacturers, use the electronic exchange of information, i.e., EDI.

4.2.1 Definition of the information needs

The results obtained in the three supplier-enterprises are very similar. The definition of information needs, from the point of view of the supplier-enterprise was achieved:

- a *Unilaterally*: the client-enterprises define what information to share and how it will be shared within the SC, while the suppliers merely have to adjust to the demands. Each client uses their own type of document, with different layouts and formats, to send almost the same information, differing only in one or another field of information. The only exception is the case of the *International* portal, where there is the option to receive information on the website or by EDI.
- b *Bilaterally*: in the case of *Sultécnica-International* (supplier-client), *Sultécnica* participated in the implementation phase of the portal, in which there was an exchange of information and tacit knowledge between the two companies for the validation of and adjustments to the relationship portal with *International's* suppliers.
- c *Multilaterally*: supplier-enterprises organised themselves and, together with *Sindipeças* (the National Auto-Parts Manufacturers Association) and *ANFAVEA*, began to discuss the decision on the part of *AGCO* that requires them to use a particular IT company. These meetings of the supplier-enterprises with *Sindipeças* and *ANFAVEA* generated tacit knowledge.

As they both operate the automotive sector, *Anfavea* and *Sindipeças* maintain a close relationship, with joint monthly meetings of the associations, which further strengthens the existing multilateral nature and the exchange of tacit and explicit knowledge.

4.2.2 Information acquisition

Information is acquired bilaterally: the information is generated by the client-enterprises and the supply-companies. *Mahle*, *ThyssenKrupp* and *International* send dispatch notices to *AGCO*, which is a pro-forma invoice.

Mahle receives information from client companies automatically through its integrated system – ERP. *ThyssenKrupp* hired a software house to perform the technical part of the collection of information coming from *International* and other clients. The software house maps the file that the client sends (request or delivery schedule) so that it automatically enters the company's internal system, without having to go through an employee. Since the information has been mapped previously, they go directly into *ThyssenKrupp*'s system. *Sultécnica* is the only company where the information is received or verified on the website of *International* and manually transferred to the company's system.

4.2.3 Information distribution

Information distribution is defined and carried out:

- a *unilaterally*: *AGCO* determines how the information is shared
- b *bilaterally*: *international* allows more than one form of distribution, in consideration with aspects related to its supplier-enterprises, which came about as a result of the tacit knowledge that the client-enterprise holds in relation to each supply-company.

4.2.4 Information usage

From the point of view of supplier-enterprises, the use of information is bilateral, since it serves the client-enterprise to place its order and supplier-company to fulfil the order. Moreover, the problems identified by the client-enterprise are passed on to supplier-enterprises so that the inter-organisational information can be better managed, thus generating explicit knowledge through the order performance and errors spreadsheet.

Mahle and *ThyssenKrupp* point out that the information shared by portal or EDI is of better quality, more accurate, and more reliable. According to one of the interviewed executives, "This way, you have greater information security. Information is safer and more accurate, that leaves no margin for interpretation. With EDI, there is higher quality information". In contrast, for *Sultécnica*, there is no great benefit for the company in sharing information through sites or by EDI. According to the company, the clients enjoy the benefits of the system, such as lower labor costs and a fewer failures. For the supplier, the system leads to increased bureaucracy, as there are specific routines for each client and penalties for any failure that occurs in the process of exchanging information.

5 Discussion and contribution

IM and KS were adopted as dimensions in the conceptual model, following Dyer and Nobeoka's (2000) KS model. In relation to IM, the proposed stages by the author

(definition, acquisition, distribution and usage) were addressed at the unilateral, bilateral, and multilateral levels of relationship.

An extra level of relationship was considered: unilateral relationship. This one relates to intra-organisational, independent actions regarding the stages, as it considers the IM and KS that occurs within an organisation. Authors suggest that intra-organisational KS keeps knowledge and information obtained from various sources up-to-date (Lukas et al., 1996; Hsu and Wang, 2008). The bilateral and multilateral levels are, in essence, inter-relational. The bilateral level involves the management of information and KS between two organisations, which may be companies within the chain or associations representing the sector (*Anfavea* and *Sindipeças*). The multilateral relationship involves at least three organisations in the chain, which may be companies or associations representing the industry.

This extension of the model by Dyer and Nobeoka (2000), developed to reflect Toyota's case, better suits other examples of supply chain dynamics since, it presents the more inclusive option: the unilateral alternative. From both the theoretical and empirical points of views, these proposed models seem to provide an ample framework. Academics may use this model to address other supply chain cases in different industries and fully consider the possible levels of decision making regarding IM and KS among the enterprises involved. Practitioners can more easily identify the true levels of IM and KS decision making, and thus allowing them to develop corrective actions improving the efficiency of the SC.

In this case study, the IM did not significantly contribute to KS, which may be explained in part by the fact that *AGCO* is the only company that defines information. KS can enable by IOIM. Nevertheless, it was shown to be dependent on others factors, which need to be investigated further. One such factor is the concentration of power in a single firm. This single firm may or may not consciously use this power to encourage KS or may even be unaware of the importance of KS among firms. Another factor that needs to be investigated concerns the means adopted by firms for KS. In this case study, the workshops, the visits to firms, and the error spreadsheets stand out as mechanisms that foster KS among firms. The first two mechanisms focus on tacit knowledge, while the third is linked to explicit knowledge.

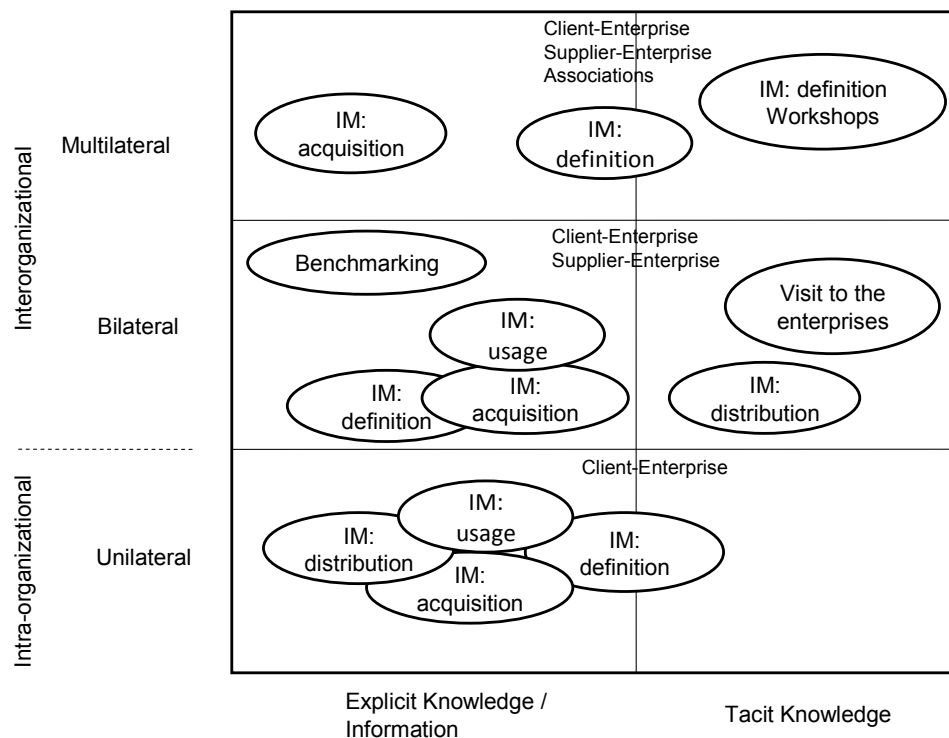
There is unanimity among the Brazilian automotive SC members (client-enterprises and suppliers) in not sharing strategic information and knowledge at the inter-organisational relationship level. This situation is noteworthy since several SC members are foreign companies and yet persist with this approach in Brazil. By contrast, according to the literature, Wal-Mart, in the retail sector, and Cisco, in the computer industry, are examples of companies that share their databases in order to define supply strategies with their suppliers.

Limitations apply to this study, since the nature and essence of the industry and country involved might have influenced the relevancy of some empirical aspects over others. Regarding measuring issues, there are questionable considerations involving information and knowledge measures, since intangibles pose some difficulties to traditional measuring techniques (Rylander and Peppard, 2004). Future research can conduct empirical studies to apply the proposed model in other industries and ensure its validity.

6 Conclusions

This paper has achieved its purpose in terms of analysing the IOIM and KS in enterprises within a supply chain in the Brazilian automotive sector. The conceptual model of the research was adapted from the models of Davenport (1997) and Dyer and Nobeoka (2000). Based on the resulting model, how client-enterprises, supplier-enterprises and associations within an automotive supply chain manage the inter-organisational information and share knowledge was investigated at each stage. The research findings are illustrated in Figure 3.

Figure 3 IM and KS from a Brazilian automotive supply chain case



The stages of IM (definition, acquisition, distribution, and usage) are aligned with the relationship levels (unilateral, bilateral, and multilateral) allowing the identification of the knowledge (explicit and tacit) shared by the organisations in the supply chain. Management of information in this automotive supply chain is defined by the client enterprise (intra-organisational), although for Davenport (1997), IM should be defined by both the customers and the suppliers. In order to discuss the demands made upon them, the supplier-enterprises use the associations (*Anfavea* and *Sindipeças*) that hold meetings in order to establish a standard that meets the needs of the companies involved in automotive SC. In this multilateral (inter-organisational) process, tacit and explicit knowledge is shared as mentioned by Volkoff et al. (2004) and Ahmadjian, (2008). In this case, the stage of defining the information needs led to a process of sharing knowledge through meetings and workshops involving everyone in the SC, although

there is no client-supplier hierarchy in these associations as there is in the supply chain context. The IM and KS were present at all levels of the relationships, demonstrating that this automotive SC is based on IM and KS. This finding further reinforces the validity of the adopted literature-based research model (Figure 2), which relates IM to KS at different relational levels.

Important elements were identified that relate to the supply chain context that could provide fertile ground for future research. While IM leverages KS, it is not enough in itself to ensure enterprises engage in KS. Strategic, tactical and operational information is viewed in different ways by enterprises in the SC. For example, the inventory level is considered strategic information by a third tier company, while for a companies in the first or second tiers of the SC such information is considered operational, which hinders inter-organisational IM and KS.

In addition, the relationships between enterprises occur within a hierarchical construct, that is, they obey the supply chain tiers as indicated by Chopra and Meindl (2001). For example, the power exercised by the enterprise in the first tier in relation to those in second and third may lead to one-way KS, where it only benefits the first tier. Power and technology are elements that need to be balanced to achieve the effective management of inter-organisational IM and KS.

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