

Knowledge Management and Supply Chain – A study in Indian Perspective

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ABSTRACT

SC management has assumed a leading operations strategy position in both manufacturing and service industries, and over the years enterprises have sincerely implemented SC management strategies in their enterprises. Knowledge Management (KM) is a major source of empowerment of SC management, and is a vital element in information intensive and multi-cultured enterprise environments. Realizing the importance of KM in Supply Chain (SC), an effort has been made in this paper to suggest a theoretical framework for KM in SC and to authenticate the frame with the help of an experiential study conducted with Indian enterprises. The majority of participants solicited for this study work in the private sector (medium and large enterprises in the Delhi/NCR region of India). The respondents in this survey are: logistics managers, SC managers and engineers. There is a need to clearly integrate SC network parameters and variables into any final KM model or framework. The results then would supply a more suitable KM framework for improving SC competitiveness.

Keywords: *knowledge management in supply chain, theoretical framework, authentication of framework*

1. INTRODUCTION

Supply chain management (SCM) has become increasingly significant with the globalization of business, and competition between supply chains is likely to stay a vital element in international competitive rivalries (Ketchen Jr. and Guinipero, 2004). The current financial disaster pooled with a hyper-competitive environment has developed an actual need for optimization practices within supply chains. Supply chains are configurations of firms working collectively in a network

that constantly need to upgrade their operations and capabilities, both upstream and downstream, from raw material to end-use consumption (Mentzer et al., 2001). Such network configurations are made up of diverse groups sharing common topics of interest, but sometimes with independent relationships. The flows of information lying at the core of the coordination and collaboration amongst network members are not only dissimilar information sources, they also offer a chance to build knowledge-based tools that are an important part of the extended firm's capabilities (Davis and Spekman, 2004). Resource Based View (RBV) theory assumes that resources are the source of a firm's capabilities, and that its capabilities are the foundation of its competitive advantage (Barney, 1991; Hamel and Prahalad, 1989; Wernerfelt, 1984).

According to Grant (1991), a firm's resources are represented by capital equipment, patents, individuals' skills, brands and reputation, financial resources, physical resources, technological resources, or enterprised resources. As an outgrowth of this stream of research, the Knowledge Based View (KBV) regards knowledge as the key resource, which emphasizes the role of enterprised capabilities to create a sustainable competitive advantage (Conner and Prahalad, 1996; Kogut and Zander, 1992; Nonaka, 1994; Spender and Grant, 1996). Goh (2006) assumes that knowledge adds value to an enterprise through its contribution to products, processes and people, while knowledge management (KM) transforms information, data and intellectual assets into permanent value by identifying useful knowledge for management actions. KM tools support the enterprise in exploring, innovating, disseminating and automating corporate knowledge (Nordin,

2011). An integrated KM approach embraces cultural, enterprise, procedural, and methodical integration. Grant (1996) argues that firms exist so that individuals, seen as knowledge resources, can integrate their knowledge through the enterprise's routines, in the form of capabilities. While other theories emphasize the structure and process of enterprise activities, KBV stress the content of those activities by exploring the concept of "capabilities", seen as an important explanatory variable of performance.

Research on enterprise learning and knowledge management focuses on a fundamental set of questions. How do enterprises create knowledge? How do enterprises maintain the knowledge they create? How can an enterprise improve without first learning something new? How knowledge is transferred within and between enterprises and what factors facilitate its transfer? More recently, questions about how to transfer knowledge across enterprise boundaries appear in the literature (Wadhwa and Saxena, 2005), bringing an original perspective to the analysis and understanding of inter-firm collaboration (Grant and Baden-Fuller, 1995). The knowledge-based approach offers new insight into the mechanism for upgrading and transferring practices within supply chains and increasing numbers of researchers are exploring inter-enterprise sharing between different actors for improving supply chain performance (Dyer and Nobeoka, 2000; Wagner and Buko, 2005).

Current SCM literature is highly focused on structural issues (governance structures, structures of supply chain processes, networks, etc.) and has huge difficulties comprehending people issues, even if it is now well-established that companies exist due to individuals' motivation and preference for the shared identities they supply (Kogut and Zander, 1996). Learning and KM can be considered as drivers for supply chain development, and may be seen as processes likely to introduce innovation in supply chains (Gammelgard, 2007). In complex supply chains, members' combined information and experience may be the most significant source of value creation. New developments in computing and information technology now enable the retention and transfer of information at a supply chain scale that was not the possible when previous major contributions on KM and enterprise learning were proposed by researchers (Valmohammadi, 2013). According to Garvin's (1993) definition, a learning enterprise is "skilled at creating, attaining and transferring knowledge, and at modifying its behavior to reflect new knowledge and insights". This definition can be easily transposed to SCM considering that supply chains are learning enterprises where knowledge can be viewed as a quasi-public good to be shared across the member firms. As companies engage in longer term partnering relationships built around mutual goals and accompanied by a rich and deep exchange of information, inter-enterprise learning is a process that unfolds over time and links with knowledge acquisition and transfer, innovation and improved performance.

To date, most studies on knowledge management have maintained an intra-enterprise viewpoint. With this study, we make an attempt fill a gap in both supply chain management literature and knowledge management literature by providing

empirical support for understanding each stage of the knowledge creation process applied in an inter-enterprise context. Our research question analyzes how the knowledge creation process can be adapted to supply chains and studies the factors enabling that process. Because this study is concerned with exchanges among members in a supply chain, we initially proposed a research framework that was then used to design a questionnaire covering all dimensions of the knowledge creation process according to the SECI model proposed by Nonaka and Takeuchi (1995). A particular emphasis is placed upon relationship context, an element demonstrated as being decisive in the knowledge creation process; in particular it defines the motivation of the supply chain partners to share knowledge over the system. To investigate our research question, a survey of Indian manufacturing firms likely to be concerned with knowledge creation within their supply chain was conducted.

2. BACKGROUND FOR THE RESEARCH

Our objective in this study is to understand how knowledge is created in a SC. New possibilities for developing knowledge within SCs have emerged as information technologies have noticeably evolved over the last 15 years. This situation is considered in our effort to know how information sharing SCs change into Knowledge Sharing (KS) ones and the impact of the context on the transfer. The two main research questions ensuing from this analysis are: (1) Is it possible to characterize the background and the four stages of the SECI model when observing buyer-seller relationships within SCs? (2) What tools and techniques support the Knowledge Creation (KC) process in a SC? Are they particular to each stage or common to the whole process?

SCM and KM represent two main streams of research that have extensively developed over the past several years and many related issues are still addressed by consultants, practitioners or academics. One of these issues concerns the link between knowledge and SC outcomes, but very few studies have dealt with this particular aspect. The literature on Inter-enterprise KM (IKM) can be classified into numerous categories in accordance with the analysis focus, as shown in **Table 1**.

Currently, the literature review shows that there is no purposeful policy to develop IKM within enterprises and that IKM practices are spur-of-the-moment, implicit, interpersonal and specific to a particular circumstance. However, enterprises are aware that learning by doing with their associates is a considerable source of knowledge that needs to be exploited in the future. KM provides a vast potential to create and maintain greater value within SCs by using correct information technology (IT), but also by better understanding and mastering the KC process. Thus, there is a need for superior industrial research leading to KM-based SC evolution, as they assure vast benefits for enterprises. This paper recommends a means to better understand how knowledge is created within a SC by studying application of the SECI model to the observation of various interaction situations between SCs.

3. A CONCEPTUAL MODEL FOR KM IN SC

In this section, we recommend a conceptual model for KM in SC as an addition of the model presented by Nonaka

and Takeuchi (1995). The locus of responses to innovation challenges has shifted from single innovators to innovative networks of varied actors (Boland et al., 2007; Tuomi, 2002).

Table 1 Summary of Selected Literature on KM in SCM

Authors	Research subject	Methodology
Dyer and Nobeoka (2000)	<ul style="list-style-type: none"> Knowledge Transfer (KT) in a network 	<ul style="list-style-type: none"> Case study based of 30 interviews of Toyota executives and senior executives + 21 first-tier suppliers (US + Japan)
Hansen (2002)	<ul style="list-style-type: none"> Knowledge-sharing routines developed by Toyota and its suppliers KS in a multiunit enterprise 	<ul style="list-style-type: none"> Case study of 120 new product development projects in 41 business units of a large electronics company
Bessant et al. (2003)	<ul style="list-style-type: none"> Product development projects Inter-enterprise learning 	<ul style="list-style-type: none"> Case study of six industries (semiconductor equipment, oil and gas, computer, aerospace, chemical)
Dyer and Hatch (2006)	<ul style="list-style-type: none"> KS in a network 	<ul style="list-style-type: none"> Analysis of 25 UK SCs Case study of 42 US automotive suppliers of Toyota and US automakers
Wagner and Buko (2005)	<ul style="list-style-type: none"> Influence of network resources on enterprise performance Knowledge-sharing activities with customers, suppliers and research institutions Analysis of specific roles of these different actors in knowledge-sharing networks 	<ul style="list-style-type: none"> Ten hypotheses tested by a mail survey of 182 enterprises Multi-industry enterprises in Germany and Switzerland
Malhotra et al. (2005)	<ul style="list-style-type: none"> SC partnership configurations KC in collaboration with associates for long-term advantage 	<ul style="list-style-type: none"> Exploratory field case study of an IT-industry SC (RosettaNet B2B initiative) Thirty-five interviews in 16 enterprises in the IT-industry SC Multiple-section survey questionnaire on 91 partnerships
Wadhwa and Saxena (2005)	<ul style="list-style-type: none"> KS amongst the SC members Link with performance 	<ul style="list-style-type: none"> Development of demo models to encourage KS concepts Application of a model for improved SCM
Halley and Beaulieu (2005)	<ul style="list-style-type: none"> Relationship between SC and KM practices 	<ul style="list-style-type: none"> Data collected from a questionnaire on 163 Quebec manufacturing enterprises Research model tested by four hypothesis
Hult et al. (2006)	<ul style="list-style-type: none"> Fit among strategy and eight knowledge elements SC performance 	<ul style="list-style-type: none"> Profile deviation analysis on 913 entities in SCs Identification of ideal profiles for five strategy types
Modi and Mabert (2007)	<ul style="list-style-type: none"> Supplier performance Supplier development KT Role of collaborative inter-enterprise communication 	<ul style="list-style-type: none"> Conceptual model to improve performance 215 supplier development experiences from US manufacturing enterprises
Andersson et al. (2008)	<ul style="list-style-type: none"> Inter-enterprise innovation IT projects Dimensions of architectural knowledge 	<ul style="list-style-type: none"> Building of a theoretical model of architectural knowledge development Swedish transport industry network

This development gives knowledge a strategic role in inter-enterprise networks (Andersson et al., 2008). In spite of this, little is known about joint KS for performance enhancement in SCs. Particularly, the process of KC and transfer that consists of capturing a part of implicit knowledge and transforming it into explicit knowledge that can be obtained and used by several actors in the SC has not yet been studied. In fact, a high level of tacitness makes the transfer of knowledge within and outside the borders of the enterprise very challenging (Simonin, 2004; Wagner and Buko, 2005). Tacit knowledge is best obtained through collaborative experience and KT needs at least a partial codification of implicit knowledge (from tacit to explicit), while applying it needs an internalization of the obtained knowledge (from explicit to tacit) (Nonaka and Takeuchi, 1995). This theory of KC developed by Nonaka and Takeuchi is based on a knowledge level that goes from individual to inter-enterprise and is particularly pertinent to observing the KS process within SCs. These authors consider that a “spiral emerges when the interaction between tacit and explicit knowledge in elevated dynamically from a lower ontological level to higher levels”.

3.1 Ba concept for KM in SCM

“Ba”, a Japanese term meaning “place”, was used by Nonaka and Takeuchi in the explanation of their theory about the key role of the enterprise in the dynamic of KC. To access KC and implement Nonaka and Takeuchi’s knowledge spiral, they identified five dimensions representing necessary conditions for knowledge spiral development: intention, autonomy, creative chaos, redundancy and variety information. Nonaka and Takeuchi assume that “Ba” permits the enterprise to optimize access to the four phases of the SECI model.

Our questionnaire cautiously integrates these five conditions in the corresponding items in SC (see **Table 2**). One important aspect of our study is that the results reveal the respondent’s insight of their shared contexts. Nonaka and Takeuchi (1995) formalize the entire process in a four-mode model called SECI (socialization – sympathized knowledge, externalization – conceptual knowledge, combination – systemic knowledge, internalization – operational knowledge) that characterizes how the contents of knowledge interact with each other in the spiral of KC (see **Figure 1**).

Table 2 Dimensions of Ba Concept

Dimensions of Ba	Questions
Intention	Your associate wants to share information with you
Autonomy	You have some autonomy to act in the background of your work with your associate
Creative chaos	Your practice with your associate changes regularly, you must familiarize yourself
Redundancy	Information flows well between your associate and yourself, even if the associates are changing
Variety of information	You have access to a wide range of information to help you handle with different situations with your associate

3.2 Socialization

The first phase of KS takes place when meetings happen with partnering enterprises and suppliers during informal and formal meetings, at corporation sites or at conferences and workshops. Socialization occurs via interactions between the focal business and suppliers or partnering enterprises, as well as customers. KT occurs concerning suppliers and their performance in terms of maintaining flexibility, quality, and responsiveness.

From tacit to tacit: socialization concerns the interaction between individuals within a group. Swap takes place through observation, imitation and sharing experiences. Socialization is a process of sharing experiences: “learning by- doing” is a practice that exemplifies the fundamental concept of socialization. Experience is the key for acquiring tacit knowledge, such as shared mental models and technical skills. This also includes observation, imitation, and practice.

However, “experience” is the key, which is why the mere “transfer of information” often makes little sense to the receiver. The variables listed in **Table 3** were chosen to measure different facet of socialization. Recall that the questionnaire was based on solving a problem that the respondent had to cope with in collaboration with one of its associates. The socialization process is the first communication between the two parties.

Table 3 Dimensions of Socialization

Dimensions of socialization	Dimensions of socialization
Face to face	Face to face
Brainstorming	Brainstorming
Informal meeting	Informal meeting
Informal swaps	Informal swaps
Transmission of best practices	Transmission of best practices

3.3 Externalization

The second phase of KS (from tacit to explicit) takes place by investigation of practices and understanding. This follows socialization and well defined informal KS. It takes place in SCs when signing contracts or going through outsourcing processes. Through socialization, one can build up potential business contacts as a part of SC operations. This then can be extended by further information swaps to understand each other’s requirements and finally go through the process of formal contract documentation. This process emerges to result in the formalization, via concrete swaps, of informal knowledge shooting from the socialization phase. To characterize the variables of outsourcing, several dimensions have been chosen some of which include: need to formalize the process, structured meetings, definition of contract specifications, and archiving documents (see **Table 4**).

Table 4 Dimensions of Externalization

Dimensions of Externalization	Dimensions of Externalization
Need to formalize	Need to formalize
Structuring meetings	Structuring meetings
Definition of contract specifications	Definition of contract specifications
Archiving documents	Archiving documents

3.4 Combination

This stage of KS occurs in SC management while swapping information among a network of enterprises in a SC through formal communication mediums such as meetings, telephone conversations, and emails.

This grouping phase transforms explicit knowledge into more formal swaps of explicit knowledge among the various SC actors such as partnering enterprises, customers, and government institutions (see **Table 5**). The combination stage systemizes the concepts into a knowledge system. Individuals

swap and combine knowledge through media such as documents, meetings, telephone conversations and computer communication networks. Information is reconfigured by sorting, combining, and categorizing. Formal education and many training programs work this way. For example, a new product concept governs the combination phase in which existing technologies are combined to develop a prototype (Nonaka and Takeuchi, 1995). **Table 5** indicates the major dimensions or attributes that facilitate the combination phase in KM.

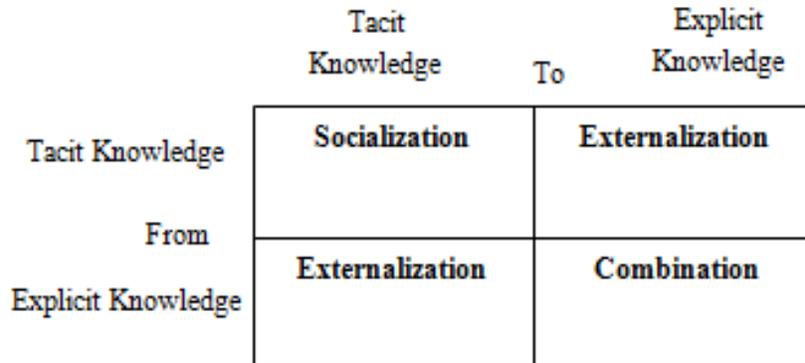


Figure 1 The Four Modes of Knowledge Conversion

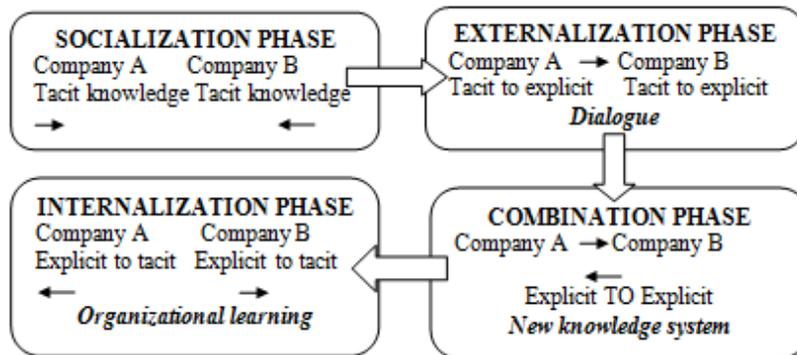


Figure 2 A Model for KM in SC

Table 5 Dimensions of Combination

Dimensions of combination	Dimensions of combination
Integration of experiments	Integration of experiments
Using several tools	Using several tools
Creation of new knowledge	Creation of new knowledge
Development of common tools	Development of common tools

3.5 Internalization

Internalization of knowledge in a SC is meant to change explicit knowledge into tacit (implicit) knowledge through a process of learning by doing or the implementation of knowledge in a SC through a systematic approach by developing a suitable implementation framework. This results in an efficient problem solving technique in SCM. **Table 6** presents the key aspects of internalization that comprise accomplishment of learning processes, solving problems

faster, external collaborations for new best practices and internal sharing of them in a SC.

Table 6 Dimensions of Internalization

Dimensions of Internalization	Dimensions of Internalization
Learning	Learning
Faster solutions	Faster solutions
External development	External development
Internal sharing	Internal sharing

3.6 Proposition of a model for KM in SC

The idea of KC between different actors belonging to the same SC can be linked to the ACT model developed in cognitive psychology (Anderson, 1983; Singley and Anderson, 1989). This model is focused on the acquisition and transfer of tacit knowledge in a unidirectional way (from declarative to procedural). However, it helps to understand the links between

tacit (procedural) and explicit (declarative) knowledge as showed in our framework (see **Figure 2**). The socialization phase finds its origin in Hans Gadamer's concept of "fusion of horizons". Gadamer (1989) developed this concept to study methodology for interpreting historical texts. He argues that a true understanding of a text is a "fusion" of the interpreter's and the author's horizons. Applied to the KM concept, socialization can be considered as a "fusion" of participants' implicit knowledge into a shared mental model. Nonaka and Takeuchi (1995) explain that the first example of socialization came from Honda, which set up "brainstorming camps" to solve difficult problems in development projects. In the background of a transactional relationship, socialization means a swap of commercial information between associates, but no mixing of their respective enterprise cultures.

The real dialogue begins with the externalization phase when associates begin to swap explicit information that comes from their own internal tacit knowledge. According to Graumann (1990), dialogue is a multi-perspective acknowledgement and is inherently related to a collective action. As associates decided to jointly solve a problem, it is necessary to transform part of implicit knowledge into explicit knowledge. Our study of Indian enterprises aims to understand this process by analyzing practices and tools used to understand this conversion. Once explicit knowledge is shared, new models and practices can be developed to create a new knowledge system. Associates swap and combine knowledge through media such as documents, meetings, emails, telephone conversations, or computerized communication networks. Reconfiguration of existing information can cause new knowledge that will be included in tacit knowledge when experiences are internalized into enterprises' implicit knowledge bases in the form of routines, technical know-how or shared mental models. The Internalization phase can be compared to the "learning-by-doing" concept that concerns the capability of workers to improve their productivity by regularly repeating the same type of action. In a SC framework, internalization occurs when a company "re-experiences" practices that were learned from other enterprises' experiences.

4. RESEARCH OBJECTIVES AND METHODOLOGY

4.1 Research Objectives

Our research question attempts to analyze how the KC process can be adapted to SCs and which factors enable that process. This research is based on the process of KM and specifically uses Nonaka's matrix of KC (Nonaka and Takeuchi, 1995; Ruggles, 1998).

4.2 Research Methodology

The majority of participants solicited for this study work in the private sector (medium and large enterprises in the Delhi/NCR region of India). The respondents in this survey are: logistics managers, SC managers and engineers. The study focused on three levels of analysis: strategic, tactical and

operational. All the individuals who were interviewed have a direct link with SC functioning and regularly face issues related to associates within the SC.

4.3 Questionnaire

The research is based on a questionnaire containing 66 questions, the majority of which are closed in nature (57 closed questions versus seven open questions). Among these items, several questions relate specially to the process of KM, to Nonaka and Takeuchi's knowledge matrix, and to KM practices. A pre-test was conducted with four SC professionals in order to refine the questionnaire. This work allowed us to reformulate certain questions and to create several sections so that the study duly addresses the issues of KM in SCM.

The questionnaire is composed of five parts: 1. The collaborative framework refers to Nonaka's Ba concept. 2. The information swap between associates refers to the process of socialization. 3. Sharing knowledge refers to the process of externalization. 4. Collaborative swaps and shared KC refer to the process of combination. 5. Dissemination and transfer of knowledge refers to the process of internalization.

4.4 Data Collected

Most of the time, the administration of these questionnaires was conducted face to face (75%), with a small proportion of questionnaires (25%) being administered by email. The choice of a face-to-face mode is justified by the qualitative part of the questionnaire: it seemed more suitable to interact directly about the subject to encourage/support the discussion. The data collection was conducted over a period of four months. All answers were originally collected manually, directly on the questionnaire in paper form and then entered into the statistical software SPSS and Excel.

5. EMPIRICAL ANALYSIS

The data collected using the questionnaire was analyzed to operationalize the model for KM in SCM and then to recognize some decisive success factors for managing knowledge effectively with the objective of enhancing the competitiveness of SCs. We also collected data on the impact of KM in SC. The Ba concept was validated from the perspective of the importance of variety and redundancy of information swapped, creative chaos, independence and willingness to share information. The KM process model (SECI) was then validated with the help of empirical data and analysis.

5.1 Company Characteristics

The firms interviewed work in industry or services at an international level. The numbers of employees vary between 100 and several thousand (**Table 7**). The turnover ranges from 1.5 million to 2.5 billion dollars. The average company age is 35 years and the deviation is 15 years. The majority of the firms are mature companies but supply chain services have not necessarily existed for a very long time: on average, around 10 years.

Regarding industry orientation, the respondents are mainly in manufacturing. Indeed, 75 % come from this sector and the remaining companies are divided into services, production and distribution of electricity, gas and water; trade, repair of motor vehicles and household goods; hotels and restaurants; transport and communications or health and social work. Considering the theme of our study, namely knowledge transfer between focal company and partnering firms or suppliers, it is more appropriate to focus on manufacturing companies. Also, manufacturing companies offer a better scope for supply chain management and their competitiveness relies on an effective KM process and implementation. Therefore, our study is mainly concentrated in the manufacturing sector.

Table 7 Size of Respondent Firms

Number of employees	Number of responses	Percentage
Less than 250	26	14.5
Between 250 and 500	32	19.5
More than 501	98	55.8
Total	156	89.9
Not responded	13	11.1
Total	169	100

5.2 Impact of KM in SC

The most important characteristic of the interviewed enterprises is that knowledge is considered central to improving their SC. The sharing of data, information and knowledge among both upstream and downstream members of a SC is perceived as critical to success. We monitor that the most important issues cited by the respondents were: reliability in deliveries (24%), the irregularity of the quality of goods delivered (17%) and the costs associated with bad inventory management (15%), supplier ability problems (9%), and the risk about supplier (10%). Many of them were related to the upstream flow of the SC. This clearly justifies the focus of our study on KM between focal and partnering enterprises in a SC.

5.3 Ba Concept

To ease data analysis, we looked at the five dimensions of Ba (intention, independence, creative chaos, redundancy and variety information) and used averages. We can watch that enterprises have a positive perspective towards swapping information and knowledge among the SC network actors. A large majority of them have a redundancy of information, independence and their intention to swap with associates is strong (more than 75%). Variety of the information and creative chaos are less represented but their percentages none the less exceed 57%. SC networks have partnering enterprises with varied characteristics and goals. This implies that autonomy, redundancy and willingness to share information significantly support KM with a goal of improving the performance of SCs. Nonaka's Ba concept is an essential element of the SECI model. In our study, we have a good representation of this context, thus lending good credibility to the following results of the four phases of the model.

5.4 KC Phases - Socialization

A phase was considered very good if this aggregate rating was higher than 5.5 (on a scale of 7); quite good when aggregate rating was between 4.5 and 5.5 and not so good when it was below 4.5. A Likert scale was used in the questionnaire. The socialization phase was regarded as having been performed by the associates when this cumulative rating was greater than 5.5 (on a scale of 7), rather well done when cumulative rating was between 4.5 and 5.5 and poorly performed when it was less than 4.5.

To validate each phase of the SECI model, we considered the average results. According to our results, the socialization phase is well represented with an aggregate rating of 5.24. We can say that, at the beginning of the collaboration, when associates have a problem to solve, they need to meet informally. Depending upon the alignment of interests of focal and partnering enterprises, the networking between them takes place. This implies that in the beginning of SC network development, information interaction will facilitate the transition to externalization. The SECI process is initiated by this phase, characterized by a swap of tacit knowledge.

5.5 Externalization

From implicit to explicit: All four dimensions are well represented. Their percentages are equal to or greater than 75%. Overall, enterprises like to keep track of their swaps while formally dealing with suppliers or partnering enterprises. This is important to make sure that performance objectives are met by both central and partnering enterprises. Formal contract processes facilitate this to be accomplished in SCM. According to our results, the externalization phase is well represented with a cumulative rating of 5.13 on the same Likert scale. After an informal swap, associates in a SC network require to formalize their reflections. This phase emerges to partake in the development of part of the final solution. It is vital to formalize the business, reassure both associates and co-improve SC performance by creating new solutions such as exchanging different methods, conceptualizing processes, and optimizing solutions.

5.6 Combination

From explicit to explicit: We considered that the combination phase was characterized by an cumulative rating of three dimensions: integration of experiments, creation of new knowledge, and development of common tools. The dimensions of combination demonstrate very different percentages from the other indicators. Indeed, enterprises appear to know how to combine the experience related to problem solving with their associates but few of them develop new knowledge. Though developing common tools or methods is not as critical as that of integration systems for knowledge creation, but they do affect the consistency, through automation and standardization, of information flow throughout the SC network. According to our results, the combination phase is weakly represented with an cumulative rating of 4.4 on the same Likert scale. Few associates created common tools together. In fact, our results point to that only

24% of enterprises developed common tools. Among these tools, most are Excel tables, EDI (electronic data swap), SAP, Kanban tool and VMI. Combination is the process of converting explicit knowledge into more complex and systematic sets of explicit knowledge. The new explicit knowledge is then disseminated among the members of the enterprise. As a general rule, this phase is difficult, and in our study, SC services are large and complex. Considering the case of sustainable SC and green manufacturing, it is essential to go beyond the black box to explore innovative SCM solutions taking into account diverse external factors such as government regulations, taxes, and political environments.

5.7 Internalization

From explicit to implicit: We considered that the internalization phase was characterized by a cumulative rating of four dimensions: learning, faster solutions, external development and internal sharing. The practices of internalization are represented mainly by the “learning” dimension and “faster solutions”. Certainly, when a solution is found in collaboration with a partner, enterprises appear to integrate them into their practices comparatively easily and thus save more and more time in their SC. Agility has become a gradually more desirable attribute during the last decade. Enterprises are developing their SC network so that the enterprises can compete based on responsiveness and flexibility. This needs a real-time information sharing system to support quick decision-making or developing quick solutions through enterprise learning and internal information sharing in a SC network. According to our results, the Internalization phase is well represented with an aggregate rating of 5.3. Internalization is the process of understanding and integrating explicit knowledge into implicit knowledge. Through internalization, created explicit knowledge is shared throughout an enterprise and transformed into tacit knowledge by individuals. Internalization is very much related to ‘learning by doing’. Explicit knowledge, such as product concepts or manufacturing procedures, has to be accomplished through action and practice. In our study, the majority of managers were able to solve their problems and share this experience with other actors of the enterprise in different contexts. These four modes do not work in isolation and they are strongly interdependent (Nonaka, 1995). To support the process of KC, individual tacit knowledge must be assimilated by other members of the enterprise, and then a new spiral of KC can begin.

6. SUMMARY OF FINDINGS AND CONCLUSIONS

6.1 Summary of Findings

Based on the conceptual framework proposed for KM in SC and empirical validation of the model, the some of the following findings may be useful for further investigation and application in practice:

- We monitor that when the situation is qualified as “bad” by the firms, only 38% of them assert creating common

tools with their associates and create knowledge. When no common tools are developed the KC process fails.

- This study shows that learning can be realized across company borders and those enterprises within a SC produce knowledge by working together. The development of tools that allow knowledge to be formed is a very important result since we show that when such tools are developed by associates, knowledge is created in the majority of these enterprises.
- Socialization and externalization are two stages that are well-perceived by enterprises but the combination stage is rarely mentioned. It most likely means that there are some blockades to KS and the nature of these brakes should be further explored. If knowledge brings value to enterprises and is a source of competitive advantage, according to KBV theory, the way knowledge is created within a SC appears to be blocked by the combination stage.
- KM in the early stage of SC network development should focus on a socialization approach to abolish barriers to networking and developing business relationships between a central company and its partnering enterprises in a SC.

6.2 Conclusions

An attempt has been made in this paper to study KM in SC networks. The objective of the study is to explore the application of an existing KM model or framework in selected Indian enterprises through experiential data collection and analysis. The model that was selected is based on Nonaka’s four stage spiral model (SECI). This model appeared interesting at the beginning of KM evolution, but advanced developments happening over the past decade, especially with SC becoming an integral part of operations strategy have revealed that it is not completely suited to the current SCM environment. There is a need to clearly integrate SC network parameters and variables into any final KM model or framework. The results then would supply a more suitable KM framework for improving SC competitiveness.

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