The Evolution of Supply Chain Management in Chinese Auto-Parts Manufacturers

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Executive Summary

Die vorliegende Studie erforscht die Entwicklung des Gebrauchs von Supply Chain Management (SCM) in 15 Automobilzulieferbetrieben von Chinas grösstem Passagierfahrzeughersteller. Die Untersuchung kommt zu dem Schluss, dass weder das Umsatzvolumen, noch die Anzahl der Beschäftigten oder die Nationalität der Joint Venture Partner Einflussfaktoren für die Entstehung und Entwicklung dieser Systeme sind. Stattdessen liess sich feststellen, dass die Entwicklung allein von den Charakteristika der Automobilteileindustrie abhängig war. Je fortschrittlicher oder komplexer die Produkte, desto wahrscheinlicher war es, dass der Hersteller Supply Chain Management-Systeme eingeführt und ihren Gebrauch sowie ihre Entwicklung vorangetrieben hat. Die Industriesektoren, die Produkte von geringerer Technologie oder Komplexität herstellten, haben SCM-Systeme zögerlicher oder überhaupt nicht eingeführt. Die Ergebnisse dieser Studie lassen sich am besten wie folgt erklären: ein SCM-System kann als ein komplexes, adaptives Versorgungsnetzwerk verstanden werden im Hinblick darauf, wie sich die Firmen innerhalb dieses Netzwerks entwickeln und anpassen. Für die praktische Anwendung dieser Beobachtung bedeutet das, dass ausländische Automobilzulieferbetriebe Vorsicht walten lassen sollten, bevor sie ihre bestehenden SCM-Systeme auf ihre chinesischen Joint Ventures (JV) übertragen.

Executive Summary

This study investigated the evolution of the use of Supply Chain Management (SCM) systems for 15 auto parts manufacturers in China's largest passenger car manufacturing group. It was found that neither the sales volume, number of employees nor nationality of the joint venture partners were factors influencing the evolution or development of these systems. Instead, it was found that this development was only dependent on the nature of the auto parts industry. The more advanced or complex the product, the more likely the manufacturer was to first deploy and push forward the use of SCM systems in its operations to an advanced stage. Those industries whose products were lower in technology or complexity deployed SCM systems more slowly or decided not to use these systems. This study's results can be best explained in these terms: a SCM system can be treated as a complex adaptive supply network with respect to how firms in the network evolve and adapt. The practical application for this finding would caution foreign auto parts manufacturers from indiscriminately forcing their home SCM systems onto their Chinese joint ventures (JV).

Key words

Supply Chain Management, Enterprises Resources Planning, China, Auto parts manufacturing, Complex Adaptive Supply Network.

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2 Introduction

Already the second largest manufacturing economy in the world by 2003 (CIA, 2004), accounting for 12.6% of the World's Gross Domestic Product (India Times 2004), China has been called the "Factory for the world" (Wolf, 2004; Asian Labor News, 2003; Mckinsey, 2002). This quote can be traced to Robert Mundell, Nobel Laureate, International Economics guru and Professor of Economics at Columbia, when he was interviewed in the article *Toyota's late drive in China* (Asian market Research News, 2002).

In order to compete in the global economy, manufacturers are in the quest to source or manufacture products that are "cheaper, better and faster." Many Western enterprises have started to manufacture in, or at least to buy or source from, China, while some of those who have already established themselves in China are expanding their operations. For example, even under a lot of pressure to limit its overseas sourcing, General Motors (GM) is increasing its sourcing in China (2008 Jan. www.industryweek.com).

By 2002, China had by-passed the US as the top country in the world to receive the most Foreign Direct Investment (FDI) (China Daily, 2002), with stock FDI inflow into China for 2007 standing at US$75 billion. Therefore, it is a fact that many companies are investing heavily into China. Getting products cheaper, better and faster are essentially the underlying results desired by a company who uses SCM (SCM) (see the definition of SCM in Chapter 2). How has SCM evolved in the Chinese context? Finding out the answer to this will be important in order for foreign enterprises starting out in China to achieve the desired results. Every practitioner who will be going to manufacture in China must ask him/herself, how is deploying SCM systems in China different from deploying them in the home country? What factors affect this determination? This study attempts to fill the need for this particular subject area given the lack of available literature. Given that China is now the "factory for the world" and research shows that SCM has had many positive influences on productivity and profitability, therefore, the study of SCM in China is central to this investigation.

It is hoped that the results of this study will provide the practitioner who is starting out in a Chinese Joint Venture (JV) with an answer as to what extent he/she should replicate the SCM system of his/her home country in his/her Chinese JV. How complex and in-depth should the system be or what is simply adequate? Why is it not

necessary to "go all the way" in replicating the exact system into the Chinese JV?

The literature survey shows that studies of SCM are still in an early stage. Even the definition of SCM is still an ongoing debate and academics have several different views of what they think should or should not be included in the definition. Most of these definitions will be presented in the literature survey for this very complicated subject. So what is SCM? In a nutshell, it is the use of a single platform or system of software that controls all the internal functions and processes within an enterprise, which is then extended to customers as well as suppliers. However, it is best to refer to the in-depth investigation in Section 3.3 in the literature survey to see how academics have defined SCM.

This study will review several models relating to the degree of progression of the adoption, usage and evolution of SCM. However, few publications deal with the actual use of these models to describe concrete application in industry, or investigate what the factors are in inducing different stages of evolution. The existing literature also points to a lack of studies based on the non-North American context.

This study is based on an investigation of the complicated topic of SCM: what it is and how the companies in the study adopted its use in their operations. Using the attributes in SCM evolution models as a guide and the other physical attributes of these companies, the study links the factors affecting the stages of evolution of SCM to this process.

What exactly did the early stage of SCM look like? The firm probably had some functions and processes linked by computers. However these systems might not have been linked, but rather were likely stand-alone. Communications to vendors and customers might still have been by telephone or fax and for those more advanced, by email. Few processes were automated. There were no mechanisms by which decisions could be made on what to make, when to make it and how much to make. In summary, the firm was not automated and not connected. The SCM evolution, in fact, was the evolution of the firm from this stage to a more advanced stage of having its processes automated, with some decision guidance, and being connected electronically to its vendors and customers. In depth discussions of the evolution models and these stages will be discussed in Section 3.5.3 in the literature survey. Perhaps the strongest justification for doing this research comes from the academic argument that SCM should be treated as a Complex Adaptive Supply Network (CASN). Using this network theory to describe and explain

SCM systems is rather new and few publications have been published using CASN. However, the CASN theory provides the perfect lead into explaining the behavior of the evolution of SCM in this study, as will be shown in the results.

The choice of an interview partner for this study was of paramount importance given that Chinese industries are very reluctant to be studied by non-Chinese sources. With much luck, patience and perseverance by this researcher, the largest passenger car manufacturer in China, Shanghai Auto Corp (SAIC), agreed to this study of its SCM system and links between its auto assembly lines and much of its auto parts companies. The interviewed auto parts companies covered most parts in an auto. The combined sales of its two wholly owned subsidiaries, Shanghai General Motors (SGM) and Shanghai Volks Wagen (SVW), commanded the most market share of all passenger car manufacturers in China (Appendix 1). As such, the research is relevant as it studies the operations of a top company in a very important and large Chinese manufacturing industry. It was fortunate that SAIC not only allowed, but backed this case study by supplying their staff to help in this investigation. SAIC also asked their subsidiaries to co-operate fully with this investigation.

The study continues with a discussion of the research propositions. The methodology is then presented, which is followed by the results and an analysis. The final section contains the discussion, and the study's limitations and conclusions with recommendation for future studies.

3 Literature Survey

Supply Chain Management (SCM) is a relatively new subject area. In this chapter, the different definitions of SCM are listed according to different researchers of over more than a decade; all articles about SCM are grouped into subject areas that researchers have identified in their studies. Upon evaluating these naturally occurring subject areas of SCM, the writer then attempts to show that the research question in this study has never been attempted. The chapter ends with establishing the need for future studies that will in turn show that this study was warranted to expand the field of knowledge, especially in areas outside the North American context.

3.1 Importance of SCM

One reason why SCM is becoming increasingly important is because of references made by the likes of Ayers (1999), who stated that SCM "is emerging as one of the most powerful organizational strategies for companies to sustain competitive advantages."

Even in the very early days (mid-1990s), surveys of large US manufacturers indicated that a solid SCM system can reduce a company's operating cost tremendously and keep inventories significantly low. This translates into better cash flow, more working capital, an increase in on-time deliveries and a significant reduction in cumulative cycle time (Stein, 1997), i.e., a cheaper, faster, better scenario. Rather than just aiming at producing products with better quality, many organizations have identified SCM as an opportunity to achieve these broader goals (Chin, Tummala, Leung & Tang, 2004). Chin et al. (2004) called this an "evolution" from seeing the challenge as one of product quality, to one of encompassing all aspects of the cheaper, faster, better scenario. This research also brought up many reasons why SCM was so successful, namely it addressed need; it incorporated corporate culture; it achieved social benefits; it promoted employee relationships and morale; and it built participative management. With such important intangible benefits, it is no wonder that so many companies adopted SCM.

3.2 Supply Chain

Jordan and Graves (1995) defined the concept of chaining as follows: "A chain is a group of products and plants, which are all connected, directly or indirectly, by product assignment decisions. In terms of graph theory, a chain is a connected graph. Within a chain, a path can be traced to another product or plant via the product assignment link. No product in a chain is built by a plant outside the chain; no plant in a chain built a product outside that chain".

Porter's (1985) seminal work on the value chain perhaps more than any other contribution focused the attention of strategists, managers and academics alike on the notion of strategic networks involving contracts between coordinated chains of organizations. Mak and Ramaprasad (2003) defined a Supply Chain as "sets of manufacturing and distribution that work together to deliver tangible goods to markets".

3.3 Supply Chain Management - Definition

There has been some confusion about the difference between Supply Chain (SC) and Supply Chain Management (SCM). While a Supply Chain refers to the concept of a chain associated with the movement of raw materials through manufacturing to the end product, SCM is a system of management approaches or a management system of this Supply Chain. But this may be an over-simplified view as Giunipero, Hooker, Joseph-Matthews, Yoon, and Brudvig (2008) pointed out: "Based on the relatively recent development of the Supply Chain literature, it is not surprising that there has been much debate as to a specific SCM definition." Cooper and Ellram (1993) wrote, "authors have even conceptualized SCM differently in the same article: as a form of integrated system between vertical integration and separate identities on the one hand and as a management philosophy on the other hand."

Lambert, Cooper and Pagh (1998) showed that "in essence, the diffusion of the field did not take place until the late 1990s, with most of the theoretical and empirical investigation commencing in 1997"; and only a handful of articles mentioned the phrase "supply chain" between 1985 and 1997.

The concept of SCM has been discussed by Ellram and Cooper (1990), Cooper and Ellram (1993), and Ellram and Hendrick (1995). It first originated in the literature about purchasing. Cooper

and Ellram (1993) used this definition: "SCM is an approach whereby the entire network – from suppliers through to the ultimate customers, is analyzed and managed in order to achieve the 'best' outcome for the whole system." Therefore, it has since developed well beyond the logistical focus on the supply chain. Novak and Simco (1991) used this definition: "The SCM covers the flow of goods from supplier through manufacturer and distributor to the end user" (p. 14). They used the "end-to-end" scenario. Towil, Naim and Wikner (1992) used this definition: "The supply chain is a system, the constituents parts of which include material suppliers, production facilities, distribution services, customers linked together via the feed forward flow of material and the feedback flow of information." Here, the forward and backward flow of material versus information scenario was used. Cavinatio (1992) used this definition: "The supply chain concept consists of actively managed channels of procurement and distribution. It is the group of firms that add value along product flow from original raw material to final customer. It concentrates on relational factor rather than transactional one." While Scott and Westbrook (1992) stated that a "supply chain is used to refer to the chain linking each element of the production and supply process from raw material through to the end customer."

Lambert's (1994) definition of SCM is "the integration of business processes from end user through original suppliers that provides products, services and information that add value for customers." For their part, Cooper, Lambert and Pagh (1997) restated that "there is definitely a need for the integration of business operations in the supply chain that goes beyond logistics." As such, SCM extends to processes concerning product development, marketing etc. Lambert et al. (1998) again defined SCM as the integration of key business processes from end user through original suppliers that provides products, services and information and hence add value to customers and other stakeholders.

Giunipero et al. (2008) summarized the work of these early 1990's academics as providing "early definitions focused on the supply chain as characterized by flow of goods, management of relationships and a concept that extended from supplier to the ultimate customer."

Mentzer et al. (2001) defined SCM as the "systematic strategic coordination of the traditional business functions and the tactic across these business functions within a particular company and across businesses within a supply chain, for the purposes of improving the

long-term performance of the individual companies and the supply chain as a whole."

Frohlich and Westbook (2001) viewed SCM as an integration of a set of activities that manufacturers used to integrate their operations with both suppliers and customers. These activities included access to planning systems, sharing production plans, joint EDI access or networks, knowledge of inventory levels and mix, packaging customizations, delivery frequencies, common logistical equipment/containers and common use of third-party logistics. Also, on the supplier side, integration associated with decisions related to outsourcing and supplier capability assessment and management, as well as customer integration, are two core elements of Narasimhan and Jayaram's (1998) decision-oriented framework of supply chain integration.

Ho, Au and Newton (2002) made this observation on a problem that SCM researchers have created: "Although the SCM construct needs to be clearly defined before proceeding to the operationalization stage, it is not uncommon that some researchers skipped this very important and initial step, and associated a set of measurement items with the construct without explicitly, or even without, presenting its theoretical definition." Dean and Bowen (1994) wrote, "While the meaning of SCM is still under debate, SCM, in its broadest sense, is increasingly seen as a management philosophy that embodies a set of distinctive management principles, assumptions and practices." The authors pointed out at least three different approaches or labels that have been used in relation to SCM. The first view tied SCM to purchasing and supply management. The second view, espoused by the early academics, was from the logistics and transportation perspective, where the researcher defined it as management of the entire flow of products along the supply chain (e.g., Ellram & Cooper, 1990). The third view was an integration of business functions across the Supply Chain, e.g. Mentzer et al. (2001).

The Supply Chain Council (2002) founded by Pittiglio, Rabin, Todd and McGrath (PRTM) defined SCM as encompassing "the effort involved in producing and delivering a final product from the supplier's supplier to the customer's customers." Burgess et al. (2003) observed that in the 100 articles under review published from 1985 to 2003 "there appears to be little consensus on the definition of the term SCM". The authors also found that in 58 of these articles, no explicit definition of SCM was used. In summing up the literature, Kathawala and Abdou (2003) concluded that SCM "has been poorly defined

and there is a high degree of variability in people's minds about what is meant."

Smichi-Levi, Kiminski and Smichi-Levi (2003) defined SCM as "a set of approaches utilized to efficiently integrate suppliers, manufactures, warehouses, and stores, so that merchandise is produced and distributed in the right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements." For the purposes of this study, this is the definition of SCM used.

Mouritsen, Skjott-Larsen and Kotzab (2003) stated that one could view the supply chain as merely "virtual", existing in the variable views of managers and decision makers within the firm; in essence, this is an existential position taking the view that a supply chain can only be understood in terms of the perception of individuals. Giannakis and Croom (2004) proposed a 3S model for conceptualizing the supply chain problem domain. The 3S are Synthesis of the business and resources network; the characteristic of Synergy between actors in the network; and the Synchronization of all operational decisions related to the control of the production and delivery of goods and services.

Burgess et al. (2006) used Mentzer et al.'s (2001) definition of SCM as a guide in their research. However, the authors wrote that "we have not dogmatically adhered to all the nuances expressed in [Mentzer et al.'s] definition." The authors then concluded that a broader view of SCM was needed in order to develop a wider consensus and resolve the current conceptual and research methodological confusion.

3.3.1 Enterprises Resources Planning

Some would argue that SCM must first have an integrated management system within the firm, such as an Enterprises Resources Planning system (ERP), and that only by extending this system to its suppliers, logistics providers and customers will a firm then have a complete SCM system. Therefore, a discussion of SCM should first include a discussion of an ERP system, which is often regarded as a pre-cursor to an enterprise. ERP's initial focus was to execute and integrate a firm's internal applications that support finance, accounting, manufacturing, order entry, human resources and inventory management. The link of inventory management and SCM was established already in the early days.

The definition of ERP given by Deloitte Consulting and also used in Computer World (1999) was as follows:

> An Enterprises Resource Planning system is a packaged business software system that lets a company automate and integrate the majority of its business processes, share common data and practices across the enterprises and produce and access information in a real-time environment.

Huang and Palvia (2001) defined ERP as "an industry term for a broad set of activities supported by multi-module application software that helps a manufacturer or a service business manage the important parts of its business." Zheng, Yen and Tarn (2000) compared both SCM and ERP systems and how they can be integrated. ERP, which is often regarded as a necessary precursor to SCM, has been experiencing radical changes in an attempt to regain its diminishing advantage (Stein, 1998; Menezes, 1999). For their part, Huang and Palvia (2001) referred to SCM products as post-ERP.

3.3.2 A convergence of both systems

Stein (1998) reported that the largest SCM systems supplier, SAP, has been using ERP systems as a step to lead customers to buy into SCM systems. They are also adapting their system to be useful for medium size enterprises. Because the cost of an SCM system has always been very expensive, only larger enterprises could afford to acquire such a system. Subsequently, the likes of PeopleSoft, who had started in ERP systems, have also gone into the SCM system business.

Zheng, Yen and Tarn (2000) presented many differences and similarities between the two systems and concluded that the trend is towards the integration of these systems. Therefore, it is expected that both systems, SCM and ERP, will converge. ERP will become a naturally occurring precursor in the development of a company's SCM system.

3.4 SCM articles according to research areas

There have been articles written exclusively on what has been published in terms of research on SCM. The first of such literature review articles is by Croom, Romano and Giannakis (2000) in which they reviewed 84 articles on SCM, looking into the level of analysis and the research methodology used in these studies. They found that

in these relatively early studies, the primary categories of SCM were defined as strategic management, logistics, marketing, relationships or partnerships, best practices and organizational behaviors. They also found that SCM could be classified in terms of the level of analysis, namely, Dyadic, Chain and Network. At that point in time, SCM literature was dominated by descriptive empirical studies.

Carter and Ellram (2003) reviewed 774 articles that were published in a 35-year span from 1965 to 1999. However, the articles were all selected from only one journal, the Journal of Supply Chain Management. Their study concentrated more on research methodologies; performing content analysis on the articles, they found that the most common type of research performed was exploratory. Another approach they took was to identify the subject area in terms of the ISM's (Institute of Supply Management's) subject. They found that the most common subject categories were Inventory and Management. Their findings, therefore, are of limited use in this study.

Burgess et al. (2006) surveyed 19 years of SCM journals and found 614 usable articles on SCM. One hundred articles were then picked for their study. The article ended with proposed future research directions in SCM.

The most up-to-date and most comprehensive article on what SCM research articles have existed is by Giunipero et al. (2008). Their study systematically reviewed and performed analysis on 405 articles that spanned the ten year period between 1997 and 2006. The study then sorted the research topics into 13 different categories and gave a count of articles in each category, thereby showing the most to least popular subject areas. These subject areas provide a framework for future researchers to use to find what has been written about SCM.

Gunasekaran and Ngai (2003) surveyed and reported that there are numerous articles on the strategies, techniques and technologies for the design and development of SCM. Most of the articles discussed the implications of one or two aspects of the supply chain – such as, for example, strategies, tools and techniques – but not the supply chain in its entirety. This is an important point, as up to now, there have been few, if any, studies of its entirety. This might be because of the complexity of the system and lack of knowledge of the interactions between each of its parts.

Much of the research on SCM has been on strategy or strategic planning. As an example, in the context of IT in SCM, Gunasekaran and Ngai (2004) listed 24 articles from 1978 to 2001 in

their literature survey on this particular aspect of SCM. This ran only second to their survey on the theme or specific topic of eCommerce with SCM. Giunipero et al. (2008) have shown that all SCM research can be systematically grouped into the following naturally occurring subject areas and only in these groupings:

In the following section (3.4), I present the findings of the literature review done by Giunipero et al., listing in descending order the most popular topics of research into SCM.

3.4.1 SCM Strategy, Strategic planning

In the SCM literature review by Giunipero et al. (2008), there were 95 articles published from 1997 to 2006 on SCM strategy, which put this research topic as the most studied category in SCM. This represents 23% of all literature on SCM research. Included in this topic was the strategic alignment between the supply chain and the company. Research included competitive advantage, Resources Based View, Agency Theory and risk management.

3.4.2 SCM Frameworks, Trends and Challenges

In the same literature review, there were 75 articles published from 1997 to 2006 on SCM Frameworks, Trends and Challenges which put this research topic as the second most studied category in SCM. This represents 18% of all literature on SCM research. Research included future trends, supply chain definitions, historical reviews and problems and benefits of SCM.

3.4.3 SCM Alliances, Relationships

According to Giunipero et al. (2008), there were 66 articles published from 1997 to 2006 on SCM alliances or relationships, which put this research topic as the third most studied category in SCM. More specifically, the topic was research into the relationship between the company and its business partners or between various suppliers to the company. Research included trust, commitment, conflict, power, intra and inter-company relationship building, partnerships, vertical and horizontal cooperation, TCA and communication. This represents 16% of all literature on SCM research.

3.4.4 SCM eCommerce and the World Wide Web

According to Giunipero et al. (2008), there were 32 articles published from 1997 to 2006 on SCM eCommerce and the World Wide Web, which put this research topic as the forth most studied category in SCM. This represents 8% of all literature on SCM research. The topic was the effect of eCommerce and the internet on the supply chain. Research included e-integration, e-procurement and website content.

3.4.5 SCM Time based Strategies

Giunipero et al. (2008) found that there were 26 articles published from 1997 to 2006 on SCM Time based strategies, which put this research topic as the fifth most studied category in SCM. This represents 6% of all literature on SCM research. The topic included managing the supply chain inventories and building flexibility into supply chains to meet demand. Research included Just-in-time, inventory management, supply chain agility and flexibility, cycle time, postponement and supplier managed inventory.

3.4.6 SCM Quality

The article literature review discovered 22 articles published from 1997 to 2006 on SCM Quality, which put this research topic as the sixth most studied category in SCM. This represents 5% of all literature on SCM research. The topic included product and service quality output of the supply chain, as well as ISO (International Organization for Standardization) and quality management practices.

3.4.7 SCM and IT

In the SCM literature review by Giunipero et al. (2008), there were 20 articles published from 1997 to 2006 on SCM and IT, which put this research topic as the seventh most studied category in SCM. This represents 5% of all literature on SCM research. This subject area was on the use of information technology or systems in the supply chain. It involved both internal (i.e., decision support systems) and external (i.e., EDI) IT tools, ranging from networking with supply chain partners to strategic alignments of the IT function. Research included how IT supported the organization, virtual supply chains, EDI, network systems in the supply chain, and strategic alignment of IT. As was already

stated, Gunasekaran and Ngai (2004) listed 24 articles from 1978 to 2001 in their literature survey on this particular subject.

3.4.8 SCM Supplier development, selection and management

Giunipero et al. (2008) noted 16 articles published from 1997 to 2006 on SCM Supplier development, selection and management, which put this research topic as the eighth most studied category in SCM. This represents 4% of all literature on SCM research. The topic included supplier development, selection and management. Research included supplier selection criteria, supplier training and improvement, supplier monitoring, management and assessment.

3.4.9 SCM Outsourcing

In their SCM literature review, Giunipero et al. (2008) found 13 articles published from 1997 to 2006 on SCM outsourcing, which put this research topic as the ninth most studied category in SCM. This represents only 3% of all literature on SCM research. The topic included the outsourcing of the supply chain process. Research included Third-Party Logistic (3PL) and contract manufacturing.

3.4.10 SCM Environmental, social responsibility

They discovered 12 articles published from 1997 to 2006 on SCM strategy, which put this research topic as the tenth most studied category in SCM. This represents only 3% of all literature on SCM research. The topic included ethical, environmental and social responsibility concerns faced by organizations managing the supply chain. Research included recovery, scrap and surplus, environmental policies, government regulations, diversity policies and practices and human rights.

3.4.11 SCM International, Global

Giunipero et al. (2008) found that there were also 12 articles published from 1997 to 2006 on SCM International and Global, which put this research topic as the tenth most studied category in SCM tied with

the previous topic. This represents only 3% of all literature on SCM research. The topic was about the globalization of the supply chain. Research included global logistics, cultural issues, international logistics, distributions, international trade, global supply and demand, and worldwide sourcing.

3.4.12 SCM Buyer Behaviour

This same SCM literature review reported that there were only nine articles published from 1997 to 2006 on SCM Buyer Behaviour, which put this research topic as the second least studied category in SCM. This represents only 2% of all literature on SCM research. The topic was about inter-firm behaviours and activities. Research included virtual teams, negotiations, new product development, internal integration, information flows and organizational decision processes.

3.4.13 SCM and HR management

Finally, Giunipero et al. (2008) found only eight articles published from 1997 to 2006 on SCM and HR management, which put this research topic as the least studied category in SCM. This represents only 2% of all literature on SCM research. The topic concerned the process of establishing a necessary reporting relationship between and among firms, as well as HR issues that affect the day-to-day performance of supply chain personnel. Research included organizational change, virtual organizations, organization effectiveness, responsiveness versus anticipatory management styles, organization learning skills, tacit knowledge, job roles, job conflicts and purchasing processes.

3.5 SCM Standards, Best Practices and Benchmarking

3.5 .1 SCM system development

When Cohen and Roussel (2004) set up the Supply Chain Operation Reference Model (SCOR) under the SCM Council, they listed performance attributes that if identified could provide a basic reference point to describe a supply chain and a procedure for eventual benchmarking. These attributes are listed in Table 1.

These attributes listed by Cohen and Roussel (2004) serve as the bases of measure for this study. More specifically, the interview questions for this study were developed by using the listed factors. Once these attributes are measured and coupled with other company data, comparing these across several companies would be useful for isolating any trends. Monitoring and pin-pointing where a company is using these factors would identify to what stage the company had evolved.

A more in depth discussion of these measures and how they were incorporated into the interviews and this study will be further discussed in the following chapters.

Performance Attribute	Performance Attribute Definition	Level 1 Metric
Supply Chain Delivery Reliability	The performance of the supply chain in delivering: the correct product, to the correct place, at the correct time, in the correct condition and packaging, in the correct quantity, with the correct documentation, to the correct customer.	• Delivery Performance • Fill Rates • Perfect Order Fulfillment
Supply Chain Responsiveness	The velocity at which a supply chain provides products to the customer.	• Order Fulfillment Lead Times
Supply Chain Flexibility	The agility of a supply chain in responding to marketplace changes to gain or maintain competitive advantage.	• Supply Chain Response Time • Production Flexibility
Supply Chain Costs	The costs associated with operating the supply chain.	• Cost of Goods Sold • Total Supply Chain Management Costs • Value-Added Productivity • Warranty/Returns Processing Costs
Supply Chain Asset Management Efficiency	The effectiveness of an organization in managing assets to support demand satisfaction. This includes the management of all assets: fixed and working capital.	• Cash-to-Cash Cycle Time • Inventory Days of Supply • Asset Turns

Table 1: Performance Attributes of the Supply Chain Operations Reference Level 1 Metrics. Source: Cohen and Roussel (2004).

3.5.2 SCM literature ties to China

Reimer (2003) studied implementation of ERP systems in China. Chin, Tummala, Leung and Tang (2004) studied the SCM practices of Hong Kong manufacturers. In their study, Chin et al. (2004) identified strategic success factors and defined the corresponding key issues in each strategic area as operational success factors. Liao and Hong (2007) studied the Chinese operation of a Japanese firm's supplier portfolio entry model.

Shue et al. (2004) studied "National difference and ERP implementation: Issues and challenges," wherein one of the companies they studied had a branch in China.

Li, Yang, Sun and Sohal (2008) studied supply chain integration using empirical data from Chinese firms. It might be explored whether the findings incorporated specific issues related to China or encompassed validity on a general scale.

Ge and Voβ's (2009) article "ERP application in China: An overview" provided much updated insight into the most current conditions of use of ERP-SCM systems in China. They found that in China most ERP implementation projects seemed not so "successful" in terms of budget, schedule and expectation.

3.5.3 Evolution of SCM and maturity models

Lee and Billington (1995) wrote the article "The Evolution of Supply–Chain-Management models and practice at Hewlett Packard" (HP). They described the process of evolution of the SCM models used at HP's manufacturing at that time. HP was trying to reduce inventory and improve order fulfillment.

Cohen and Roussel (2004) used the concept of "Evolution" to describe the development of Supply Chain Organization. Another use of "Evolution" by the same authors can be found in their notion of the "stages of supply chain process maturity" to describe the stages of evolution of SCM (see Table 2). The four stages listed are: Stage 1, Functional Focus; Stage 2, Internal Integration; Stage 3, External Integration; Stage 4, Cross-enterprise Collaboration.

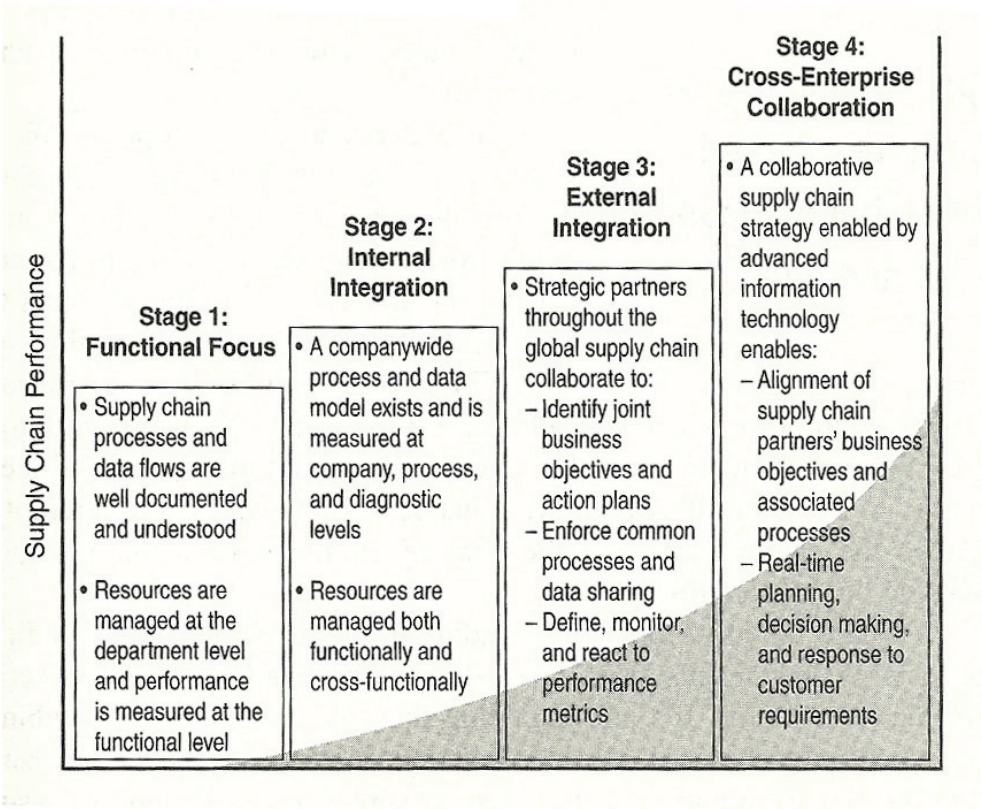

Table 2: Stages of Supply Chain Process Maturity. Source: Cohen and Roussel (2004)

An additional description of the evolution process was also used in firm-to-firm collaboration (Cohen & Roussell, 2004). A spectrum of possible relationships was used to illustrate the evolution process of supply collaboration.

The leading ERP - SCM software supplier, SAP, provides a tool called an "SCM value calculator" that can tell by a company's industry, stages of development, revenue and profit margin what the company's saving would be if it were to invest in one of SAP's various SCM systems. SAP calls these "Stages of Development," which are subdivided into four levels: Stage 1, Disconnected Systems; Stage 2,

Internal and External Interfaces; Stage 3, Internal Integration and Limited External Integration Efficiency; and Stage 4, Multienterprise Integration (www.sap.com/scm/). The wording used in Simchi-Levi's chart showing the stages are clear, concise and was what this study used as a guide to design the questions for identifying the stages of evolution.

Stage Capability	I: Disconnected	II: Interfaces	III: Integrated Internally	IV: Multienterprise Integrated
Internet	Visibility	Catalogs	Exchanges	Unattended trading
Integration	None	Batch	Interenterprise	Supply chain networks
Supply chain planning	None	Informal demand planning	Formal global demand planning	Integrated global planning
Production scheduling	None	Basic MRP	Constraint-based	Advanced planning systems (APS)
Integration with suppliers	FAX/phone	EDI/FAX/ phone	EDI with all large suppliers	VMI, online RFQ
Customer delivery	Research	Local inventory	Available to promise (ATP)	Capable to promise (CTP)

Table 3: SAP Stages of Excellence. Source: Simchi-Levi, Kaminsky, and Simchi-Levi (2004).

Lockamy and McCormack (2004) used the five-stage Business Process Orientation (BPO) maturity model (SEI, 2002) to develop their own SCM maturity model. The maturity stages of supplier customer relationships are shown in schematics in Table 4.

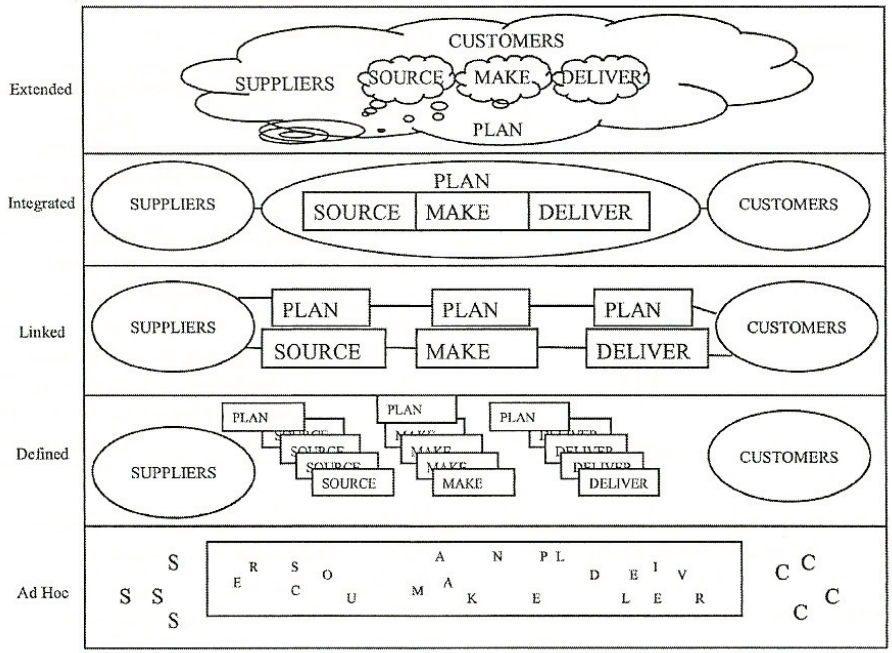

Table 4: Supply Chain Management Maturity Model. Source: Lockamy and McCormack (2004).

3.6 Firm-to-Firm Relationships

A study of the Supply Chain would be incomplete and not meaningful if the context of its relationship between organizations or firms-to-firms were not investigated. Mills, Schmitz and Frizelle (2004) wrote, "SCM also considered the behavioral and political dimensions of trust and power, conflicts and dependence between supplier and buyer." Types of relationships, including those with respect to culture, are investigated below.

3.6.1 Strictly a Buyer-to-Supplier relationship

The phrase "at-arm's length" would describe many of the relationships in the business world where the supplier and the buyer are independent companies with nothing other than strictly a buyer-supplier relationship. This would mean that there would be no other considerations or additional conditions attached for each of these firms doing business with each other strictly for business reasons.

3.6.2 Other than a Buyer-to-Supplier relationship

There are other subtypes of this relationship with different implications for firm-to-firm relationships and operations. This has also been referred to as "relationship-specific" (Dyer, 1993).

3.6.3 Parent Company-to-Subsidiary relationship

When one of the firms is the parent company of another, the relationship is very special, as in this relationship the parent might be the only buyer of the subsidiary's goods and services. Such vertical integration is most often the reason why the subsidiary was set up in the first place, i.e., as a supplier for the parent company to expand, to control and to secure its supply chain.

3.6.4 Associated companies within a group

When firms are in the same group, the relationship might also be because of dependency, as firms are tied by their association to the group.

3.6.5 Buyer and Supplier relationships within a cultural context

There exist even more complex relationships in countries such as Japan and Korea, where history and other factors affect the formation of groups that are important in understanding firm-to-firm relationships.

3.6.6 Keiretsu

This structure is unique to Japan. Keiretsu has no direct translation into English (Miyashita & Russell, 1996). The closest English translation would be connected, linked to, or forming an alliance with. Although this structure has been in existence since after World War II, Western management only learned about it in the 1990s (Miyashita & Russell, 1996). T. Boone Pickens, the American corporate raider, was credited with bringing the existence of the Keiretsu to the US public's eye with his failure to obtain a seat on the board of a Japanese company where he had already became a significant shareholder.

3.6.7 Types of Keiretsu

The Keiretsu is comprised of a bank and a structure made up of many different companies that form a cluster around the bank. Many of these companies have significant common holdings between them. A Horizontal Keiretsu would be all the companies that have strong connections to or that are owned by the same bank. A Vertical Keiretsu is comprised of a very large company that holds many direct subsidiaries radiating from the core. The subsidiaries in turn hold many suppliers or subcontractors radiating out in more layers. The Big Six, i.e., the largest six banks in Japan, together with the even larger Japan Industrial Bank each formed its own horizontal Keiretsu. These are Sumitomo, Mitsubishi Group, Mitsui Group, Fuyo Group, Sanwa Group and Dai-Ichi Kango (DKB) group. Mizuho Group was formed after the merger of DKB and Fuyo groups. The structure got even more complex when the large companies that were directly connected to the bank in a horizontal Keiretsu subsequently formed a vertical Keiretsu around it.

3.6.8 Horizontal Keiretsu

The analogy of a convoy of ships could be used to describe a horizontal Keiretsu (Miyashita & Russell, 1996). The flag ship, which is in the middle of each convoy, is the bank. The analogy implies that these ships sail together and also keep an eye on each other. Following the flagship are two or three other giants. These are usually an insurance company and a very large manufacturer. These giants are then followed by other ships, i.e., smaller companies. It is also common to have a trading company in the convoy. Examples of the

Horizontal Keiretsu include the six largest Keiretsus based on banks: Sumitomo, Mitsui and Mitsubishi are classified under the Zaibatsu subtype[1]; and Sanwa, Dai-ichi Kangyo and Fuyo are classified under the Large Bank subtype (Ueda & Saski, 1998). IBJ and others banks are also considered Horizontal Keiretsus, but are not listed under any subtype.

3.6.9 Vertical Keiretsu

Examples of a large Vertical Keiretsu are NEC, Sumitomo Kinzoku, Toyota, Toshiba, Mitsubishi Kasei, Mitsubishi Juko, NKK, Fujitsu, Matsushita, Shin-nittetsu, Nissan, Hitachi, Kobe-seiko, etc. (Ueda & Saski, 1998).

3.6.10 Automotive Companies and Keiretsu

Another analogy that has been used is a group of companies surrounding a "mother" company (Chalos & Sung, 1998). For example, in order to achieve cost savings, some Japanese automotive companies engage in some forms of cost sharing with smaller companies (Kawasaki & McMillan, 1987). This cost sharing might be done by investments in customized assets, supplier support services and training (Dyer & Ouchi, 1993; Chalos & Sung, 1998). The parent company's primary function is with design and assembly in relation to the suppliers, who could be either independent or in an alliance, but not owned by the "mother" company (Chalos & Sung, 1998).

With respect to the vertical Keiretsu, Asanuma (1985, 1992) showed that Japanese auto companies have not used the vertical Keiretsu as a tool of exploitation, but rather as a mutually beneficial arrangement in which both upstream and downstream firms share the cost of relationship-specific investment and insure against expropriation using Transaction Cost Economics as a theoretical base (Williamson, 1985). This practice of cost sharing with smaller companies has not been restricted just to automotive companies, but has also been used in high technology firms (Asanuma & Kikutani, 1992; Kawasaki & McMillan, 1987). Besides cost-sharing, risk-sharing of downstream firms and supplier has also been practiced (Asanuma,

[1] This Japanese term referring to industrial and financial conglomerates in the Empire of Japan, whose influence and size allowed for control over significant parts of the economy from the Meiji period until the end of WWII.

1985, 1992). This observation is supported by a study of the history of the evolution of the vertical Keiretsu in several industries (Nishiguchi, 1994). It has also been shown that the keiretsu is a more cost-efficient way to manage than the large scale vertical integration of downstream suppliers in US firms (Dyer, 1993). One such cost saving is deemed the "costs of governance" (Williamson, 1995). It was shown that Japanese vertical keiretsu has become an ideal hybrid form of contracting where excessive "costs of governance" could be avoided (Dyer, 1993; Nishoguchi, 1994).

3.7 SCM and Toyota

Toyota uses the "Kanban" system in SCM. In Japanese the first part of the character (Kan) means visual, while the second part (Ban) means a card, board or ticket. Taiichi Ohno (1988), who had been credited with developing the Just-in-time (JIT) system in Toyota, said that Kanban is a means to achieve JIT. A reviewer of this book claimed that if there were a Nobel Price for management innovation, Ohno would be the prime Candidate to receive this (Thomas, 1988).

Kanban is a card, board, ticket or label put on the outside of a container, tote or box. These containers travel from station to station within the production line. As work is performed, the information on the card/ticket/label is changed to show the content and the stages of its production, essentially transferring information from downstream to upstream. These Kanban cards are used as production orders and only when a corresponding Kanban card is matched will the part proceed to the next stage (Mascolo, Frein, & Dallery, 1996). Toyota allows suppliers to use either a manual system or the more modern electronic Kanban system.

Heiko (1989) tied the JIT system to Japanese culture. Firstly, there is the demand-pull system with the corresponding Japanese cultural feature of the Japanese as a customer-orientated culture. Secondly, production lead time minimization corresponds to the Japanese cultural concern with speed. Thirdly, there is the need to increase inventory turnover due to the extremely huge urban density in Japan, which puts a premium on space and hence a need to minimize its use. Heiko tied other factors tied to Japanese culture, including material staging areas, neatness and visible signs, or the application of Kanban to broadcast problems.

One unexpected result from this literature survey on Toyota's Kanban system is the fact that quite a few books have been written

on Toyota's culture, for example Liker's (2004) "The Toyota Way" and Liker and Hoseus's (2008) "Toyota Culture, The Heart and Soul of the Toyota Way." Instead of an emphasis on mathematical predictions and modeling in SCM, the literature put corporate culture and people ahead at Toyota. This is very different from what academics have written on SCM. Toyota also has not pushed it suppliers to use an electronic system for Kanban. Such manual systems used in their SCM are counter intuitive. It also runs counter to what this study is predicting.

3.8 Stages in Auto Supply Chain

Jordan and Graves (1995) showed that an automotive supply chain might be modeled as a four-stage supply chain, comprised of the component, engine, body and final assembly operations. In the context of this study, only the final assembly operation or the assembly of all parts at the auto production line is being studied.

3.9 Relevant generic theories in SCM

The findings of Chin et al. (2004) were based on the analysis of success factors, which is a result of Porter's (1980) five-forces framework. Therefore, these were based on the theory of the firm and its strategy.

In general, many of these theories might apply to varying degrees to SCM issues depending on the specific topic, i.e., network theory, cost approaches, transaction cost economics (Williamson, 1985), agency theory and resources based theory.

Burgess et al. (2003) found in their analysis of 100 SCM research articles, that theories related to transaction cost economics and competitive advantage dominated. For example, Hakansson (1982) viewed the organization as a node in a network of organizations. These networks existed because of the need to exchange resources (Hines, 1995). SCM surely fits this description: the goal is to achieve a better network position, and the variables in question are the node, links and markets. This particular theory elements are relationships, power and trust. However, a more specific network theory, Complex Adaptive Supply Network (CASN) fits this study much more accurately, and is discussed in more detail in Section 3.11.

For cost approaches, the goal is to achieve cost minimization in SCM. The variables are processes, cost, products and ownerships.

For agency theory, the goal is to get the best contract possible, and the major variable, besides principal and agent, is the all important information system. The theory elements are self-interest, bounded reality and risk aversion.

For resources based theory, the goal is the ability to secure or control resources; the variables are capital, labor, capabilities and information. The theory elements are resources dependency and core competencies. There is some overlap between this and network theory.

In this study, theories that link cultural context to certain group behaviour will also be examined. Upon completion of the data analysis, each of the stated theories and its associate elements will be revisited to provide an explanation from these established theories.

3.10 SC developed theories

Mills, Schmitz and Frizelle (2004) concluded in their strategic review of Supply Networks that there have only been two theories developed about the study of supply chain or networks: Forrester's (1961) "Bullwhip" effect and Bucklin's (1965) postponement. The reason given for the lack of theory development was a heavy concentration of research on manufacturing consumer products and components. It was also observed that researchers were looking for the same kind of industrial networks and transactions that were similar and not different.

3.11 Literature leading into research topic and Complex Adaptive Supply Network

Holland (1995) proposed a Supply Network evolution model based on the Complex Adaptive System (CAS) and fitness landscape theory to model the dynamic behaviors of the Supply Network evolution with the dynamic interaction between the firms and the environment.

Choi, Dooley and Rungtusanatham (2001) argued that past literature had recognized SCM as a system only, but that it should be recognized as a Complex Adaptive System (CAS). With respect to adaptation, they found that the parts in these systems would change their physical abilities and adapt their behavioral processes to react to environmental demands.

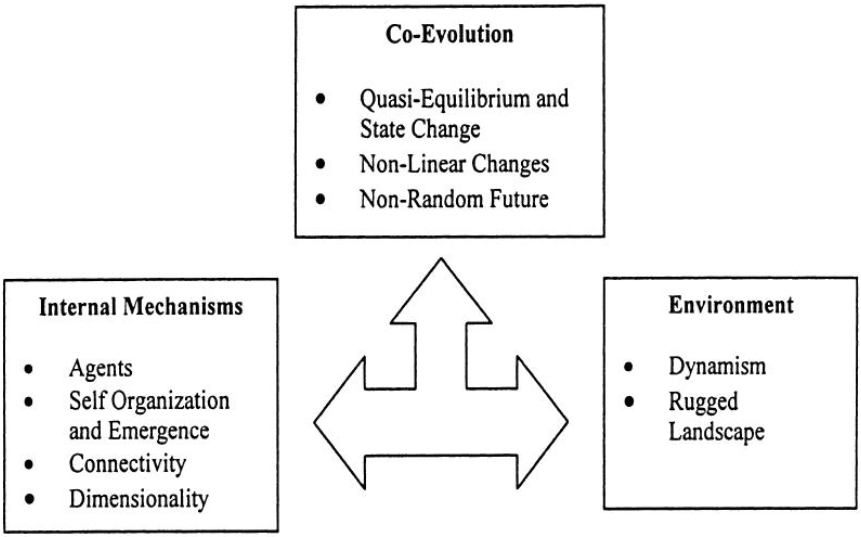

Figure 1: Underlying dynamics involving Complex Adaptive Systems. Source: Choi, Dooley, and Rungtusanatham (2001)

Surana, Kumara, Greaves, and Raghaven (2005) showed that the concept of CASN allowed the supply chain to be understood as a living system that would adapt and co-evolve with the dynamic environment in which it existed. They also showed that the patterns that arose in such a condition of co-evolution would be identified. The term CAS has now evolved to that of CASN, which incorporated the Supply Network into the concept of the Complex Adaptive System.

Pathak, Day, Nair, Sawaya, and Kristal (2007) argued that entities within these CASNs would make choices concerning adaptation and survival. These systems would evolve over time and also self-organize as a response to their environment. After completing a literature survey, Nair, Narasimhan, and Choi (2009) concluded that "it is important to study supply chains from beyond a simple buyer-

supplier dyad and from the network-based perspective so as to move closer to the realistic relational behaviors in supply chains."

Wycisk, McKelvey, and Hülsmann (2008) validated Choi et al. (2001) and Surana (2005) to reaffirm that supplier networks can be fully defined as Complex Adaptive System (CAS).

Pathak, Dilts, and Mahadevan (2009) studied the US automotive industry, investigating the population and topological evolution as a CASN.

Li, Yang, Sun, Ji, and Feng (2010) wrote, "One of the major challenges for Supply Chain managers is to develop a network structure and collaboration mechanism that can facilitate adaptive, flexible and synchronized behaviors in a dynamic environment." They also wrote that "researchers are still only in the early stages of investigating the general principals that govern the birth, growth and evolution of supply networks with complex network structure and mechanism for collaboration." They argued that in order to successfully solve this problem, the Supply Chain should be treated as a Complex Adaptive Supply Network (CASN).

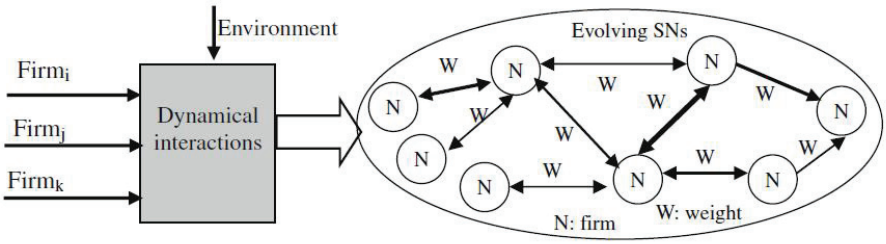

Figure 2: Supply Network Evolution Model: Source: Li, Ji, Sun, Lee (2008)

Therefore, these literatures suggested that SCM systems should be studied as dynamic systems; the evolution of how the parts developed was also of concern. However, it is very surprising that—judging from the very few articles that have been published using this theory to explain SCM behavior since it was first suggested by Holland in 1995—few academics have supported the use of CASN to explain the behavior of the SCM system.

3.12 Factors affecting SCM evolution

What are the factors of a firm that would affect SCM evolution? Several of these factors are pointed out in the literature.

3.12.1 National culture

Heiko (1989) showed that JIT practices at Toyota were tied to Japanese cultural characteristics or behaviors. Since JIT was just one of the techniques in SCM, this hinted that nationality or more specifically, national culture influences technology adoption.

It was also shown, in the context of Japanese vertical keiretsu manufacturing, that there were positive knowledge spillovers through affiliation, as well as a positive impact on firm-level total factor productivity growth (Branstetter, 2000). It demonstrated the flow of technological information across firm boundaries in a context similar to this study with the driving force being increased productivity.

Furthermore, in the context of ERP implementation, it was found that companies in developed countries were more likely to succeed, as higher IT maturity and favourable computer culture made organizations ready to handle complex technology (Haung & Palvia, 2001).

Ge and Voβ (2009) "assumed that results indicating that variables describing national culture on a macro-level have a significant influence on a specific country's adoption rates will be reconfirmed." This was as indicated by Van Everdingen and Waarts (2003) concerning ERP application for some ten European countries, as suspected throughout this paper, and as argued in Sheu et al., (2004) and Harrison et al., (2000). Van Ecerdingen et al. (2003) found that high-context and polychromic cultures such as China's had significantly lower ERP adoption rates than low-context and monochromic cultures.

3.12.2 Complexity of product

Using (higher or lower) product complexity as one of their foci, Michelino, Bianco, and Caputo (2008) studied the most important Italian firms to assess their stages of SCM adoption. Malone, Yates, and Benjamin (1987) found that IT tools support an effective management of products constituted by a large number of components. Garcia-Dastugue and Lambert (2003) found support

that product complexity impacted on the adoption of web-based tools enhancing integration, such as EDI using internet protocols.

3.12.3 Size of firm

When modeling the firm, Li et al. (2010) used one of the seven elements (resources constraints), defining it as follows: "Resources constraints on a firm are related to people, material, money technology, knowledge, capabilities and information. Firms utilize resources to fulfill customer orders." Another element was fitness. They found that a firm's fitness evolved with the evolution of the supply network. They also found that there was positive feedback between a firm's fitness and the probability that it would win the competition.

Organizational size was found to play a critical role in terms of the level of adoption and use of technologies (Mabert & Venkataramanan, 2003; Nguyen, Murphy, & Olaru, 2003; Kamaruddin & Udin, 2009).

Ge and Voβ's (2009) article, "ERP application in China: An overview," stated that "the role of size and ownership can be studied in relatively greater depth than elsewhere (Reimers, 2003)."

Huang and Palvia (2001) wrote that "business size is an important determinant of organizational IT investment and usage. Many big systems started in big companies and ERP systems were initiated by large organizations."

4 Research Design

4.1 Research Questions

As already discussed, Li et al. (2010) showed that researchers are still in the early stages of studying the general principals that govern the birth, growth and evolution of supply networks with complex network structures and mechanisms for collaboration.

Huang and Palvia (2004) studied ERP implementation issues in advanced and developing countries. Michelino, Biano, and Caputo (2008) studied Internet and SCM adoption by Italian firms. Pfohl and Gareis (2005) studied supplier parks in the German automotive industry. McCormack et al. (2008) as well as McCormack, Ladeira, and Valadares de Oliveria (2008) studied the maturity of Supply Chain and performance in Brazil. Kamaruddin and Udin (2009) studied Supply Chain Technology Adoption in Malaysian automotive suppliers. In their review of SCM and logistics research, Sachan and Datta (2005) called for more research from other parts of the world besides North America and also companies in other parts of the world and these are not functioning in the North American context.

In summarizing the literature survey, there was a clear need to understand the following: the evolution of supply networks specifically in a non-North American context. The research questions for this study were developed with this intent in mind.

4.1.1 Research Question 1

How does a Supply Chain Management system develop and evolve in Chinese auto-parts companies?

4.1.2 Research Question 2

What factors caused these evolutions? What factors have little or no effect? And why?

In their review of SCM and logistics research and in relation to future research directions, Sachan and Datta (2005) suggested that with respect to studies in time and maturity, future research in the discipline would involve the questions of "how" and "why."

4.2 Where would the answers be located in SCM subject areas?

In section 3.4, it is mentioned that Giunipero et al. (2008) arrived at a clear and exhaustive list of SCM subject areas. One can easily come to the conclusion that if the answers to these questions were to be found, it would likely be in the first subject area, i.e., SCM Strategy or strategic planning.

Another possibility might be in the second most studied area, i.e., SCM frameworks, trends and challenges. A more detailed look into the subject matter indicated that these articles were concerned only with future trends, supply chain definitions, historical reviews and the problems and benefits of SCM, but not with the development and evolution of the SCM system itself. Since evolution and development may be considered time-based, then the fifth most studied subject area, SCM and time-based studies, might have these answers. However, an examination of the time-based articles revealed that they were based on making the operations faster or more efficient in terms of time, without any ties to the evolution of the processes.

As was already shown in the literature survey, an in-depth search on articles dealing with the SCM strategy and strategic planning subject area was not able to yield answers about the evolution of SCM in any context except those that have already been discussed.

4.3 Methodology used

The case study approach can interpret reality, particular complex interactions between firms in emerging markets (Hoskisson, Eden, Lau, & Wright, 2000). A case study approach was chosen to investigate the evolution of SCM in the real world. A case study offers the opportunity to study a phenomenon in its own natural setting where complex links and underlying meanings can be explored, while also enabling the researcher to study whole supply chains (Miles & Huberman, 1984; Yin,

1994, 2003). A case study method is appropriate where existing knowledge is limited because it can generate in-depth contextual information and result in a higher level of understanding (Oke & Gopalakrishnan, 2008). Given this reasoning, the case study method has been chosen for this study.

The methodology adopted is the one suggested by Yin (1994, 2003). Firstly, the study question must be clearly presented. Secondly, any propositions must be spelled out. Thirdly, the unit of analysis must be defined. Fourthly, the logic linking the data to the proposition is proposed. Lastly, the criteria for interpreting the findings are stated.
In this study, the interpretation of findings is in the discussion (Chapter 6).

4.4 Development of Propositions

Given that no past literature has yielded any information to answer the research questions, the writer developed the following propositions. The intent of this study is for the benefit of the practitioner, therefore this study is written in simple English where a practitioner would not be discouraged to read an article with complex technical and academic terms. This is consistent with the nature of Operations Management, which says that the language is to be as simple as possible and easy to understand.

Chin et al. (2004) used the term "degree" when referring to how a company had implemented SCM in one of the questions in their survey. In their study, they also attempted to answer the question, "how much is optimal?" The research questions of this study are along this line of thinking.

A practitioner would be interested to learn how a SCM system can be implemented in a Chinese context. How will this process develop or evolve? Then, the practitioner would also be interested to know how their product, if of a certain complexity, would affect SCM systems. Or, how complex an SCM system is optimal for our product? Give that the practitioner's operation is of a certain size in operation or in sales, how complex should the SCM system be? These would give guidance as to whether or not the practitioner should force a SCM system from their home operation onto their China JV. Responses to the four propositions below would provide the answers to some of these questions. From an operational point of view, this researcher sincerely believed that since it was very difficult to get interviews from Chinese auto parts manufacturers and that a second chance might

not be possible, the selection of propositions needed to be tied to variables where clear information could be obtained,. Therefore, the tactic was to ask simple questions with the main objective of getting clear and useable information as data that would be consistent for all involved companies.

4.4.1 Proposition 1

> *The evolution of a Supply Chain Management system is dependent on the nationality of the foreign joint venture partner in an auto parts company.*
> *A company that has a joint venture partner who is from a more technologically advanced country will evolve faster in the use of SCM than a company that has a joint venture partner who is from a less technologically advanced country.*

Given that a foreign auto parts manufacturer would most likely be from a more technologically developed country—since the auto companies invited these parts companies to come into China when the auto companies first started their operation to manufacture in China—it was logical that these companies would bring most of their home systems to the new Chinese JV. One of these systems would be SCM. Therefore, the more advanced manufacturers would bring in the more advanced systems, including SCM, and the less advanced would bring in less advanced systems.

As already discussed, with respect to one of the techniques in SCM, Heiko (1989) showed that Just-in-time (JIT) practices at Toyota were tied to Japanese cultural characteristics or behaviors. Therefore, this link between national culture and SCM has already been established in the literature, coincidentally in the same auto manufacturing industry and in the context of SCM.

Moreover, Branstetter's (2000) found that, in the context of Japanese vertical keiretsu manufacturing, there were positive knowledge spillovers through affiliation, as well as a positive impact on firm-level total factor productivity growth. This demonstrated the flow of technological information across firm boundaries in a context similar to this study with the driving force being increased productivity.

Haung and Palvia's (2001) found that in the context of ERP implementation, companies in developed countries were more likely

to succeed, as higher IT maturity and favorable computer culture made organizations ready to handle complex technology.

As already quoted in the literature survey, Ge and Voβ (2009) "assumed that results indicating that variables describing national culture on a macro-level have a significant influence on a specific country's adoption rates (as indicated by Van Everdingen and Waarts, 2003, for ERP application for some ten European countries and suspected throughout the paper, or argued in Sheu et al., 2004 and Harrison et al., 2000) will be reconfirmed." And finally, there is Van Ecerdingen et al.'s (2003) finding that high-context and polychromic cultures such as China's had significantly lower ERP adoption rates than low-context and monochromic cultures.

Proposition one is supported by past literature, which showed a precedent in terms of a relationship between SCM and national culture.

4.4.2 Proposition 2

> *The evolution of a Supply Chain Management system is dependent on the nature of the industry of the auto parts company.*
> *A company that has more complex products will evolve faster in the use of SCM than a company that has a much simpler product.*

Intuitively, the more complex a product is, the more parts or sub-assemblies it would have and be manufactured from. Following this logic, the need for a more advanced SCM system would be required to address this complex manufacturing procedure and increase material handling and co-ordination of such a product. The converse could be true for a much simpler product.

As discussed above, Michelino, Bianco, and Caputo's (2008) study of the stages of SCM adoption of the most important Italian firms used (higher or lower) product complexity as one of its foci. Malone, Yates, and Benjamin (1987) found that IT tools support an effective management of products constituted by a large number of components. Then there was also Garcia-Dastugue and Lambert's (2003) findings, which supported the notion that product complexity impacted on the adoption of wed-base tools enhancing integration, such as EDI using internet protocols. There is enough support from

literature to conclude that product complexity is an important factor in SCM evolution.

4.4.3 Proposition 3

> *The evolution of a Supply Chain Management system is dependent on the number of employees of the auto parts company.*
> *A company that has more employees will evolve faster in the use of SCM than a company that has fewer employees.*

Along the same lines of logic as in proposition two, if the requirement for labour in the manufacturing of the product were high, then the need for a more advanced system would be necessary, as both the complexity and number of personnel issues would create pressure and necessitate a need for a more advanced or complex SCM system.

As discussed above, Li et al. (2010) modeled the firm by using one of the seven elements ("resources constraints") defined as follows: "Resources constraints on a firm are related to people, material, money technology, knowledge, capabilities and information. Firms utilize resources to fulfill customer orders." Also, as mentioned, Mabert and Venkataramanan (2003), Nguyen et al. (2003), and Kamaruddin and Udin (2009) found that organizational size played a critical role in terms of the level of adoption and use of technologies. Finally, there was Ge and Voβ's (2009) argument in "ERP application in China: An overview," which stated that "the role of size and ownership can be studied in relatively greater depth than elsewhere (Reimers, 2003)." There is strong support from the literature for considering firm size as a factor influencing SCM evolution.

4.4.4 Proposition 4

> *The evolution of a Supply Chain Management system is dependent on the sales volume of the auto parts company.*
> *A company that has more sales volume will evolve faster in the use of SCM than a company that has much less sales volume.*

Following the same line of thinking, sales volume must also be an indicator of stress on the manufacturing system. The sheer volume would again show pressure on the system and necessitate the need for a more advanced or complex system.

Besides, as pointed out by Li et al. (2010), Huang and Palvia (2001) stated that "business size is an important determinant of organizational IT investment and usage. Many big systems started in big companies and ERP systems were initiated by large organizations."

4.4.5 Logical thinking tying data to proposition

In the propositions, some of the measures are very straight forward, namely, the country of origin of the company, sales volume and number of employees. These do not warrant further explanation.

The most important measure in this study is the stages of evolution or relative stages of advanced evolution. In the next chapter, using an industry accepted framework for benchmarking SCM, interview questions are discussed, which were designed to disclose information about the exact current stage of the company's SCM status. The industry framework lists factors such as connectivity, automation, flexibility, sophistication of software, etc. The discussion of these will be expanded in the next chapter.

The one factor left for discussion is the complexity of the product. It is pretty easy to distinguish that a brake-housing is less complex than an entire completed instrument panel unit; but, ranking a housing for lighting as a more complex product than an air conditioner may be less obvious, even though true. This research rallied the help of professionals in the auto industry to confirm the ranking of product complexity, i.e., to confirm that the relative ranking of complexity in this study is correct from a practical industry point of view.

Factors considered were the number of components making up a part, the number of different materials in its composition, its technological requirement, and the historical development of the auto parts industry.

4.5 Unit of analysis

The unit of analysis is the supply chain link between auto parts companies and the auto companies in one automotive group company.

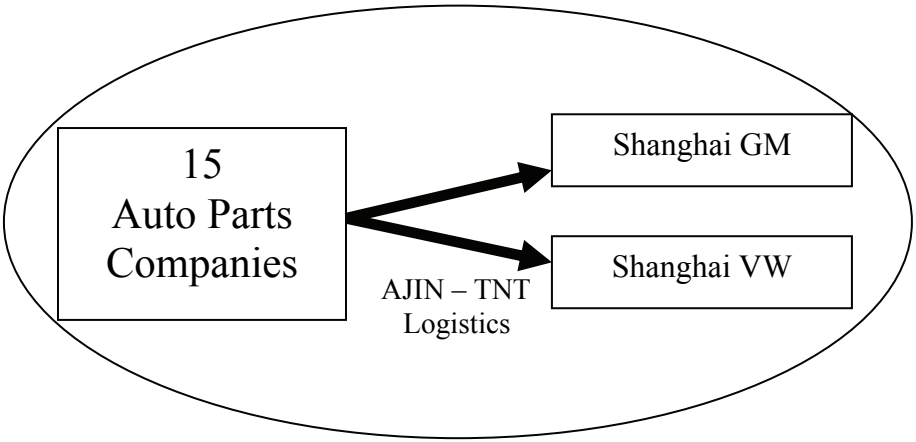

Figure 3: Unit of Analysis (Showing all interviewed companies) :

The Supply Chain linkages between Auto and Auto Parts Company of SAIC.

5 Data collection and data analysis

5.1 Making the research question operational

On an operational level, the most likely way one can gain access to study a Chinese operation is if an offer to perform research is accepted by the firms. Offering to investigate the current state of affairs of a company's SCM system—or, if the company still does not have this functioning, then its Enterprises Resources Planning system—may be the only way to gain access for these studies.

5.1.1 SCOR as study design

The most important goal of this study was to investigate and pinpoint the stage of evolution in each company's development of its SCM. The Supply Chain Operations Reference Model or SCOR model (Cohen & Roussel, 2004) in Table 1 illustrates five performance attributes for measuring a supply chain; moreover, the usefulness of SCOR has been verified (Wong & Wong, 2009).

However, these can not be used at face value. A cursory investigation of the companies points to the fact that some of these companies still do not use SCM systems, but ERP only. So it is meaningless to use these as measures. Another point is that both operational and financial data are listed in the performance attributes. During the undertaking of this study, these were nearly impossible to collect or simply were not available. To elaborate, firstly, at the time of the study, these data were not being measured and recorded. Secondly, some data were too complicated or were unavailable—e.g., the data necessary to decipher or separate currently available information (in order to get the *desired* data) were not present. Thirdly, the time needed to separate and analyze these data would have been too long, and would have made the study simply impossible to carry out within a reasonable time. Lastly, even if the data were available, the companies might not have released these to the researcher as financial data would be seen as much more sensitive than operational information released in interviews.

5.1.2 Problems in SCM measurements

"*The gap lies in the lack of valid measurement criteria and adequate methodologies to aggregate individual performance measures into a single index of overall performance. Most methodologies are unable to account for relative importance of performance measures, which varies among firms*" (Wong & Wong 2004).

Lockamy and McCormack (2004) stated that there have only been a small number of studies attempting to empirically link specific SCM practices to supply chain performance. They also found that SCOR failed to address the issue of integration synchronization. Given these findings, this study will avoid measuring performance.

5.1.3 Determination of obtainable measures

Given these difficulties and based on these performance attributes, this writer decided on collecting the following data or measures, which were obtainable and meaningful for this study. The first determination was whether the company was using SCM systems or still using Enterprises Resources Planning systems only. Secondly, what was the connectivity of the company to its customers and its suppliers? Thirdly, what level of complexity or sophistication had their system reached? Fourthly, what process automation had been implemented or deployed? Fifthly, how flexible and responsive was their Supply Chain?

After determining the evolutional level of the company's SCM system, other company data were also gathered so as to be used in the analysis of behaviour. Examples of these data are the starting date of operation (length of operation), annual sales, the number of employees at the location, the nationality of the joint venture partner, etc.

In some instances, the researcher tried to probe into the culture of the company. This was possible only if the staff being interviewed were themselves able to elaborate or correctly identify their company culture, or if the lines of questioning led to this topic.

5.1.4 Use of Maturity Models in study

The SCOR Maturity Model (Table 2) shows the four stages of maturity from the initial functional focus, to internal integration, then external integration, and finally cross-enterprise collaboration. However, the SAP SCM Maturity Model (Table 4) is presented in very clear and concise language that can be easily adapted into interview questions that could identify a firm's evolutional stage.

SAP uses similar labels for the four stages, these being disconnected, interfaces, integrated internally and multienterprise integrated. It lists the following six separate attributes ("stage capability") for ease of identification: internet, integration, supply chain planning, production scheduling, integration with suppliers, and customer delivery. For each of these six attributes, corresponding stages are clearly specified. For example, the first attribute is "internet," which is used in Stage 1 for visibility; in Stage 2 for catalog; in Stage 3 for information exchanges; and in Stage 4 for unattended trading. The fifth attribute is "integration with suppliers," which is used in Stage 1 for the use of Fax and phone; in Stage 2 for EDI, Fax and phone; in Stage 3 for EDI with all large suppliers; and in Stage 4 for VMI (or Vendor Managed Inventory) and online RFQ.

The clear and concise wording of the conditions informs the basic line of questioning for this case study. When the answers to these questions were received, the writer was able to align the firm's current stage with these measures and determine the stages.

However, the study deviates from the SAP model in that the classification of stages is not used in its entirety, as this study is not to establish the stages as SAP suggests, but rather to establish the study's propositions. The questions were developed to cover all six attributes of the SCOR maturity model. The relative ranking would be the sum of the total areas reached by the firm. For those categories receiving verbal answers, another relative rating scale within that category would be used. Aware that this would mean assigning each question equal weight, which by itself is an assumption, this writer decided that this study had to start from somewhere. In short, the firm achieving the highest number of areas would be ranked the highest, which is essentially the same as what all maturity models aim to measure.

The ranking of the relative complexity was discussed above. The factors considered were the number of components making up the part, the number of different materials in its composition, its technological requirement, and the historical development of the parts industry.

5.2 Choice of Study Subject

The choice of candidate (in this case, a company) to interview is of paramount importance in this study. Chinese companies as a rule are usually very secretive and, in most cases, will not agree to have an outsider perform a research study in their company or operation. For example, Hatani (2008) found Chinese managers were hesitant to disclose suppliers' names on a survey sheet.

This writer had already been in contact with the candidate company since 2002 in order to ask permission to study the company and its subsidiaries. Shanghai Auto Industry Corporation (the parent or group company) is the largest auto manufacturer in China. It owns three car lines, namely, Shanghai General Motors (SGM), Shanghai, Shanghai Volks Wagen (SVW) and Shanghai Auto Company (SAC)—the new "home" designed and manufactured company that started in late 2006 with the Roewe 750 car model (using Rover 75 as a basic design) followed by the Roewe 550 model launched in March 2008. (Notice the difference between the company names and the name of the parent or group company—Shanghai Auto Industry Corporation [SAIC]). Appendix 1 shows the number of passenger cars sold by China's top ten passenger car manufacturers. In 2007, SGM had the top sales in China while SVW was ranked third.

The ideal scenario is to study as many as possible of the parts suppliers to these three car companies under SAIC.

5.2.1 Proposal for study

As mentioned, this writer had been in contact with the SAIC auto group company since 2002 to request to study its Supply Chain Management (SCM) system within the organization. For many years, the request had been received by polite silence and had not triggered any response or acknowledgement. Finally, in April 2007, a Director of the group company working at its headquarters gave a first response and asked this writer to put the proposal in writing. (The proposal was first written in English [Appendix 2] and then translated into Chinese [Appendix 3].) After the Director studied the proposal, he then presented it to the Executive Director for approval. Unfortunately, that same month, SAIC, the group company, was performing a major organizational restructuring, and the proposal was not acted on. (SAIC was aligning some of its auto parts companies into the public side of the organization, while others were kept as

private companies controlled by the group company.) However, the Director was able to arrange interviews for the two pilot case studies.

5.2.2 Pilot case studies

Besides the obvious reasons, there were specific reasons for running two pilot case studies: firstly, and probably most importantly, to find out if the study was feasible; secondly, to find out if the subject matter was relevant, of interest and useful; thirdly, since the two pilot studies would include interviewing the top logistics person at Shanghai GM and Shanghai VW, to gain insight into other subject matters of specific interest to these auto companies besides the proposed study; and fourthly, to seek guidance and information from, and also the blessings of, the auto companies to do the study.

The results of the pilot case studies were then brought back to the group company to illustrate the study's relevancy and usefulness, and persuade the group company to approve the entire study proposal. Fortunately, SVW was interviewed before the proposal was written and the results were incorporated into the proposal for submission. It illustrated to the Logistics Director at SVW that the study was relevant, of interest and useful. Furthermore, she gave several suggestions of other topics for discussion that were of interest from her point of view. These were not originally known to the writer.

5.2.3 Approval from Study Subject

The study was finally approved after the New Year in 2008 by the Director of the group company (SAIC), the same person who had originally asked for the proposal in the previously year. This was made possible because the Director had since been promoted to be the final decision maker for the approval of this proposal. The approval also implied that the other conditions in the proposal were accepted, as support from SAIC was needed to successfully conduct this study.

5.3 Measures taken to ensure accuracy of responses received

In order to ensure that the responses from the interviewees were accurate and honest, the following measures were taken by design.

The writer asked for the group company to provide an assistant who was currently working at the group company. The assistant was to accompany the writer to all interviews as well as to act as the liaison between the auto parts company and the writer.

The first contact or introduction was made by a subordinate of the Director, who was a senior manager. This senior manager called each of the auto parts companies and asked for their cooperation to the best of their ability, as the study was for the benefit of the group company. The contacts were then passed on to the interview assistant for confirmation of interview times and dates. The assistant would then follow up with a more in-depth telephone conversation and convey to the auto parts companies what the interview was about, while confirming that the proper people were being interviewed, i.e., those in-charge of each company's SCM system who had day to day knowledge of its usage. The interviews were mostly with either purchasing or logistic managers or directors; in a small number of companies, the IT manager carried the SCM function.

All interviews were performed in Putonghua or Mandarin, China's national language. Although some of the interviewees' mother tongue may have been Shanghainess or some other local dialect, Putonghua is still the predominating and proper language of business spoken at most Chinese national level companies as well as the official spoken language in China.

5.3.1 Data gathering period

In order to make the study a "snap shot" of the operation, all the interviews were performed within a two-week period in March 2008. The interviews usually lasted between one to two hours with few exceptions. In many cases, a plant tour would follow the interview.

5.3.2 Post Interview contact and confirmation of results

After each interview, the data were summarized and the summaries (for the individual company only) sent back to the interviewees for

confirmation. The relative rankings were not disclosed. The replies were further studied, especially the ones where the interviewees had adjusted or added to the original results. Not all of these adjustments or additions were accepted by the writer for inclusion.

Company J did not respond to our request. It did not supply company profile data and did not respond to check our interview results. The researcher did not push the point nor asked SAIC to intervene.

5.3.3 Confirmation and assistance from other sources within the group company studied

As the Director of the group company was in-charge of the Supply Chain function of all its subsidiaries, he also had a very good idea already of how each of them performed and ranked. He was briefed on several occasions with the research's preliminary findings. He also provided some input into this study. For example, he concurred with the researcher's findings, specifically with our pick of the top ranking company as most evolved in the use of their SCM system.

Another person utilized as a resource in this study was a manager on the Group's Management Board. He was the overseer for the Group Company, representing it at the Board of Director meetings of each of the subsidiary auto parts companies. He thus had intimate knowledge of the operation of the companies participating in this study, although not specifically of the supply chain. The background information he supplied on the management and operations of the auto parts companies was helpful to explain their behaviour.

After all the interviews were done with the auto parts companies, the researcher interviewed a subsidiary that was not an auto parts company, but a logistics company. It was a joint venture between SAIC and TNT. This was the logistics provider or trucking company used to deliver most of the auto parts from the auto parts companies to the auto manufacturers' assembly lines, or to the staging areas supplying the assembly lines. Their strategic manager had information and intelligence about all the participating auto parts companies, specifically about their SCM operations. Investing this link that was used for logistics fulfillment completed the picture for studying the system. These sources helped in providing a triangulation of results.

5.4 Assumptions

One assumption made in this study is that each company interviewed had essentially the same amount of time, or enough time, to evolve and start using a SCM system at any time they so chose.

Given the fact that many of these companies were brought into China as suppliers to the auto companies, it is also assumed that these companies were very successful in what they had been doing as they were still in business. Furthermore, these companies were adapting to whatever forces that were facing them. In other words, these companies were evolving. These companies were evolving so that they could do a better job or have better performance and stay in business. This evolution was based on need. Without this evolution, these companies might not have stayed in business or remained as qualified suppliers to the auto companies. Surana et al. (2005), Pathak et al. (2007), and Li et al. (2010) all pointed to a supply chain system as a complex adaptive supply network wherein the parts in the network would adapt and evolve because of the environment.

5.5 Data Collection

5.5.1 Interviewed companies

The interviewed companies were picked from the list of subsidiaries in the Annual Report of SAIC. There were four selection criteria. Firstly and most importantly, the goal was to pick as many parts manufacturers as possible to cover as much of the entire auto industry as possible. Secondly, due to time constraints, only those companies located within a three-hour drive of the car assembly plant were picked. Thirdly, those companies that were not associated with the direct production were not picked. For example, the marketing companies, the design centers and other companies who do not manufacture parts were not picked. Fourthly, those making truck parts only were not picked as this is beyond the scope of this study, which is only about the passenger car. Of the 15 companies picked, one was not able to meet after several attempts to reschedule.

There were exceptions to the selection criteria of interview partners, for example, a tool and die company that made the auto door panels and interior structural components. Normally, a tool and

die company would not be considered a direct "parts" supplier or manufacturer, but this tool and die company supplied a large and important part of the automobile.

Another exception was the selection of a non-SAIC wholly owned subsidiary. Huizhong, an important component supplier (front and rear axles, shock absorbers), was moved to the public portion of the group company in April 2008, so it was no longer a wholly owned subsidiary.

A third exception has already been mentioned. ANJI-TNT Logistic, the company that delivers the auto parts to the assembly lines of the auto companies, was interviewed last. Because ANJI-TNT Logistic serves all the other companies participating in this study, this interview essentially provided a summary of all the other interviews. Also, because the company specializes in logistics fulfillment and SCM, it helped the writer to understand some of the behaviour of the auto parts companies.

Table 5 lists the manufactured parts manufacturers interviewed for this study.

It was impossible to interview the manufacturers of all the parts in an auto, as some of the manufacturing functions are still kept by the auto assembly line or within its compounds. For example, the engine plant is within or next to the assembly line compounds. In the case of the engine, we were able to interview the piston manufacturer. Another example is the car doors—large parts that are compression molded next to the assemble line. However, we were able to interview the company that manufactured the tool and die to make these door panels. A different example is the manufacturer of the IP or instrument panel. In the case of IP manufacturer Yanfeng Visteon, its final manufacturing line is placed next to the Shanghai VW assembly line. But we were able to interview Yanfeng Visteon and also to have a plant tour where the IP skin is manufactured before being semi-assembled and sent to a final assembly next to the VW assembly line.

Essentially, the majority of all parts manufacturers of an automobile have been covered by this study. However, it was not the intent or within the scope of this study to interview manufacturers for all the parts in an automobile.

In order for the auto manufacturers to comply with the Chinese Central Government's stipulation about the use of locally-made parts (imposed at the time of the approval of these joint ventures), there exist auto parts companies that are called Complete

Knock Down (CKD) and Semi-Knock Down (SKD) companies. These were deemed less relevant to this study and thus excluded from the selection.

In order to fulfill the stipulation that the content of an auto must have a certain percentage of locally-made auto parts, a local company would be started whose sole function is to purchase auto parts from foreign companies and directly resell them to the auto companies. By doing so, these auto parts would be labeled as local content from a local company. Those companies who just import and resell are known as CKD companies, while those that import parts and then do some simple assembly work on the parts before reselling them are known as SKD companies.

Table 5: List of Auto Parts Manufacturers interviewed in this study

Front and rear axle
Shock absorber
Cabin system, instrument panel
Interior trim, door trim
Exterior trim, painted bumpers
Seat
Steering wheel
Sun visor
Air conditioning systems
Engine cooling systems
Compressors
Evaporators
Condensers
Radiator
Heater
Oil cooler
Charge air cooler
CV universal joint, drive shat, cross joint
Clutch
Torque converter
Lamps seating
Brake calipers
Booster wheel cylinder
ABS
Automatic and manual steering systems
Starter
Generator
Sealing strips
Engine piston
Non-ferrous die casting
Die for doors and internal frames
Door closure parts

5.6 Interview partners

The interviews were conducted with front-line managers who worked with the SCM system or ERP system on a daily basis. They were usually the ones who were put in charge of managing these systems. Some of them might or might not have been the one in their companies to choose these systems, although many participated in the investigation and decision making processes to purchase these systems. In the opinion of this researcher, compared to management higher up in their companies, these managers would give a more accurate account of the actual situation, as more senior management might be inclined to give more favourable answers for political or other reasons.

In many cases, the companies provided us with more than one person for these interviews to ensure that whoever was needed to answer our questions and provide information would be present.

A list of the interview partners with their name, company, title and address is provided in Appendix 4.

5.6.1 Auto parts company A

Company A is a German JV with SAIC. The facility started operations in February 2001 with the current employee count at about 1,700. The company manufactures non-ferrous components (brake housing castings) for Shanghai GM, Shanghai VW, Changan Ford, Volvo, Renault, JAC, Dongfeng/PSA Peugeot and Citroën, and other smaller car companies like Anhui Jianghuai Auto Company, Geely (Jili), etc. The company describes itself as one that does development, production and assembly of the following products: the cylinder well; cylinder top; air intake module; exhaust recirculation; recycled air-intake circulation system and pumps, including engine oil pumps; water pumps; and vacuum pumps. Annual sales in this location were RMB$0.615 billion in 2005; RMB$0.808 billion in 2006; and RMB $1.005 billion in 2007. The factory is located inside the City of Shanghai. It is very likely that the Shanghai City government will force this company to relocate as most of the surrounding manufacturers have already been forced to move elsewhere to locations outside of Shanghai.

5.6.2 Auto parts company B

Company B is a 50/50 German JV with SAIC. The facility started to operate in August 1997 with the current employee count at 680. The company manufactures engine cylinder heads for Shanghai GM, Shanghai VW, First Auto VW, Tianjin Toyota, Changan Ford and Dongfeng. It also exports to GM in the US and Deutz in Germany. It makes very few products except for an important, high precision and expensive component as—the cylinder head for the engine. Annual sales in this location were RMB$59.5 billion in 2005; RMB$57.7 billion in 2006; and RMB$66.7 billion in 2007. This company is located on the back of Company A and shares the same property line. As with Company A, there was pressure from the Shanghai City Government to relocate this plant to a location outside of Shanghai.

5.6.3 Auto parts company C

Company C is a US JV with SAIC. It is a fairly young company that only started operations in June 2004 with the current employee count at about 700. The company manufactures the very large die used by auto companies to make the exterior panels (by stamping and welding) as well as the internal frame parts. It also produces the die for closure parts and other assembly parts. It supplies to Shanghai GM, its most important customer. Annual sales in this location were RMB$0.34 billion in 2005; RMB$0.72 billion in 2006; and RMB$1.0 billion in 2007. The company is located in one of the industrial area in Shanghai.

5.6.4 Auto parts company D

Company D is a French JV with SAIC. It started operations in February 1995 and the current employee count in this location is 1,140. It manufactures the complete range of electrical devices for all uses in an auto application. In its company promotion, it calls itself the largest supplier (in size) in China of such devices for the auto maker. Its customers are Shanghai GM, Shanghai VW, First Auto VW and non-VW, Puegeot, Changan Ford and Suzuki, as well as several truck manufacturers. Annual sales in this location were RMB$0.645 billion in 2005; RMB$0.951 billion in 2006; and RMB$1.248 billion in 2007. Company is located in one of the new industrial development area in Pudong, Shanghai.

5.6.5 Auto parts company E

Company E is a German JV with SAIC. It started operations in September 1995 and the current employee count is only 277. It manufactures rubber components and sealers for the auto. Its customers are Shanghai GM, Shanghai VW, Shanghai Sunwin, Chery, Guangzhou Honda, Hainan Motors, Changan Ford, Jiangsu Nanya, Xian Suzuki, Beqi Futian, Beiqi Jeep Co, Shenyang Jinbei, Tienjin Toyota, Nanjing Naveco and Yizheng Auto. Annual sales were RMB$ 28.5 million in 2005; RMB$43 million in 2006; and RMB$47.9 million in 2007. The company is located in Qingpu District.

5.6.6 Auto parts company F

Company F is a 50/50 German JV with SAIC. It started operations in September 1994; the number of current employees in this location and on the production lines inside the Shanghai GM and Shanghai VW production lines is over 10,000. This company makes the complete instrument panels for autos. Besides those listed, they also supply to Changan Ford, Anhui Jianghuai Auto Company and Geely (Jili). The only financial data supplied was the annual sales figure of RMB$13.6 billion for 2007. Of this total, RMB$10.6 billion was for domestic sales and the reminder for sales to the US. The company is located very close to the Shanghai VW assembly lines in Anting Industrial Park.

5.6.7 Auto parts company G

Company G is a French JV with SAIC. It started operations in June 1992 and the current employee count is 1,083. This company supplies metal products, for example, oil pan bottoms, transmission cases, transmission side covers and cylinder cover housings. Its customers are Shanghai GM, Shanghai VW, First Auto VW, Changan Ford and some diesel truck companies. It has also supplied to the US as well. Its annual sales in this location were RMB$0.34 billion in 2005; RMB$0.43 billion in 2006; and RMB$4.7 billion in 2007. The company is located in Jiading District.

5.6.8 Auto parts company H

Company H is a German JV with SAIC. It started operations in December 2001, with a current employee count of 771. This company

supplies the very important powertrain for the auto. Its customers are Shanghai GM, Shanghai VW and First Auto Works. Its annual sales in this location were RMB$0.30 billion in 2005; RMB$0.34 billion in 2006; and RMB$0.43 billion in 2007. The company is located in Qingpu District.

5.6.9 Auto parts company I

Company I is not a JV, but rather a wholly owned subsidiary of SAIC. It started operations in 1997, with a current employee count of 277. It manufactures springs for the auto's suspension system. Its customers are Shanghai GM, Shanghai VW, Changan Ford, Chrysler, PSA Peugeot and Chery. Its annual sales were RMB$29 million in 2005; RMB$38 million in 2006; and RMB$45 million in 2007. The company is located within Shanghai.

5.6.10 Auto parts company J

Company J is a Japan JV with SAIC. It started operations in May 1990 and undertook a major restructuring and injection of new capital and partner in 2004. This company did not release any financial information or employee count in the interview. It manufactures air conditioners for autos. Its customers are Shanghai GM, Shanghai VW, First Auto Works, Changan Ford and a few smaller auto companies. The company is located in an old residential area inside Shanghai that has not been planned for re-development.

5.6.11 Auto parts company K

Company K is a 51/49 German JV with SAIC. It started operations in November 1994 and its current employee count at this location is 900. It supplies the steering systems in autos. Its customers are Shanghai GM; Shanghai VW; First Auto Works VW and Audi; Anhui Jianghuai Auto Company; Dongfeng Peugeot and Citroen; Brillance Auto Jinbei and BMW; Hainan Auto; and Volvo. It also exports to Tata in India and Volvo in France. Its annual sales were RMB$0.75 million in 2005; RMB$1.0 billion in 2006; and RMB$1.15 billion in 2007. The company is ranked number one in China in its business sector and is also a leader in Asia. The company is located in Jiading District.

5.6.12 Auto parts company L

Company L is a Japan JV with SAIC. It started operations in February 1989, with the current employee count at 1,180. It manufactures all types of electrical structures and plugs, including head light stands. Its customers include Shanghai GM, Shanghai VW, Toyota, Nissan, Wuhan Honda plus a few other smaller car companies. Its annual sales were RMB$1.4 billion in 2005; RMB$2.3 billion in 2006; and RMB$2.8 billion in 2006. The company is located in Jiading District.

5.6.13 Auto parts company M

Company M is not a JV, but rather a wholly owned subsidiary of SAIC. It started operations in July 1994, with a current employee count of 915. It manufactures automotive brakes. Its customers are Shanghai GM and Shanghai VW. Its annual sales were RMB$1.3 billion in 2005; RMB$1.7 billion in 2006; and RMB$2.4 billion in 2007. The company is located in Jiading District.

5.6.14 Auto parts company N

Company N is a four-party JV with 50% German JV; SAIC only owns 35%. It started operations in August 1988, with a current employee count at this location of 1,800. It supplies Shanghai GM, Shanghai VW, First Auto Works, Brilliance Auto, Geely and Chery. It manufactures the drive shaft and associated products. Its annual sales were RMB$1.0 billion in 2005; RMB$1.5 billion in 2006; and $1.1 billion in 2007. The company is located in Zhoupu District.

5.6.15 Auto parts company O

Company O is another wholly owned subsidiary of SAIC. It started operations in November 1996, with the current employee count at 6,400. It supplies Shanghai GM, Shanghai VW, First Auto Works, Changan Ford, Anhui Jianghuai Auto Company and Brilliance Auto. Its annual sales were RMB$3.6 billion in 2005; RMB$5.2 billion in 2006; and RMB$6.2 billion in 2007. The company is located in a residential area very close to the river in Pudong.

5.6.16 Logistic Transportation Company P

Company P is a 50/50 JV of SAIC with an international logistic company. The company was located within Shanghai.

5.7 Interview approach

The interviews were conducted at the facilities of each auto parts company. The writer and assistant made appointments well in advance for these interviews and traveled to their sites.

Efforts were made to conduct the interviews in as casual and low key a manner as possible to give the interviewees a level of comfort wherein they would provide information in a less guarded way. For example, the writer and assistant were in casual office attire and did not wear a tie. The interviews were started with a statement about how they would be conducted as casual conversation between the parties without any recording device (except written notes made by the writer and assistant).

The writer's approach to the interviews was to pose general, open-ended, fact-finding questions, which touched on predetermined specific areas of the supply chain.

5.7.1 Interview questions

The interviews usually started with a request for a short introduction on the company products and then on the company's list of customers. Other questions included how these customers were connected and how they placed their orders. Then, how the company was connected to or communicated with its suppliers was investigated. This would usually lead to questions on forecasting and/or production planning. Questions would then be asked about who in the company was responsible for the forecasting/production planning as well as about how this was done. This would lead into the "systems" questions where the specifics of the system were investigated. These included questions about the system that had been installed in the company; the modules that had been deployed; how many years the system had been in place; and what had been the problems during deployment. Questions were also asked about accuracy of the data; existing problems with the system; projected plans for the future, etc. Questions were also asked about the cost of software and

deployment as well as the history of implementation and the reasons for selecting the specific software.

Questions would then be on the company's ranking of the problems in managing their supply chain. Usually, further questioning focused on why these problem had started and what, in the company's point of view, were the solutions to these problems.

Questions were asked about the effects on operations of the snow storm in early 2008 in southern China. Then questions were asked about how much of their products were supplied by one supplier and how much by more than one supplier.

Other lines of questioning were followed when and where the interviewees were willing to elaborate in more detail. For example, some of these questions were about the culture of the company, how many expatriate managers were working at the location, and company strategies (i.e., capital investments and expansion plans).

Factual data about the company would also be asked for in order to anchor the company, for example, the nationality of the JV partner; the year of starting operations at the location; the number of employees at the location; and the sales volume for the past three years—all variables in the propositions. In some cases, those interviewed did not have the answers, which were received afterwards.

5.8 Summary of Results from Interviews

Table 6A/B and Table 7A/B below contain the interview results arranged in the correct order of relative advanced evolution rating.

Table 6A Evolution ratings: Interviewed companies that used Supply Chain Management System							
	Comp F	Comp K	Comp M	Comp E	Comp D	Comp H	Comp C
Relative advanced evolution rating	1	2	3	4	5	6	7
Company Profile							
JV nationality	German	German	none	German	French	German	US
number of employees at your location	10,000	900	915	277	1140	771	700
Facility start date	Sep. 1994	Nov. 1994	Jul. 1994	Sep. 1995	Feb. 1995	Dec. 2001	Jun. 2004
Years in operation (completed)	13	13	13	12	13	6	3
annual sale at your location 2007 (RMB)	13.579B	1.150 B	2.40 B	47.86 M	1.248 B	0.428 B	1.00 B
annual sale at your location 2006 (RMB)		1.000 B	1.67 B	42.951 M	0.951 B	0.335 B	0.720 B
annual sale at your location 2005 (RMB)		0.750 B	1.32 B	28.526 M	0.645 B	0.298 B	0.340 B
Status of use of software in SCM							
production module implemented	X	X	X	X	X	X	X
warehouse stock module implemented	X	X	X	X	X		X
finance module implemented	X	X	X	X	X	X	X
number of modules implemented	6		7	6	5	X	5
number of years using SCM software	4		4	4	3	5	months
using self-developed SCM software	X	X					
using commercial SCM software		X	X	X	X	X	X
looking into using SCM software							
using ERP software	X	X		X			X
basic departmental function establish on computer not necessarily connected together	X	X					
Data input							
at the end of the production cycle	X		X				
per shift	X	X			X	X	
per day	X						X
longer than one day				X			
Data accuracy	db check procedure	okay	very high	accurate	not accurate	gap	

Table 6B Evolution ratings: Interviewed companies that used Supply Chain Management System							
	Comp F	Comp K	Comp M	Comp E	Comp D	Comp H	Comp C
Relative advanced evolution rating	1	2	3	4	5	6	7
Connectivity							
Upstream							
connected to supplier by EDI	X	X				X	
connected to suppliers by own website	X	X					
connected to suppliers by email	X	X	X	X	X	X	X
connected to suppliers by FAX			X	X	X	X	X
Downstream							
connected to customers by EDI	X	X	X	X	X (some)		X
connected to customers by own website							
connected to customers by customer website	X	X	X	X	X	X	X
connected to customers by email	X	X	X	X	X	X	X
connected to customers by FAX		X		X		X	
Automation							
auto scanning of barcode on products in production	Some	X					
barcode on individual shipping product	Customer's req.	X					
barcode on individual production items	nec. or not	X					
barcode on production items by batch	X	X					
barcode on individual intermediate production items	nec. or not	X					
barcode on shipping products by batch or case or lot	Customer's req.	X	X	X	Case		Case
barcode on incoming raw material		X	X				
will start using barcode					X		X
do not use barcode						X	
Flexibility							
1 part 2 suppliers	some	strategy	large quan/sup prob		some	X	
1 part 1 supplier	most	usually	most	nearly all	some		nearly all

Table 7A Evolution ratings: Interviewed companies that used Enterprises Resources Planning System only								
	Comp L	Comp N	Comp I	Comp O	Comp A	Comp B	Comp G	Comp J
Relative advanced evolution rating	8	9	10	11	12	13	14	15
Company Profile								
JV nationality	Japan	German	none	none	German	German	French	Japan/ German
number of employees at your location	1180	1800	277	6400	1700	680	1083	
Facility start date	Feb. 1989	Aug. 1988	1997	Nov. 1996	Feb. 2001	Aug. 1997	Jun. 1992	Jan. 2004
Years in operation (completed)	19	19	11	11	7	10	16	4
annual sale at your location 2007 (RMB)	2.83 B	1.138 B	44.9 M	6.24 B	1.005 B	66.7 B	0.470 B	
annual sale at your location 2006 (RMB)	2.32 B	1.470 B	37.9 M	5.24 B	0.808 B	57.7 B	0.430 B	
annual sale at your location 2005 (RMB)	1.42 B	2.030 B	29.4 M	3.58 B	0.615 B	59.5 B	0.335 B	
Status of use of software in SCM								
production module implemented								
warehouse stock module implemented								
finance module implemented								
number of modules implemented								
number of years using SCM software	this year							
using self-developed SCM software								
using commercial SCM software								
looking into using SCM software	X				X	X		
using ERP software	X	X	X	X	X	X	X	
basic departmental function establish on computer not necessarily connected				X	X	X		X
Data input								
at the end of the production cycle	planned							
per shift								
per day		X	X	X	X		X	
longer than one day								
Data accuracy	some part	not high				100%	good	

Table 7B Evolution ratings: Interviewed companies that used Enterprises Resources Planning System only								
	Comp L	Comp N	Comp I	Comp O	Comp A	Comp B	Comp G	Comp J
Relative advanced evolution rating	8	9	10	11	12	13	14	15
Connectivity								
Upstream								
connected to supplier by EDI								
connected to suppliers by own website		planned						
connected to suppliers by email	X	X	X	X	X	X	X	X
connected to suppliers by FAX	X	X	X	X	X	X	X	
Downstream								
connected to customers by EDI	X	X	X	X	X	X	X	
connected to customers by own website								
connected to customers by customer website	X	X	X	X	X	X	X	X
connected to customers by email	X	X	X	X	X	X		
connected to customers by FAX		X	X					
Automation								
auto scanning of barcode on products in production								
barcode on individual shipping product								
barcode on individual production items	planned							
barcode on production items by batch	X							X
barcode on individual intermediate production items								
barcode on shipping products by batch or case or lot	X	X	X	X	X	Lot	Case	
barcode on incoming raw material			X					X
will start using barcode								
do not use barcode								
Flexibility								
1 part 2 suppliers	vol/risk high	some					large vol sup	
1 part 1 supplier	usually	most	most	most	most	most	small vol sup	usually

5.8.1 Data Analysis

The summaries of the interview results are listed above. After completing an analysis, this writer assigned rankings to the companies according to their relative stages of advanced evolution. Then, the columns for each company were rearranged in order of the most- to least-advanced ranking from left to right. Table 6 shows the seven companies that were already using SCM systems. The ranking continues onto Table 7 for the other eight companies that were still using Enterprise Resources Planning (ERP) systems only, i.e., that had not yet started on SCM systems. Of course, these eight companies using ERP are relatively less advanced and less evolved than the companies using SCM.

First, those factors of little or no importance are discussed below, followed by a discussion of the other, more important factors.

5.8.2 Relative ranking: advance in evolution

As discussed above, this writer developed the "relative advanced evolution rating" scheme (by coupling the SCOR model with wording from SAP's interview questions) to disclose information that could be used to determine the current stage of the company's SCM status. From the results, it is obvious that the lower eight firms in Table 7 with in-house ERP systems only have not really gone passed Stage 1 (Disconnected), while most of the more advanced firms in Table 8 have not gone passed Stage 2 (Interfaced).

5.8.3 Flexibility / Responsiveness: Snow Storm Effect

Most of the companies responded that the snow storm had little or no effect on their operation. However, the fact that Shanghai GM shut down its assembly line twice during the period of the snow storm in southern China helped to alleviate the pressure for products. However, many tier-2 suppliers were seriously affected. But, the ordinary warehouse backup stock and emergency stock were enough for all companies interviewed to supply to the assembly lines during this period.

Since this factor had the same result for most companies interviewed, it was not a useful factor for differentiation.

5.8.4 Flexibility / Responsiveness: Number of supplier(s) per part

The most common result was that most parts had only one supplier. There might be many reasons for this. Firstly, it was established policy to have only one supplier, as bulk-buying would also mean a better negotiated price for the part. Secondly, many tier-2 suppliers were the only qualified suppliers because of parts quality. Thirdly, respondents said that it was much tougher to manage two different suppliers for a single, identical part.

In *Automotive News Europe* (2008, 13/9), Lan and Ciferri reported that VW planned to cut suppliers in China by one-third in five years. This showed that policy had a major effect on the choice of supplier(s) for parts.

As these factors led to similar results for most companies interviewed, it was not useful as a differentiating factor.

5.8.5 Factor not listed: required safety or backup stock.

One of the questions asked concerned the level of safety or backup stock. This was not listed because it was determined only after the interviews that the assembly line asked for this stock level, so it was not a decision that could be made by the parts company, but rather by the auto company.

5.8.6 Connectivity

The only result that stood out concerned the companies that were already using Electronic Data Interface (EDI) to connect to their supplier. While it was a requirement for the assembly lines to be connected to the parts company by EDI, it was a surprise that many of the companies were still reporting that some of their upstream suppliers (i.e., tier-2 suppliers) could only be reached by FAX and did not even use emails for communication.

5.8.7 Automation

Few of the companies had any form of automation started. Shanghai VW required that each pallet of parts shipped to them have a barcode functioning as a label. The majority of the companies had only reached this point in automation, with very few venturing forward to adopt other forms of automation to track stock or finished material,

or material in-process. Very few companies were considering auto scanning of parts during the manufacturing process, while a few more companies were using barcodes for their final products only. There was absolutely no talk of or plans for the use of Radio Frequency Identity Devices (RFID) in their future plans. This is pretty surprising when compared to other industries where RFID is already a matter of fact in the production procedure.

5.8.8 Status in the use of software in SCM

Of course, by definition, this study measures the evolution of the use of SCM systems by auto parts companies; therefore, the specifics of software usage are the most important basis for this comparison.

As discussed, in the case of auto parts companies, the use of ERP systems was a necessary pre-cursor to the use of SCM systems. The eight companies that had only reached the first stage in their evolution were therefore rated below the seven companies that had evolved to deploy SCM systems.

Within the group of SCM system users, those companies rated higher had successfully deployed more modules (including difficult modules) for a longer time, and more importantly, their system's data were trustworthy and accurate. As discussed, a single measure for the performance of SCM was very difficult to determine, but this did not stop the researcher from asking how the interview companies ranked their own performance of the system.

After weighing all the factors, this writer derived an overall relative advanced evolution ranking for each company.

5.9 Propositions acceptance or rejection from results

Depending on the results, this study's propositions were either accepted or rejected.

5.9.1 Proposition 1

> *The evolution of a Supply Chain Management system is dependent on the nationality of the foreign Joint Venture partner in an auto parts company.*
> *A company that has a joint venture partner who is from a more technologically advanced country will evolve faster in the use of SCM than a company that has a joint venture*

partner who is from a less technologically advanced country.

REJECTED

Given the results, this proposition was rejected. There was no correlation in any of the companies interviewed between the country of the Joint Venture partner and the evolution of or even whether SCM systems were considered in the Chinese JV. For example, the two companies ranked as the most evolved in the use of SCM were German JV; but, so were the 12th and 13th ranked companies. Half of the companies interviewed could not even be considered as having an electronic connected SCM system. These could only be classified as enterprises with an ERP system linked by other means to the outside.

5.9.2 Proposition 2

The evolution of a Supply Chain Management system is dependent on the nature of the industry of the auto parts company.
A company that has more complex products will evolve faster in the use of SCM than a company that has a much simpler product.

ACCEPTED

Given the results, this proposition was accepted. It was observed that the more sophisticated, complex or advanced the industry, the faster and more willing a company was to start early deployment of SCM software.

The top rated company is a company where instrument panels are manufactured. Instrument panels are a complex mix of electronic technology coupled with plastic manufactured technology put on a structural frame. The lower ranking companies, however, manufacture metal castings, with the lowest ranking company being an air conditioning company.

However, the correlation was not perfect and there were some exceptions; these exceptions are discussed in more detail in the following chapter.

5.9.3 Proposition 3

The evolution of a Supply Chain Management system is dependent on the number of employees of the auto parts company.

A company that has more employees will evolve faster in the use of SCM than a company that has fewer employees.

REJECTED

With only one exception (the company with the largest number of employees at the location was also the top ranked), the results found no indication that companies having more employees would lead to faster deployment and evolution of a SCM system.

5.9.4 Proposition 4

The evolution of a Supply Chain Management system is dependent on the sales volume of the auto parts company.

A company that has more sales volume will evolve faster in the use of SCM than a company that has much less sales volume.

REJECTED

As with Proposition 3 (the only exception was the top rated company, which also had the top sales volume), the results show no correlation between companies with higher sales volume and faster deployment of or more highly evolved SCM systems.

6 Discussions, Limitations and Conclusions

6.1 Discussion

While most of the studies on SCM have been on the design and optimization of the supply network as a static system, this study is on the evolution of a supply network as a *dynamic* system. Although the structure and collaboration mechanisms of a supply network might be static in the short term, these will evolve in the long run.

Li et al. (2009) wrote that with changes in the environment, the firms, coupled with its adaptive capability responding to such changes, made the necessary adaptations fitting their study of the "Evolution Complexity of Complex Adaptive Supply Networks". This study illustrates some of the factors that would or would not cause the firm to evolve.

6.1.1 Proposition 1

It seemed intuitive that the more technologically advanced the foreign JV partner, the more likely it would be to force its SCM system onto its Chinese JV operation (Proposition 1). However, this was not found to be the case. Was nationality the wrong factor to use as a measure? Might ethnicity or company culture have been a better measure? Hult, Ketchen and Nichols (2002) combined three factors in the term Cultural Competitiveness: Entrepreneurship, Innovativeness and Leaning. Sheu et al. (2004) broke down national differences into six subcategories, which were culture and language; management style; government/corporate policies; regulation/legal requirements; internal technical personnel resources/labour skills; and geography/time zone. Could the use of Hofstede's cultural dimensions that characterize Chinese culture in terms of low uncertainty avoidance and high collectivism be a better measure?

As discussed above in the development of the propositions, Van Ecerdingen et al. (2003) found that high-context and polychromic cultures such as China's had significantly lower ERP adoption rates than low-context and monochromic cultures. However, it was very difficult during the interviews to access a company's culture given the short duration of the interviews and the question as

to how much those individuals being interviewed correctly portrayed company culture.

Another surprising finding in the case of one company was the fact that the decision to advance to the deployment of a SCM system was initiated by the Chinese partner and not the foreign JV partner.

Another unexpected point came up in the interviews. In several cases, the foreign JV partner did not want to increase its investment in its JV. Some companies found the deployment of a SCM system expensive due to the purchase of the software, annual licensing/user fees and other deployment costs such as internal training. They also found that the financial return did not justify the investment.

Given that cheap labour costs are one reason why foreign JVs are in China to manufacture, using cheap and unskilled labour (for the physical counting of inventory, to make up for inaccuracies in warehouse data) is a much cheaper, but less efficient way to make up for some of the deficiencies of a non-SCM system. Just for the sake of argument, if one could disregard connectivity and other important capabilities that are achievable with the use of a SCM system, then using manual ways of counting or tracking the physical movement of inventory would still be an acceptable, though less efficient, less accurate way of getting the work done.

Based on transaction cost theory, even though the cost of each transaction might be cheaper with a SCM system, the capital investment necessary to acquire, deploy and manage the system would far exceed the financial benefits. In a research report by Nucleus Research in June 2007, a survey showed that for one brand of SCM systems, 34% of customers surveyed indicated that they were unlikely to ever achieve a positive ROI without changes in their deployment. This was attributed to the fact that annual ongoing costs were greater than the value of benefits received. At least for this system, even the cost for each transaction might be higher than the use of any other means.

This study found that the top two ranked companies did their own software programming in-house and used self-developed SCM systems. By doing so, these companies significantly lowered the total cost of using a SCM system. Since the systems were self developed, there was more commitment from company staff to see that these systems functioned correctly and efficiently.

A company whose process is different from that offered by a SCM software vendor would be faced with the task of Standardization, i.e. writing a program to adapt the standard package software to the company's actual process flow. Standardization is a major, some would say additional, cost in SCM software implementation. There is no way to get around the cost of standardization as the software would simply not be useable if standardization is not done.

As it would not be productive to investigate the rejection of this proposition on its own, a holistic approach for explaining the findings follows.

6.1.2 Propositions 3 and 4

Propositions 3 and 4 were both rejected as the evolution of SCM systems did not show any correlation with the physical size (i.e., number of employees or sales volume) of those companies studied. Again, this result was somewhat surprising, as it seemed intuitive that organizational size should matter. And again, what seemed intuitive was proven wrong. However, there seems to be an exception to this result in this study. The top ranked company (i.e., most evolved) also has the most number of employees as well as the highest sales volume of all the companies interviewed. This is contrary to the findings in the literature. Most findings (Mabert & Venkataramanan, 2003; Nguyen, Murphy & Olaru, 2003; Kamaruddin & Zulkifli, 2008) established that the organizational size had a positive influence on the adoption of Supply Chain technologies.

However there is also a body of literature that shows the contrary. Patterson, Grimm and Corsi (2003) suggested that smaller firms were more likely to be innovative because of the flexibility afforded by smaller size and fewer levels of bureaucracy. Iskandar, Kurokawa and LeBlanc (2001) found small firms could more readily adapt to changes in technology, manufacturing processes and market forces than could larger firms. They also found that smaller firms, although often lacking the financial resources, tended to be more innovative, flexible, responsive and less bureaucratic; therefore, these smaller firms had a greater incentive to adopt and integrate EDI.

Given that two opposing bodies of literature exist on the effect of organizational size on the adoption of technology (indicating two or more opposing forces at work), the rejection of these propositions is not entirely surprising. A different line of questioning designed to

separate these forces, if possible, would be needed to identify the influence of these forces.

6.1.3 Proposition 2

Proposition 2 was the only proposition accepted. Once the company rankings were arranged in order, a trend could be observed. Those companies with the most advanced or most highly evolved functioning SCM systems were the more technologically advanced, having to manage more complex systems. On the other end were the less technologically advanced companies that had not evolved past the stage of using an ERP system only. These companies were from the more basic manufacturing industries, i.e., springs, axels, metal castings and air conditioning.

Examining the cost issue again, these basic industries might have been under higher cost pressure to lower manufacturing costs as their products were "lower" tech, which means the existence of more competitors able to compete even in the high quality demand automotive environment. Also, "low-tech" products can not command a higher markup as can high-tech products. Without the higher markup or margins, these companies might not have been able to justify spending the large investment necessary to deploy SCM systems.

Another observation is that these low-tech companies might also have had lower or less advanced management ability. An example was gathered from other sources. It was learned that the Managing Director from one of these less advanced companies was recently replaced in January 2008. That company had been known for its chronic management problems for quite some time. The logistics and purchasing managers in these less advanced companies might not have been in a position to get senior management to buy-in and deploy a SCM system as the process is very long, difficult and costly, and there are no guarantees to show such adoption will be successful. The success rate of implementation of SCM is also not favorable. Ge et al. (2009) found that in China most ERP implementation projects seemed not so "successful" in terms of budget, schedule and expectation.

If motivation was not based on cost, then what motivated the other companies to deploy SCM systems? Hines's (1995) view of organization and networking theory stated that these networks existed because of the need to exchange resources. Since using SCM

systems was all about the formal linking of these networks and exchanging resources, it was easy to see the tie between networking theory and SCM systems. However, power and trust were the elements in this theory.

In the interviews, some parts companies aired the opinion that the auto assembly lines still did not trust the parts suppliers enough to open up their SCM systems to them. On the other hand, one auto company expressed the opinion that the parts suppliers were now gaining power to the point where the parts suppliers might not be prepared to fulfill 100% of the parts ordered from them. There were many reasons behind these power struggles. The first one was a lack of resources and investment. In 2005 and 2006, the common prediction among researchers was that China's passenger car industry would soon have an excess of manufacturing capacity. This writer attended a presentation at a doctoral seminar where just such a prediction was argued. In reality, the opposite occurred. Those auto parts manufacturers who had listened to this school of thought (i.e., that there would be an excess capacity) would not, of course, have increased future investment in their Chinese manufacturing facilities. They might have even decreased their capacity in anticipation of this excess. They were caught when auto sales continued to increase and the predicted excess capacity never materialized.

As investments into capacity expansion in auto parts manufacturing take years, the result was that many parts manufacturers found themselves pressured to increase capacity, but could not do this enough to meet current demand. Some manufacturers, anticipating a future slowdown or even a downturn in demand, still decided not to increase capacity. Consequently, there was a shift of power as parts manufacturing capacity was strained and assembly lines found that their orders might not be fulfilled. The assembly lines, for the first time in their existence in China, found that these suppliers (most of whom were bought over by them from abroad) might even ration parts and not entirely fill their orders. It might have been a good strategy for these suppliers to seriously investigate and apply Cachon and Lavriviere's (1999) advice in the article "Capacity Allocation using past sale: When to Turn-and-Earn."

Under these circumstances, both resources based theory and network theory would have favored the establishment of formal networks like those created by the deployment of SCM systems, i.e., connectivity. If these networks were established, a company would be in a more favouable position to compete for, secure, lock-in or

control limited resources from a supplier when compared to companies without such formal networks.

These conditions applied not only to tier-1 suppliers, but also to tier-2 suppliers as well; it was an industry-wide phenomenon at the time. However, if there had been a downturn of the industry, then the power structure and demand would have shifted the opposite way. How would the same parts suppliers have reacted then? It was exactly this connectivity and automation that those companies still using ERP systems only did not have; and, it was difficult, if not impossible, to do manually.

It might be just a matter of time before the other eight companies get connected if they are to stay relevant. However, under current conditions, this study has been able to observe the current factors and their influence (or lack thereof) on the future development of SCM systems. But, arguably, it might *not* be a matter of time before the other companies evolve as it has already been shown that if there is not a "need," companies do not necessarily evolve to a more advanced state, i.e., their status quo would be sufficient, depending on the complexity of their manufactured product.

Revisiting the two research questions, we can see that this study has provided these answers: neither the nationality of the foreign JV partner, nor the sales volume or number of employees causes advancement in the use of SCM systems. However, the more complex the auto-part, the more likely the parts company is to evolve to use the most advanced SCM system available.

The writer believes that this finding has a very practical use for the practitioner. Companies should not simply force the use of the SCM systems used in their home countries to their Chinese JVs without considering what this study has shown.

6.2 Justification of assumptions

One assumption made in this study is that each company interviewed had essentially the same amount of time, or enough time, to evolve and start using a SCM system at any time they so chose. As stated above, Pathak et al. (2007) argued that entities within these CASNs would make choices concerning adaptation and survival. These systems would evolve over time and also self-organize as a response to their environment. So, these firms could choose and adopt a more advanced use of SCM if needed.

In terms of the company profiles, Company J had the lowest ranking in evolution; with a company history of only four years, it was also one of the two youngest companies. This company truly might not have had enough time to start their SCM systems. However, Company C (ranked seventh) had even less time since its start, having completed only three full years at the time of the interview. This illustrates that there would have been ample time if the company J had been committed to deploying a SCM system. Therefore, the assumption made has been shown as a valid one supported by the results.

6.2.1 Justification of the Variables

This researcher is well aware that the term "Evolution of SCM" is rather new in the literature, but given that every process does, and should, evolve, decided to use this as a variable nevertheless. A re-examination of the use of this term based on the study results is now warranted.

After the interviews, it was abundantly clear to this researcher that those who set out to deploy and implement SCM had only very vague ideas of what they could achieve at the first pass. Not one single entity interviewed used a one-step approach to get to its present position. This was just simply impossible. Therefore, the implementation of any SCM system took many, sometimes baby steps (step functions in learning) to get to what a company would find useful. It was common to see that only after the first modules were successfully deployed would attempts be made to add additional modules. If there were failures, then adjustments would be made to rectify the problems. The company would even abandon certain processes if these did not work. The term "evolution" represents precisely this overall process.

6.2.2 Justification of Methodology

As its methodology, this study applied the SCM evolution model used by SAP, the largest SCM systems supplier in the world. Then, a line of questioning was designed to identify the stage of the firm's evolution within this model; this was done by evaluating for the six separate attributes listed for identification (see Section 3.5.3; table 3). This was believed to be the most proven, realistic and relevant evolution

model. Justifications for the other variables are discussed in the above section.

In hindsight, it is clear that using questionnaires and surveys would not have worked for this investigation. The typical survey or questionnaire found in the published literature (where quantitative investigations were more likely to get published) asked the respondent to compare his/her company to its peers in the industry or to self-rate the company. From the interviews, it is abundantly clear that this transparency was not present in the Chinese auto parts industry. Those interviewed were usually the lone suppliers and many did not know or care who their competitors were. And, all were subsidiaries of the same group, SAIC. Furthermore, those interviewed knew very little about how their sister companies within the same group used SCM.

This author offered to run a seminar where the results of this study would be presented. And while the offer was well received by those who were interviewed, unfortunately this author has still not received support from management to host such an event. Those interviewed welcomed such an opportunity to get to know their peers within their own auto group. Again in hindsight, using the case study method was the only practical way to perform this investigation, along with incorporating the support of academic arguments as discussed in Section 4.3.

6.3 The holistic approach to interpreting this study: Complex Adaptive Supply Network (CASN)

This study should be viewed in its entirety and not on the rejection or acceptance of individual propositions. The study was an evolutionary process, which, of course, was time dependent—a "snap-shoot" of a dynamic system. While the acceptance of Proposition 2 is crucially important (i.e., that product complexity is positively correlated with more advanced evolution of SCM), the rejection of the other three propositions should not be brushed off as being of little use. The writer has argued that it is the combination of these propositions and results that really brings out the implications of this study.

The rejection of Propositions 1, 3 and 4 is as important as the acceptance of Proposition 2. In fact, the implications of this rejection—that neither the nationality of the JV partner or the organizational size as defined by the number of employees or the sales volume have an impact on the evolution or the adoption of

SCM— emphasize more of what this study has shown. These were all important variables, but they were all outweighed by the single motivation that caused the evolution: the perceived NEED stemming from the environment.

Recalling one of the original articles that led to this study, we find this statement by Li et al. (2010): "One of the major challenges for Supply Chain managers is to develop a network structure and collaboration mechanism that can facilitate adaptive, flexible and synchronized behaviors in a dynamic environment." They also wrote that "researchers are still only in the early stages of investigating the general principals that govern the birth, growth and evolution of supply networks with complex network structure and mechanism for collaboration." They argued that in order to successfully solve this problem, a supply chain should be treated as a Complex Adaptive Supply Network (CASN). Pathak et al. (2007) also argued that entities within these CASNs would make choices concerning adaptation and survival. These systems would evolve over time and also self-organize as a response to their environment. Surana et al. (2005) showed that the concept of CASN allowed a supply chain to be understood as a living system, which would adapt and co-evolve with the dynamic environment in which it existed. They also showed that the patterns that arose in such a condition of co-evolution would be identified.

This study has come full circle. There could now be another study, one of only a handful, supporting the reasoning that a SCM should be treated as a CASN. The components in these networks would adapt and evolve because of "a need to," as exerted by forces in the environment, above all other variables. This would explain rather important conclusions, including that the nationality of the JV partner had little to no effect on the evolution of SCM. It also corroborates this study's observation that the more complex the product, the more the firm was forced to adapt out of need to advance its SCM usage.

6.4 Practical applications from findings

The study started with the need to provide answers to questions from a practitioner starting a Chinese manufacturing JV. How is the deployment of SCM systems in China different from the deployment of such systems in a company's home country? What factors affect this determination? This study has determined that the answer would not depend on factors such as the country of origin of the practitioner,

or the size of the firm in terms of sales volume or number of employees. In the companies interviewed in this study, the answer depended heavily on the complexity of the product that was manufactured. The reason behind this was the evolutionary pressures of the business environment forced onto the firm. It was simply a natural response to survival in a harsh business environment.

Forcing the Chinese JV to adopt a very advanced stage of SCM usage might not be necessary, indeed, might even be wasteful if the product produced were relatively non-complex. But if the product were complex, it is most likely that the Chinese JV would need to be very advanced in the use of SCM in its operations.

6.5 Research finding and fit with SCM theory

To repeat what has been written above, the findings from this study are best explained as follows: the firms using SCM were, in fact, behaving as if in and connected to a Complex Adaptive Supply Network. This finding represents one more study in support of using CASN towards explaining SCM behavior, something very few publications have done. Of course, it is hoped that future studies into SCM behavior will consider adopting the use of CASN to explain their findings.

6.6 Limitations

This study was a "snap-shot" of an ongoing phenomenon, a dynamic system. If it were possible to conduct, a time-series or longitudinal study over an extended period would likely yield different findings.

The study did not have access to information on the strategy of the companies interviewed, at least, not from senior management. Without these, the study was only able to second guess the strategy based on observing the company's behaviour.

This study is based on only one automotive group. Even though it is the largest Chinese passenger car manufacturer, SAIC might not be representative of all Chinese auto manufacturers. And, the results might not be transferable to other Chinese industries. Nevertheless, it is the first study of its kind.

One very important limitation was the lack of access to financial figures. If these data had been made available, then two

out of five of the major performance attributes in the Supply-Chain Operations Reference (SCOR) metric would have given both the Supply Chain Cost and Supply Chain Asset Management Efficiency (Cohen & Roussel, 2005). With these data, more rigorous measures could have been factored into the design of propositions. But, unfortunately, these were not made available. Not that it mattered, however, as the literature indicated that a so-called "one measure" value of performance for SCM was probably not meaningful and difficult to operationalize.

The ranking of stages of relative advanced evolution could be made even more rigorous if an even more elaborate system could be found.

Since China is a "high context" culture, the results from this study might not be accurately transferable to a different culture.

6.7 Conclusions

What seemed intuitive was proven not to be the case in this study. This study found that the evolution of a set of auto parts manufacturers supplying to essentially the same auto assembly lines were in different stages of evolution with respect to the use of their SCM systems. Key findings include that factors such as the size of operation, sales volume or nationality of the JV partners were not determinants in the evolutionary process, but that the nature or more specifically, the complexity of the product of the industry was. The findings fit nicely into the theory that SCM should be treated as a Complex Adaptive Supply Network (CASN), explaining this behavior as stemming from the need of each part in these complex systems to adapt and evolve to the business environment surrounding it.

6.7.1 Future studies

Ideally, this study would be allowed to continue so that a time series or longitudinal study of the companies could be generated over several years. Furthermore, if a second Chinese automotive group (such as First Auto Works of Changchun) would allow a similar study to be performed, there would be a better chance to test whether the same prepositions would be accepted or rejected. Then, maybe a generalization would be possible. More studies of the phenomena around the adoption and evolution of SCM systems in business

operations should be carried out on a greater number and variety of Chinese industries. Lastly, it is hoped that further studies could show if these phenomena are unique to companies in the Chinese context or whether they could extend across other cultures or countries. Further studies following the lines of development of CASN that resulted in practical guidelines for SCM development strategies would be very useful to practitioners.

One regret of the researcher concerns the fact that all the firms in the study were subsidiaries of the same auto group. From the literature survey, it was abundantly clear that different relationships would affect SCM behavior differently, but as there were no deviations from the parent company / subsidiary relationship for all the firms studied, none of the effects of this theory could be separated and observed.

Another regret concerns the inability to study the effects of culture. Besides the mention of national culture clearly spelled out in the rejection of Proposition 1, this study did not look at the effects of culture on SCM adoption and evolution. The firm's culture (more specifically, the culture of the use of IT in the firm) is also a factor that should be investigated for possibly having an affect on SCM evolution.

The results of future research into these topics would make wonderful additions to a fuller understanding of SCM behavior.

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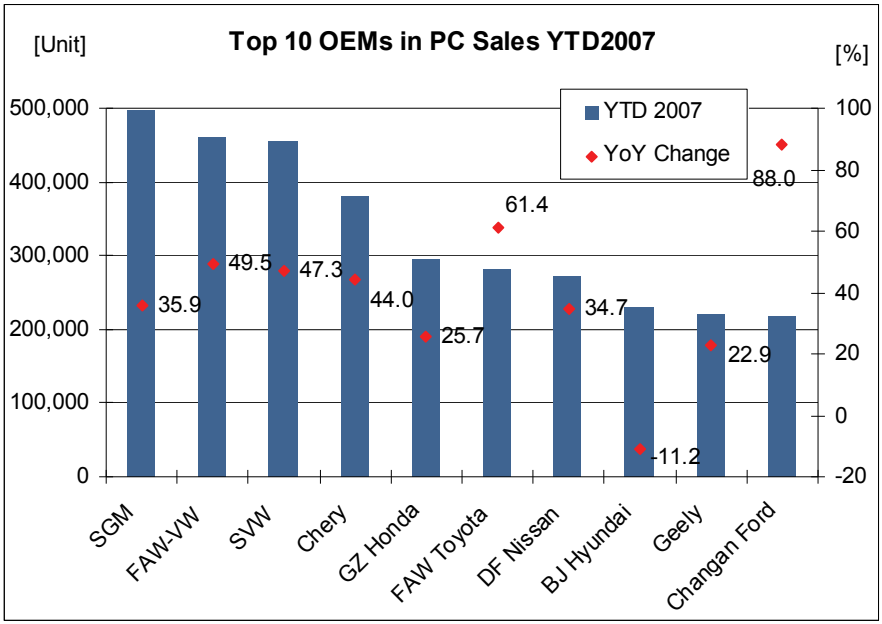
8 Glossary

CAS	complex adaptive system
CASN	complex adaptive supply network
CKD	complete knock down
EDI	electronic data interface
ERP	enterprise resources planning
HR	human resources
IT	information technology
JIT	just-in-time
RFID	radio frequency identity device
SCM	SCM
SCOR	supply-chain operations reference model
SKD	semi-knock down
VMI	vendor managed inventory

9 List of Appendices

Appendix 1

Passenger Car Sales in China for 2007



Source: SAIC

Appendix 2

Proposal to Shanghai Auto Industry Corp

A Proposal to study the Supply Chain of SAIC group of companies

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Mission

To study the supply chains, it characteristics and its performance in the Shanghai Automotive Industry Corp group of companies based on the supply chains of SGM, SVW and SAC personal car company.

Introduction

As we have seen from the evolution of automotive companies elsewhere, quality issues will come to past as production increase and with it, an increase in quality by parts suppliers with improvements in their quality systems and manufacturing experience.
The next arena for competition and acquiring sustainable competitive advantage is in the supply chain.

Wal-mart became the largest retailer in the world as it pioneered several of the current practices in SCM. Practices like Vendor Managed Inventory (VMI), Cross-docking, and Radio Frequency Identification (RFID) were first put into practice by Wal-mart. Many of these are now practices adopted across different industries and in different countries.

With much difficulty, the largest supplier of the world's office furniture Steelcase transformed its operation to a fully automated system on a 1-system across all operations and all location SCM system. The transformation has been written into a case study by this consultant. From this case study, one can have many learning to the difficulties encountered and how Steelcase managed to overcome these. It remains the largest office furniture supplier in the world and with the successful implementation of this system; it has acquire new competitive advantages.

Then there is the case of Barilla, when in the 1980s adopted the Just-in-time (JIT) system of manufacturing. Then it was only a small pasta manufacturer in Italy with a small local distribution network. Barilla continues to improve using practices to strengthen and manage its supply chain. It is now the largest supplier of spaghetti and pasta in the world.
Many more examples can be shown how companies use SCM to become the world most dominant and important supplier.

There is no other supply chain that is more important than in an automotive assembly operation. The consequence of downtime due to shortages of parts is astronomical. Car companies must know how to improve on their supply chain in order to compete in the future. Of course, there are quality problems causing material shortages, but this are but one of many factors affecting the efficiency of the supply chain. Before a car company can improve on its supply chain, it must

know the characteristics of its supply chain, how each of its links are performing, what works and what does not work, why does some links works better and some does not perform as good.

The parent company who owns both the car manufacturers and parts suppliers has much to gain from knowing it supply chain performance. It can than decide on strategies towards growing certain part of the operation and what not to invest in. Such decision can only be arrived after data from such study is analyzed. With intimate knowledge of the supply chain, the parent company will know how to manage each of its links to acquire competitive advantages to compete from it supply chain.

What is needed?

The most important is a clear massage (a letter for broadcast and another letter carry by the interviewers) from SAIC group's management on the importance of this survey and asks all companies, whether it is wholly owned or JV or unconnected suppliers, to lend support by participating in this study to the best of their abilities. It is also important to put in the letter to enforced the idea that they are not survey or whether they are good or bad suppliers but on the characteristics of their operation (workflow, process etc). This study is to be use for future planning and realization of where each company stands in the supply chain.

The consultant will need an assistant. The idea behind this is 2-fold. The assistant as a worker and the assistant as a trainee and eventual lead person for future or follow-up investigations.

As a worker, this assistant should have basic understand of the working/structure of SAIC group of companies and also must have worked in either SCM or logistic and/or planning. The assistant will do the basic gathering of company data/history etc. The assistant will also contact each of the companies to set up the appointments for interviews or follow up interviews. The assistant will travel with the consultant to these company and participate fully in these interviews. The assistant with the consultant will sort the data for analysis, prepare analysis and eventually presentation of study result. For the benefit of the consultant, the assistant should have good English skills.

From doing these interviews, the assistant will have enough experience to perform other interviews or follow-up interviews without the presence of the consultant. It is hope that after the study, the assistant will become the lead or key contact person for the group's entire supply chain and also become the group's most knowledgeable supply chain person. The assistant will have a full understanding of the analysis and why any conclusions were arrived at.

As the study was first thought of by Mr. Yang, the consultant requests that Mr. Yang be the designated person that the consultant will report to and receive instructions from.

The consultant asks for no monetary benefits in return for this study. However, the consultant will like to have a proper workplace (a desk) to work in close proximity with the assistant. The consultant will like to have proper identification to access the SAIC headquarter building and the use of the cafeteria for meals. The consultant requests that the assistant should have a car or the use of a car to go to onsite interviews. The consultant asks that SAIC to repay the assistant the standard company rate for all expenses incurred from these necessary travels. If there are any foreseeable extraordinary expenses that maybe incurred, the consultant will request an approval beforehand. The consultant request that if other equipment may be needed for the study, that it will be supplied to the assistant.

The consultant requests for the inclusion of several questions on establishing the company culture of those being interviewed. The consultant will use this data for a study to be published. However, before this report is made public, a copy will be submitted to Mr. Yang to ask for SAIC's clearance to use findings from the study.

Needless to say, the consultant will sign a secrecy agreement with SAIC before the start of this study. Support is needed from SAIC to request data from the companies to be survey that they co-operate and provide the necessary data and/or document needed for this study.

Proposed Course of Action

Stage 1	Proposal to SAIC management
Stage 2	On acceptance of proposal, select assistant and perform pre-study data gathering
Stage 3	Draft of survey questions and consultation with Directors/Managers of Logistics of SVW, SGM and personal car company
Stage 4	Perform survey/interviews
Stage 5	Result sorting and analysis. If necessary, ask for follow up interviews or clarifications.
Stage 6	Presentation of results and analysis

Consultant's schedule and availability for the study in the next 6 months

May 14 to June 9 (4 weeks) proposed first round interviews in Shanghai

(June 23-July 20, consultant teaching in Hong Kong on weekdays M-Thurs mornings)
June 29 – July 2 consultant can be in Shanghai
July 5 – July 8 consultant traveling with students in Shanghai
July 20 – July 28 (1 week) consultant can be in Shanghai
August 13 - Aug 24 (2 weeks) consultant can be in Shanghai. Ideally this will be the presentation of results and analysis.

Of course, for all other times, the consultant is accessible by email and telephone. This will be the form of communication between consultant and assistant when the consultant is not in Shanghai. The assistant will have a heavy workload on his own gathering data from the car manufacturer as well as the suppliers. The consultant is at a disadvantage in doing this task.

Discussion of proposed study/survey with SVW Division Manager, Logistics, Xu QingQiao

When asked if a study is performed to its supply chain, what are the questions that she wants to see answered in this study; Ms Xu came up with these questions:

1. SVW help developed many of the suppliers for the past 20 years. SVW was once the most important customer of these suppliers, but now others car companies may have surpass the importance of SVW as a customer to these suppliers. What is the current view of the relationship between SVW for these suppliers? That is, SVW has a certain view about these suppliers, but is it the same opinion from the suppliers' point of view?
2. As the customer - supplier relationship is a 2-way street, what is the supplier's holistic rating of SVW as an organization?
3. The flow of information (communication/data) and the flow of goods are not aligned or matched. It is difficult to align these two flows, what style of communication, or what common platform must be used to make this alignment? What system is good? What system is bad? Knowing well that if 200 suppliers out of 400 adopted such a system/platform for communication, it is already a very good adoption rate.
4. With many customers each supplier now has, how does the supplier rationalize the relationship between, price, required quality, resources needed to be committed and how much to supply each customer? In other words, what are the medium and long term planning for the supplier? These decisions may have to be made at a very high strategic level, i.e. what are the resources planning of the suppliers? It is necessary to know as SVW needs to know how to manage each supplier differently.

5. For CKD and SKD suppliers, what is it relationship with its parent company? For example, how do they handle problem solving?
6. If SVW is willing to share information in one system common to all, does the supplier has capability to share "real" information? Will the supplier share "real" information?

Basis of Study/Survey

The study/survey will be conducted by onsite interviews of directors or managers of supply chain or logistics or purchasing. It will be studied along the supply chains of SVW, SGM and SAC personal car company. It will be a list of questions (NOT a questioneer) asked by both the consultant and assistant. These questions will NOT be supplied to the interviewee before hand. We will request a minimum of at least 1 hour of the interviewee's time. More if it is a major component supplier of that it supplies a variety of products or if it has other complicating issues.

As this is the first systematic study/survey of the supply chain, a decision must be made initially how complicated this study is to be conducted. The more complicated it is, the more time consuming it will be and more likely the supplier will be less co-operative with their time and information. Then there is the problem of information overload and the study may be out of unfocused, i.e. study and measure too many factors and cannot arrive at any conclusions or trends or observations. This will establish the Scope of the Study.

In Table 1, the performance attributes of a supply chain are listed. Management can selected to measure only the most important functionality of the supply chain, which is shown in the first row under Supply Chain Delivery Reliability.

Table 1 Supply Chain Performance Attributes

Performance Attributes	Performance Attribute Definition	Level 1 Metric
Supply Chain Delivery Reliability	The performance of the supply chain in delivering the correct product, to the correct place, at the correct time, in the correct condition and packaging, in the correct quantity, with the correct documentation, to the correct customer.	• Delivery Performance • Fill Rates • Perfect Order Fulfillment
Supply Chain Responsiveness	The velocity at which a supply chain provides products to the customer.	• Order Fulfillment Lead Time
Supply Chain Flexibility	The agility of a supply chain in responding to marketplace changes to gain or maintain competitive advantage.	• Supply Chain Response Time • Production Flexibility
Supply Chain Costs	The cost associated with	• Cost of Goods Sold • Total SCM Cost

	operating the supply chain.	• Value-added Productivity • Warranty/Returns Processing Costs
Supply Chain Asset Management Efficiency	The effectiveness of an organization in managing assets to support demand satisfaction. This includes the management of all assets: fixed and working capital	• Cash-to-Cash Cycle Time • Inventory Days of Supply • Asset Turns

Source: Cohen & Roussel, *Strategic Supply Chain Management*, McGraw Hill, 2005.

There is nothing more important than measuring: ***The performance of the supply chain in delivering the correct product, to the correct place, at the correct time, in the correct condition and packaging, in the correct quantity, with the correct documentation, to the correct customer.*** This will be one of the important Factor of this Study.

SVW have between 400 to 500 suppliers or at various stages of being approved as a supplier. With such a large population, it is impossible to interview every supplier. A hierarchy of study/survey candidate selection criteria will be established. For example, those who supply major components to all 3 car companies and are subsidiary of SAIC will be selected first. This may already narrow the population down to the 70 on so within the SAIC group of companies. However, a sampling of non SAIC group suppliers will be added so as to provide a correct representation of suppliers for this study. This will establish the Population of the Study.

This study is for the benefit of SAIC as well as the car companies, so as such, the directors/managers who are involve in the planning or logistic will be interviewed and consulted on what they want to know from this study. This direct input is necessary because if it is information that they wants, then the car companies will support this study. Ms Xu at SVW has already posted questions that she wants to be answered from this study. Looking at the performance attributes that this study is proposing to measure, it will definitely NOT supply the answers to her questions.

The consultant is also in the opinion that the measurement of "hard factors", i.e. delivery performance, fill rates, perfect order fulfillment etc. will only show the overall performance of an individual supplier, but will not show the "how" or "why" or characterize the individual suppliers. It will definitely not explain why the supplier behaves the way it behaves. Obtaining these hard factors will not need a completed questioneer or require an onsite interview. The car companies may have these data already.

It is the acquisition of data for the "soft factors" that need an onsite interview. These are the information that will characterize the supplier beyond obvious factors like ownership, i.e. it is wholly owned or a JV or unrelated to SAIC; or whether it is CKD or SKD. The questions asked in the onsite interviews are to find out how a supplier will behave and why it behaves in such a way. It is hope that the study will review characteristic that allow us to separate suppliers into logical groupings. If these trends and grouping are observed in relationship to the supplier's performance, then the car companies will be in a better position to use the right strategy to manage each individual supplier or groups of suppliers.

The consultant is proposing that one of these measures be the culture or company culture. From the consultant's current research, it is highly likely that a possible grouping is along the lines of company culture. It is also most likely that along the lines of each car companies, i.e. Shanghai GM (a US JV), Shanghai VW (a German JV) and SAC (a totally Chinese company) that different supply chain behavior may be observed from the SAME parts supplier. As such, we may observe that each supply chain is affected by the car company as much as by the parts supplier. Therefore, we may be investigating 3 different and unique supply chain relationships.

The onsite interview questions will be design along the lines of getting the supplier to tell us how they behave and why they behave that way (i.e. their culture) but in the CONTEXT of supplying parts to each car company. We will also ask the director or managers of the car companies to review these questions that we are going to use at the interviews and solicit their comments and suggestions. Whenever possible, we will incorporate these into our questions before we proceed to the actual interviews.

Already, most current research has shown that good guanxi facilitates a good supply chain. We will also look into the role guanxi plays in a supply chain relationship. This positive correlation may already be intuitive to some of us, but we will keep an open mind until the study show whether this relationship holds.

The maturity of a supplier with respect to SCM will also be another possible grouping. The study will help to review at what stage of evolution each interviewed supplier is at with respect to its supply chain operations.

This study is but a small but very important first step to reviewing the "whole picture". Once this study is done, then what to do with the conclusions from these observations can then be discussed. How to couple this with overall company strategy and selection of supply chain strategy can also began. At that point, current models of strategy can be considered. The need to measure other factors many also be apparent then. The decision whether to measure factors that will lead to establish benchmarking may also be considered. But those are beyond the scope of this study and should only be consider after this study.

From the results, it is most likely that it will be observed that there may be divergence of strategies between the part suppliers, the car manufacturers and SAIC. If this is observed, than it is important for SAIC to consider how to align these strategies to get the most out of the supply chain and convert these threats into a competitive advantages. In the end, it is the overall strategy and well being of SAIC as a group that has most to gain from this study.

It is towards presenting a clear and concise report with conclusions based on analysis of data acquired during this study that the consultant will spend most of his effort in doing, so that top management at SAIC can make strategic decisions based on this finding.

The Next Step

The consultant waits for a favourable answer to proceed with this study. Once it is approved, the appointment of an assistant will be necessary to start the study.

The consultant is schedule to meet with SGM's manager of logistics on Apr 10.

Appendix 3

Proposal to Shanghai Auto Industry Corp in Chinese

上汽集团供应链研究项目建议书

提交人：Sam Chiu （趙資靈）

2007 年 4 月 9 日

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任务

以上海通用, 上海大众和上汽乘用车分公司为基础，研究上汽集团企业供应链的特点和绩效。

概述

正如别的汽车公司的发展历程所表现出来的那样，质量问题终将成为过去，原因是产品数量的增加，以及由于汽车零部件供应商具有了改良的质量管理体系和更为丰富的制造经验，使其所提供的配件的质量得到了提高。

若想使公司在以后的竞争舞台上获得持续竞争优势，就需从供应链着手。

沃马特凭借它先进的供应链管理实践经验，一举成为世界上最大的零售商。像供应商管理库存，接驳式转运，无线射频识别等技术都是由沃马特率先应用到实践中的。其中许多技术已被多个产业和国家所采用。

作为世界上最大的办公家具的供应商，Steelcase 公司克服多重困难，将其运作体系全自动化。这个全自动化体系把所有的业务和本地供应链管理系统合为一个整体。这个改革被本顾问写入为典型案例。学习这个案例，人们能够了解 Steelcase 所遇到的困难及 Steelcase 是如何克服它们的。通过这一体系的成功实施，Steelcase 保持了世界最大的办公家具提供商的地位，并且获得了新的竞争优势。

接下来是 Barilla 案例。20 世纪 80 年代，此公司应用了 JIT 生产系统，在此之前，Barilla 只是意大利一家很小的意大利面食生产商，只有很小的当地分销网络。应用即时生产系统后，Barilla 不断加强和控制其供应链，从而成为现今世界上最大的意大利面食供应商。

很多实例可以显示出这些公司是如何应用供应链管理而成为世界上最强大、重要的供应商的。

比起其它行业，在汽车装配业中，供应链所起的作用是最为重要的。因缺乏零部件而停工所造成的后果是无法估量的。所以，汽车公司必须懂得如何改进它们的供应链以应对未来的竞争。当然，也有因质量问题而导致材料缺乏的情况，但这只是影响供应链效率的众多因素之一。在一家汽车公司开始改进它的供应链之前，必须了解它的供应链的特点所在，如供应链的各个环节是如何运作的，哪个环节运转良好，哪个不能运作，以及为什么有些环节运转的比较好，而有些运转不灵。

了解供应链的运作，拥有汽车制造商和零部件供应商的总公司可获益颇多。它有助于公司决定投资策略——哪些业务环节需要增加投资，而哪些环节不宜。这种结论只有在分析这个研究的数据后才能得出。有了对供应链的熟知，总公司就会了解如何控制供应链的各个环节，以使其获得极大的竞争优势。

什么是最需要的？

最重要的是，上海汽车工业（集团）总公司的管理层应该明确传递这样一个讯息（下发一份通知，调查者持有一份），即这次调查很重要，请所有的公司—无论是全资企业、合资公司，还是独立的供应商—尽可能地对这个调查提供支持。同时，还应在函件中强调这一信息，即这项研究不是调查这些公司本身是否是优秀的供应商，而是调查它们运作的特点（如工作流程等）。这个调查将用做未来规划及认识未来这些公司在供应链中所处的位置。

我们的顾问需要一位助理。这可起到一箭双雕的作用，助理既可以做些工作，又会得到锻炼，最后还可以做后续调研。

适任这个工作，这个助理需要对上海汽车工业集团公司的运行和组织架构有初步的认识，并且有供应链管理或物流/或规划方面的相关经验。助理应对公司的资料/历史等方面的情况作初步的搜集工作。他还要联系每个公司，预约访谈或后续访谈的时间。助理需要与顾问一起拜访这些公司，并全程参与这些访谈。其后，助理还应和顾问一起整理分析所需的资料，准备对调研数据的分析并最终介绍调研结果。为了便于和顾问一起工作，助理应有良好的英语水平。

完成访谈工作后，助理应具备足够的经验单独进行其他访谈或后续访谈。希望通过这个研究，该助理可以成为熟悉集团整个供应链的人，对分析过程充分理解，并明白结论从何而来。

由于这个研究是由杨先生最初发起的，顾问请求将指派杨先生作为听取汇报及提供指导的人选。

对于这项研究，顾问不要求任何金钱的回报。尽管如此，顾问希望能有一个合适的工作地点（一个写字台）以便和助理进行交流；另外，顾问希望在上海汽车工业公司总部有适当的通行权及在自助餐厅用餐的权利；希望助理有车或可以调派汽车以供外出访谈之用。顾问要求上海汽车工业公司按公司标准支付给助理必要的交通费开支。如有预期的额外开支，顾问会提前申请批准。还有，如果研究需要使用设备，希望公司能够提供给助理。

我们的顾问要求在访谈中设置几个关于公司文化的问题。顾问将在以后的研究中用到这些公司文化方面的资料。但在这个报告发布之前我们将向杨先生提交一份副本，从而使上汽确保此项研究成果被恰当使用。

当然，顾问在开始研究之前会和上汽签订保密协议，同时需上汽支持资料搜集工作，相关公司的配合调查并提供必要的数据和文件是非常重要的。

调研计划

步骤一　　向上海汽车工业总公司管理层提交方案；
步骤二　　方案被接受后，选任助手，进行前期数据收集；
步骤三　　起草采访问题，并与上海大众, 上海通用及上汽乘用车分公司公司物流经理进行会谈；
步骤四　　进行调查和访谈；
步骤五　　汇总、分析调查结果。必要时进行跟踪访谈或确认；
步骤六　　汇报研究成果。

顾问在接下来六个月的时间表及行程安排表

5 月 14 日至 6 月 9 日（4 周）， 计划在上海进行第一轮访谈；
（6 月 23 日至 7 月 20 日，周一到周四上午，顾问在香港教学。）
6 月 29 日至 7 月 2 日，　　顾问在上海停留；
7 月 5 日至 7 月 8 日，　　顾问带学生访问上海；
7 月 20 日至 7 月 28 日（1 周），顾问在上海停留；
8 月 13 日至 8 月 24 日（2 周）， 顾问在上海停留，希望此时汇报研究成果

当然，其他时间可通过邮件或电话联系顾问。顾问不在上海期间，顾问与助理也通过这种方式联络。从整车和零部件厂搜集数据这一繁重的工作，主要由助理完成。

上海大众物流经理徐青乔对该研究所提的建议

在被问及如果对汽车供应链方面展开研究的话，她期望从该研究中得到什么问题的答案时，徐女士提到了下列问题：

1、上海大众汽车有限公司在过去的 20 年里发展了许多供应商。上海大众曾经一度是这些供应商最重要的客户，但如今，在作为客户对这些供应商的举足轻重性方面，其它汽车公司或许已经超越了上海大众。这些供应商现在如何看待与上海大众的关系？也就是说，上海大众对这些供应商有一个明确的定位，但这些供应商是否持有同样的观点呢？

2、客户与供应商的关系是双向的，供应商们对上海大众在整体上市如何定位的？

3、信息流与货物流并不一致或匹配。要匹配这两者实属不易。应该采取何种沟通交流方式或何种公共平台来达到这种一致呢？什么是好系统，而什么又是不好的系统呢？假设 400 个供应商中有 200 个采用一种系统或平台进行沟通交流，那这已经是一个非常好的实施率了。

4、现在每个供应商都有很多客户，那么供应商是怎样合理协调价格、要求的质量、所投入的资源以及每位客户需要分配多少之间的关系呢？换言之，供应商的中期和长期计划是什么样的呢？也就是，供应商的资源计划是什么，这些决策可能不得不需要高层才能做出，但上海大众有必要知道如何区别管理这些供应商。

5、对于 CKD 和 SKD 供应商来说，他们与其母公司的关系如何？举例来说，他们采取何种问题解决机制的？

6、如果上海大众愿意通过同一系统与供应商共享信息，供应商是否有能力共享真实的信息呢？供应商又是否愿意共享真实的信息呢？

调研的基本内容和方法

该调研将通过现场采访供应链、物流、采购总监或经理来进行。该研究调查将以上海大众、上海通用和上海乘用车分公司的供应链为线索。顾问和助理会就一份问题（而不是用问卷）清单而提问。这些问题不会提前提供给被采访者。我们将采访至少一小时。如果采访对象是提供多种产品或者有其它复杂的问题的主要零部件供应商，采访时间将会更长。

因为这是第一次对供应链进行系统的调研，我们首先要决定该研究的复杂程度。该研究越复杂，花费的时间就越多，供应商在时间和信息方面就越不配合。这就可能产生信息超荷和研究主题不集中的问题，即，太多的研究和评估导致得不到任何结论、趋势或观察结果。这将决定此次调研的范围。

下表列出了供应链绩效特性。管理层可通过选择最重要特性来评估供应链绩效，第一行的供应链交付可靠性就可以反映其水平。

表格一 供应链绩效特性

绩效特性	绩效特性的定义	一级指标
供应链交付可靠性	供应链绩效是指在合适的地点和时间，持有必要的文件，以合适的状态和包装及所要求的数量交付所要求的产品给相应的客户。	• 交付绩效 • 补货及时率 • 完善的订单执行率
供应链响应性	即供应链将产品交付给客户的速度	• 定单执行完成时间
供应链灵活性	即供应链对市场变	• 供应链反应时

	化做出反应以获得或保持竞争优势的敏捷性	间 • 生产灵活性
供应链成本	即与经营供应链有关的成本	• 销售货物的成本 • 管理供应链的总成本 • 增值生产率 • 保修/退货处理成本
供应链资产管理效率	某组织管理资产以满足需求的效率，包括所有资产的管理：固定资产和流动资产	• 现金-现金周转时间 • 存活周转时间 • 资产周转

评估供应链绩效非常重要，即评估-在合适的地点和时间，持有必要的文件，以合适的状态和包装及所要求的数量交付所要求的产品给相应的客户。这是此项调研的重要内容。

上海大众在不同层次的供应商有 400 到 500 家。数量如此之多，我们不可能采访到每一家供应商。我们将确定标准，以此来挑选此次调研的被采访对象并确定其层级。举例来说，我们将首先选择那些提供主要零部件给三大整车厂的上汽下属的供应商。这就将供应商减少到 60-70 左右。但我们会对非上汽的供应商进行抽样，将其加入研究对象清单中，使样本能体现代表性。

该研究是为上汽集团（F0）和整车厂的利益而实施的。我们将采访负责计划物流的总监或经理，并了解他们期望从该研究中知道什么。上海大众的徐女士已经提出她的问题，期望从该研究中得到答案。如仅评价前面提到的供应链交付绩效指标，显然无法回答徐女士的问题。

顾问认为供货及时率、合同执行率等一些硬指标仅能反映出单个供应商的总体表现，而不能反映出此总体表现是如何及为何产生的，也不能反映出供应商的特性，并且这些指标并不需要我们进行问卷调查和实地采访，因为整车企业已经有这些数据了。

只有一些“软指标”需要我们进行问卷和采访。这些软指标能更为深刻的定义供应商的特点，而不是肤浅的了解供应商的所有权，如上汽独资，合资或者独立的供应商，再如是 CKD 或 SKD 供应商。我们希望用这些问题和访谈来弄清楚这些供应商将来的行为表现，并且弄清楚这些行为表现的深层次原因。通过分析来将供应商进行有逻辑的分组，从而使上汽能采取更好的策略管理各个供应商或者某一类供应商。

顾问建议将文化或者说公司文化纳入评估特性中，因为顾问根据目前所从事的研究认为公司文化可能在一定程度上对供应链绩效产生影响。同时相同的汽车部件供应商在不同的整车厂如上海通用，上海大众，上汽乘用车分公司供应链绩效可能也会不同。所以，每一个供应链表现是同时受汽车公司和零部件供应商互相影响的。据此，我们会研究三个不同的供应链关系。

我们现场调研的内容设置是以获得供应商如何运转以及为什么他们会这么运行（如他们的文化），而不是他们是如何把零部件供应给汽车公司的。在进行现场采访之前，我们会向三个汽车公司的采购、物流经理或者主管就访谈问题征求意见。只要有可能，我们把他们的建议采纳到我们的采访问题上。

目前有很多研究表明好的关系造就好的供应链。同样我们也会把关系作为影响供应链的一个因素。对这种正相关性我们在一定程度上主观上已经认同，但未经验证前我们还是会就这个观点保持开放的观点。

根据供应商在供应链管理方面的水平进行分组也是一种选择。这个研究能帮助我们了解这些被调查的供应商在供应链管理上处于何种水平，处于哪一个发展阶段。

这个研究虽然小，却是了解全局的第一步。一旦研究完成，我们则可以就得出的结论进行讨论。然后再开始研究如何与公司整体战略相结合，采取何种供应链战略。到那时，我们需要对当前的战略模式进行回顾；同时，到那时候是否有必要对其他一些指标进行评估就清楚了。我们也可以考虑是否决定就这些指标进行对标分析或建立标杆。但由于这些内容超出了本次研究范围，所以只能以后再做研究。

零部件供应商，汽车生产商和上汽集团之间极有可能产生战略上的分歧。如在研究中发现有这样的分歧，上汽集团需要做的一项非常重要的工作就是应该考虑如何协同各方的战略，如何从供应链中获得更多好处，以及如何把威胁变成竞争优势。最后，希望这个全局战略能给上汽集团企业带来最大的利益。

本方案致力于呈现一个清晰且严谨的报告。顾问将致力对调查期间获得的研究资料进行分析，以供上汽集团管理层战略决策作参考。

下一步工作

顾问希望上汽高管审阅此方案以开始此项研究。一旦方案获得批准，他认为有必要配备一个助理来协助这项研究。

顾问将在 4 月 10 日和上海通用公司物流经理会面。

Appendix 4

List of Interviewed Partners

1) Shanghai Automotive Industry Corporation

Mr. Edward YANG Weijin
Director, Economic Operations Department
Shanghai Automotive Industry Corporation (Group)
489 Weihai Road, Shanghai 200041, China

Mr. Frank YE Hai
Manager, Corporate Business Management Board
Shanghai Automotive Industry Corporation (Group)
489 Weihai Road, Shanghai 200041, China

Mr. David XU Jun (interview assistant)
Manager, Business Department no. 1
SAIC Motor (Korea) Company Limited
Shanghai Office
489 Weihai Road, Shanghai 200041, China

2) Auto Companies

Mr. XU Qiuhua
Deputy Director, Production Control & Logistics Department
Shanghai General Motors Corporation Limited
1500 Shen Jiang Road, Jin Qiao, Pudong, Shanghai 201206, China

Ms XU Qing Qiao
Division Manager, Logistics
Mr. GU Zheng Jiong
Manager, Disposition, Logistics
Shanghai Volkswagen
82 Chang Ji Road, Shanghai 201805, China

3) Auto Parts Companies

Mr. YAO Yang
Production Department Manager
Kolbenschmidt Pierburg Shanghai Nonferrous Component Company Limited
570 East Yun Ling Road, Shanghai 200062, China
Mr. WANG Guo Xiang
Production Department, Planning Logistics Deputy Section Leader
Kolbenschmidt Shanghai Piston Company Limited
271 Lu Ding Road, Shanghai 200062, China

Mr. QIN Kaiyu
Purchasing & Sales Department Manager
Mr. HAO Liu
Purchasing Supervisor
Shanghai Sekely Die Technology Company Limited
775 Jinsui Road, Shanghai 201209, China

Ms Rosalie ZHANG Yi
Purchasing Department Manager
Mr. RAO Zhen Hao
Production Department Logistic Center Manager
Shanghai Valeo Automotive Electrical Systems Company Limited
501 Keyuan Road, Zhangjiang Hi-Tech Park, Pudong, Shanghai 201203, China

Mr. XUE Ning
Planning & Logistic Department, Manager & Economist
Shanghai SAIC – Metzeler
4600 Waiqingsong Highway, Qingpu District, Shanghai China

Mr. Alex TONG
IT & Logistic Department Senior Manager
Yanfeng Visteon Automotive Trim Systems Company Limited
540 Moyu Road, Anting Shanghai 201805, China

Mr. LIN Song
Technical Supporting Center Director, Senior Engineer
Shanghai Cosmopolitan Automobile Accessory Company Limited
168 Baian Road, Jiading, Shanghai 201890, China

Mr. YU Tao
Manager, Purchasing Department
Mr. ZHANG Jian
Manager, Logistic Department
Mr. ZHANG Qian
Logistics Engineer, Logistics Department
Shanghai Sachs Powertrain Components Systems Company Limited
3189 Ji He Road, Hua Xin County, Qingpu District, Shanghai 201708, China

Mr. SONG Wujiang
Manager, Purchasing Department
Shanghai Automotive Company Limited China Spring Factory
291 Yunchuan Road, Shanghai 20191, China

Mr. HUANG Wei Zhong
Production & Logistic Department Manager
Shanghai Sanden Behr Automotive Air Conditioning Company Limited
285 Shi Long Road, Shanghai 200232, China

Ms Yangtz JIANG
Director, Purchasing & Logistics
ZF Shanghai Steering Company Limited
2001 Yong Sheng Road, Jiading, Shanghai 201821, China

Mr. LIN Hai
Manager, Commercial Department, Purchasing Department
Shanghai Koito Automotive Lamp Company Limited
767 Yechang Road, Jiading, Shanghai 201821, China

Mr. HU Gang Zhu
Director, Logistic Department
Shanghai Automotive Brake Systems Company Limited
915 Ye Cheng Road, Jiading, Shanghai 201821, China

Mr. ZHANG Lu
Manager, Purchasing Department
Shanghai GKN Drive Shaft Company Limited
900 Kangshan Road, Zhoupu, Shanghai 201315, China

Mr. WAN Xingwei
Manager, Logistics Department
Huizhong Auto Parts Company Limited
1493 Huaidong South Road, Pudong, Shanghai 200122, China

Mr. RUAN Shuhui
Strategy Development Department, Deputy Manager (Officer-in-charge)
ANJI – TNT Logistics Company Limited
595 Cao Yang Road, Shanghai 200063, China

Sammy (Sam) G-Ling Chiu

EMPLOYMENT HISTORY

*1) 1998.1 to **Present***

UNIVERSITY OF TORONTO, ROTMAN SCHOOL OF MANAGEMENT - Director for Asia Pacific, Executive Programs

As the principal representative of the school in Asia, my mandate is to start the first faculty program in Hong Kong. My responsibility include marketing, planning and execution of executive training programs. These programs include non-degree programs, executive MBA program and in-house corporate training programs. Another mandate is to identify and negotiate with HK and China universities to offer executive education programs in partnership. Secondary responsibilities include working to improve alumni relationships and teaching in some of the programs.

2) 1994.1 to 1997.12

As a **consultant** my work has been with a) an internet service provider b) a medical and diagnostic laboratory; and c) an international pharmaceutical company's US branch; in locating and negotiating joint ventures or licensing partners in China. Other involvement are in preliminary marketing and demographic studies, HR and training, and liaise with the local authorities on the setting up of the China office and licensing agreements. Other consulting work included assignments with past employer in 9) below.

3) 1993.4 to 1993.12

HONSON TECHNOLOGY LTD., HONG KONG - Consultant

Personal Responsibilities:

- Preparation of business proposal for a plant start-up to manufacture building materials and a coatings plant in South China.
- Market research of products to be manufactured.
- Liaise with local authorities & PRC partners.
- Assist director of finance in arrangement of funding.
- Participate in trading of coatings materials, computers, pagers, mobile phones, satellite receivers to PRC.

Company Services:

- Manufacturing of coatings and building materials, trading.
- Development and marketing of Hong Kong and China real estates.
- Arrange funding for PRC projects

4) 1992.1.6 to 1993.3.19

ICI STAHL USA, Peabody, MA, USA - Consultant

Personal Responsibilities:
- Training of production, QC and technical staff; customer technical support.
- Pinpointing and correction of trouble or critical areas/factors.
- Provide information on updating manufacturing equipment.
- Streamlining production methods and increase efficiency.
- Setting up of documentation and record keeping of critical factors for production control and preparation for future ISO registration.
- Restructuring of staff and reassignment of job functions.
- Development and production of new products.

Company Services:
- Manufacturer of polyurethane and formulated products for use in coatings
- Supplier to these industries: leather, automotive, PVC converters, textile, flooring, electronics, medical equipment.

5) 1989.10 to 1993.4

LAUZE, CHIU INTERNATIONAL INC., MONTREAL, PQ - Vice President

Personal Responsibilities:
- Setting-up of agency network in Far-East
- Launching of new products
- Liaise with customers, agents and principals.
- Sourcing of Projects.

Company Services:
- Sales and marketing of North American properties and business in Far-East.
- Immigration services.

6) 1988.11 to 1989.10

WESTMORLAND INVESTMENT FUNDS, TORONTO, ONTARIO - Sales Manager

Personal Responsibilities:
- Setting-up of agency network in Far-East
- Sales and marketing of investment funds/immigration projects

Company Services:
- Investment fund for immigration

7) 1987.3 to 1988.9

ICI PERMUTHANE/STAHL, PEABODY, MA. USA - Consultant and Technical Sales Representative

Personal Responsibilities:
- As consultant, listed in 4) above.
- As technical sales, sales and marketing of company products in Canada.
- Territorial sales of about US$1 million per annum.

Company Services:
- Listed in 4) above.

8) 1985.1 To 2009.06

SUNBURST STAMP COMPANY - Owner/Operator

Personal Responsibilities:
- Trading of stamps and postal history.

Company Services:
- Stamps for collectors, philatelic supplies.

9) 1977.7 to 1987.3

MICROCOLOR DISPERSIONS LTD., TORONTO, ONTARIO - Technical Director

Personal Responsibilities:
- Development of products, QC.
- Training of staff.
- Costing of products.
- Purchasing of raw material.
- Formulation and development of production methods.
- Technical service and customer liaison.

Company Services:
- Manufacturing of dispersions for paints and plastics.
- Products use in trade sales paints, industrial coatings, PVC (plastisol, drysol), PUR form, epoxy resin castings, aluminum and steel siding coatings, fiberglass/polyester applications, printing inks, cement and concrete, flooring.

EDUCATION

1) Master of Business Administration, with recognition on Dean's List, 1997.5, from the University of Toronto, Rotman School of Management. Winner of an award of outstanding contribution towards the international development of the Executive MBA program.

2) Master of Engineering (Chem. Eng.), 1982.2, from the University of Toronto, School of Graduate Studies.

3) Bachelor of Applied Science (Chem. Eng.), 1977.5 from the University of Toronto, Department of Chemical Engineering.

4) Bachelor of Science (completed 2 of 3 years), 1974.5, at the University of Toronto, St. Michael's College.

5) Secondary School Honour Graduation Diploma, 1972.5, from St. Peter's High School, Peterborough, Ontario. Award includes Ontario Scholar and honourable mention in Sir Isaac Newton Test in Physics.

6) Passed HKCEE, 1970.6, enrolled in Form 5 at Rosaryhill School, Hong Kong.

PROFESSIONAL MEMBERSHIPS

Professional Engineer - registered with the Association of Professional Engineers of Ontario.