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Supply Chain Management in The Brazilian Automobile Industry: Bottlenecks for Steadier Growth

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ABSTRACT

Taking the Lean Production System as the reference model, this paper analyses the supply chain management approach and the relationship between private and public sectors in the Brazilian automobile industry. Through a case study conducted from October 2006 to October 2008 in a private owned automaker, two bottlenecks in this Brazilian industrial sector are identified: (1) Emphasis on coordination rather than integration in supply chain management; and (2) Insufficient channels of communication between private and public sectors, resulting in inefficient policies to nurture automakers with low production volume.

KEYWORDS

Brazilian automobile industry,
Supply chain management,
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1. Introduction

The purpose of this study is to identify some of the bottlenecks for achieving a higher level of economic growth in the Brazilian automobile industry, by means of a case study conducted in a private owned automaker, which assembles Mitsubishi light commercial vehicles.

The automobile industry was chosen for study because this sector provides a rich ground for the analysis of inter-firm relations and the relevance of adopting an integrative approach towards supply chain management. Additionally, the automobile industry plays an important role in the Brazilian economy. In 2007, Brazil was seventh in worldwide vehicle production, with 2,977,150 units and this industrial sector was responsible for 18% of the country's industrial GDP. In 2005, the number of direct and indirect jobs generated by the sector was estimated in 1.5 million (Anfavea, 2008).

This study adopts the Lean Production System as the reference model for evaluating the Brazilian automobile industry, because Lean Practitioners acknowledge the importance of promoting integration among automakers, suppliers and dealers, encouraging technical assistance and information exchange to improve the outcomes of the whole supply chain network. Such a production system is of great relevance for the Brazilian automobile industry, which strives to achieve competitive advantage through "operational effectiveness" - i.e., improving quality and lowering cost simultaneously (Fleury and Fleury, 2003). Moreover, due to its comprehensive approach to supply chain management, Lean Practitioners adopt capacity building efforts to address the individual level (skil development and training of the workforce), organizational level (strategic planning, organizational culture, human resources, infrastructure, and information resources), and system level (interactions with the government and inter-firm relations). The Lean Production System is, therefore, in line with the UNDP (1998) framework for capacity building, which is an important guideline for emerging economies such as Brazil pursuing economic growth and sustainable development.

This paper is divided into three sections. The first section presents the conceptual framework of the study. Section two discusses the new tendencies in the Brazilian automobile industry. Data collected during fieldwork survey as well as the main findings are shown in section three, followed by a conclusion.

1. The Japanese Approach to Supply Chain Management: Reliance on Integration

The high level of economic development observed in post-war Japan has drawn the attention of scholars to the practices adopted by Japanese automakers and their approach to supply chain management, which became known as the Lean Production System.

The practices used under the Lean Production System, so-called Lean Practices, are meant to bring continuous improvements to manufacturing processes through the commitment of the workforce towards the reduction of non-value-added tasks. Such practices should be considered principles that direct the way workers conduct their jobs, rather than simply techniques, and they aim to achieve an ideal situation of perfection (Imai, 1986; Liker, 2004). Moreover, they are only optimized when jointly implemented with all firms in the supply chain network. Take the example of *genryo-seisan* (production plans based on dealers' order volume), which is focused on reducing the gap between dealers' orders and the production of vehicles to zero. Inasmuch as this perfect match could be considered ideal, *genryo-seisan* functions as a guiding principle that directs the

negotiations between automaker and dealers, so that they can make a joint effort to constantly improve the system (Fujimoto, 1999). In this manner, Lean Practices can be defined as: guiding principles focused on reducing non-value-added tasks which are optimized when jointly utilized by an automaker and its supply chain network.

One of such practices are the *kaizen* activities, in which workers on the shop floor are constantly trying to improve the manufacturing process by implementing minor changes in their daily work. Kaizen is connected to the idea of "ongoing improvement, involving everyone", including top management, managers and workers and is based on incremental rather than radical innovation. The philosophy of *kaizen*, therefore, assumes that the product and work processes can always be improved and the entire workforce should be constantly committed to finding ways to promote ameliorations. Participation in kaizen activities develops new knowledge, skills, and abilities that may be applied to subsequent problem-solving tasks (Farris et al, 2009; Imai, 1986). Hence, *kaizen* creates an environment and organizational culture which compels the workforce to constantly improve the company's products and internal processes, even in periods of prosperity and without any apparent external threat.

Education and training are essential to develop such an organizational culture and to create a mind-set in the workforce which continually identifies and finds solutions for manufacturing problems. In fact, a high level of involvement of blue-collar workers can only be achieved through a mixture of on-the-job and off-the-job training that goes far beyond the acquisition of basic knowledge of electronics and mechanics. During on-the-job training, blue-collar workers in Toyota learn much of what is deemed white-collar work, so that they can develop a wide range of skills that go from the repetitive work of operating machines to handling minor maintenance tasks and dealing with unforeseen situations (Koike, 1988). Moreover, the Japanese approach to quality control involves the entire workforce in all areas of the firm, as well as suppliers and dealers. The responsibility to maintain and enhance quality standards is delegated from inspection and quality control personnel to workers on the shop floor (Cusumano, 1985; Imai, 1986).

Due to the important role played by blue-collar workers, Lean Practitioners acknowledge the necessity to provide real-time information for workers at the shop floor. This information is available through the practice of Visual Management, which is based on the use of numerous charts and signboards scattered throughout the factory to supply data about the production process for both managers and blue-collar workers. The so-called *Andon* Signboards, for instance, located

above assembly lines, provide real-time feedback of production troubles and are an efficient mechanism for defect detention and on-the-spot inspection (Fujimoto, 1999).

The *kanban* system and just-in-time manufacturing are Lean Practices that demonstrate the relevance of a close relationship between the automaker and its supply chain network. The *kanban* system is a production and inventory control system in which the downstream station obtains just enough components as needed and the upstream station produces just enough to replenish what has been used. The optimization of the *kanban* system requires the adoption of just-in-time manufacturing, or synchronized delivery, in which components are supplied at exactly the same time as the body sequence in the assembly line. Just-in-time manufacturing demands a close relationship with suppliers, since components are delivered in frequent and small lot size.

The Lean Production System promotes a high level of integration among all firms in the supply chain network by interconnecting all stages of the production process, including product development, manufacturing, purchasing and after sales services. One of the clearest advantages of such an integrative approach to supply chain management is the optimization of just-in-time manufacturing and consequent decrease of inventory costs. Moreover, production problems such as machine failures, defective production, time-consuming machine setups, long transportation distances, might create the need for buffer inventories. Inventory reductions will make those problems visible and when they are solved, a rise in productivity and quality can be expected (Flynn et al, 1999). Lieberman and Demeester (1999) present empirical evidence of an increase in productivity due to inventory reductions in a survey conducted in the Japanese automobile industry.

Dyer and Nobeoka (2000) also affirm that "the cost and quality of a vehicle are a function of the productivity of a network of firms working in collaboration." Their research emphasizes the advantages of integration in Toyota suppliers' network for knowledge sharing and collaborative improvements. In fact, the close contact and face-to-face interaction between automaker and supplier is said to facilitate tacit knowledge transfer, to reduce communication errors and make feedback more effective (Dyer, 1996). Since this type of integrative supply chain management favours the accumulation and sharing of knowledge within the network, the automaker will not lose the expertise of an activity outsourced to its suppliers.

Regarding this topic, Takeishi (2002) distinguishes "task partitioning" from "knowledge partitioning." While the former indicates which organization is responsible for the tasks of manufacturing a specific component, the latter designates "who has knowledge for the tasks among

organizations." He advocates that an automaker should "keep the knowledge of the outsourced task within the firm, rather than outsourcing the knowledge together with the task." This discussion is relevant for this paper because it illustrates the problem of focusing on coordination rather than integration in supply chain management. By focusing on coordination, automakers outsource both tasks and knowledge to their first-tier suppliers. There are no joint efforts in problem-solving and knowledge is not shared. In an integrative approach, the automaker keeps the knowledge even when outsourcing the task. Integration, therefore, favours information sharing and creates conditions for enhancing productivity and quality of the whole supply chain network. This knowledge sharing and accumulation might become a competitive advantage for the supply chain network (Dyer, 1996). Moreover, one should also consider the risks involved in excessive specialization on the core competence, since the firm might lose "both assets and talents as a result of outsourcing of manufacturing operations and just coordinating product flows to markets" (Kemppainen and Vepsäläinen, 2003). By keeping a high level of knowledge sharing within the supply chain network firms might avoid this problem of overspecialization, because, at the same time that they focus on their core competence, relevant information remains available and can be more easily shared at the inter-firm level.

Additionally, Japanese automakers recognize the importance of considering public policies and the relationship between public and private sectors for successful strategic planning. The pattern of communication between the government and firms is close and intense, focused on promoting collaboration to achieve mutual objectives (Evans, 1995; Dore, 2000). One should note that the capacity of managers and public officials to design efficient strategies or policies is limited by bounded rationality. Not only is it difficult for them to comprehend all the forces at play in the world's economic environment, but also to anticipate the effects of the interaction of such forces (Simon, 1991; Conner and Prahalad, 1996). Accordingly, a constant and close pattern of information exchange between public and private sectors is necessary for designing effective policies and for readapting such policies to unpredicted changes in the economy.

In summary, the type of inter-firm relation and the interaction between public and private sectors show the integrative approach of Lean Practitioners, which prioritizes the parties' mutual goals over their individual interests. Information exchange, technological transfer and diffusion of practices among firms are strongly emphasized. Such a holistic view created a pattern of close relationship among firms and an environment of cooperation, which involves joint efforts to

improve productivity and quality of the entire supply chain network, facilitating technology spill over and information sharing across firms and industrial boundaries.

2. The Automobile Industry in Brazil

Shapiro (1994) and Evans (1995) stress the importance of state intervention for persuading transnational automakers to start assembling vehicles in the 1950s in Brazil. By prohibiting car imports in 1956 and conceding import tax exemptions to automakers interested in producing vehicles locally the government successfully introduced the automobile industry in the country. There was a conviction that this industrial sector could lead industrial transformation and, therefore, the government focused on attracting as many foreign companies as possible. No initiatives were undertaken, however, to protect and nurture domestic companies. As a result, by 1968, the automobile industry was completely dominated by transnational firms and was vertically integrated until the mid-1970s. Export oriented policies in the 1970s were unsuccessful due to an over-valuated exchange rate and to the uncertainty of the Brazilian economy, and automakers continued to focus on the domestic market (Figure 1). The industry stagnated in the 1980s and, at that time, Brazilian plants lagged "far behind the world pace in terms of productivity and product quality" (Womack et al, 1991).

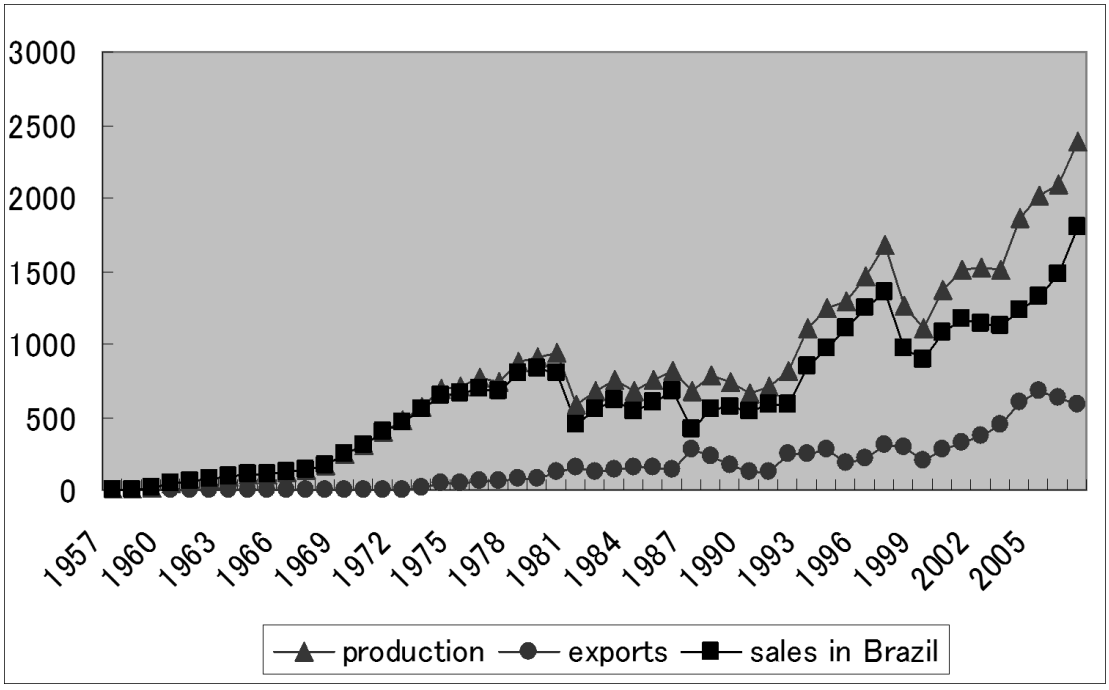

Figure 1. Performance of the automobile industry in Brazil - 1954-2007 (thousand units) (Anfavea, 2008)

The restructuring of the Brazilian automobile industry started in the early 1990s. The government reduced import tariffs on vehicles, auto parts and equipments in 1991 and initiated a process of discussion with union leaders and representatives of automakers and auto parts suppliers with the purpose of gathering data to direct future policies for this sector, under the so-called Chamber of the Automobile Industry. Such discussions resulted in agreements regarding the need to decrease the price of domestic vehicles (especially those under 1000 cc), increase the existing financial mechanisms to facilitate automobile purchasing, create export promotion policies, and increase investment to modernize Brazilian factories (Anfavea, 1994; Anfavea, 1995; Finep, 2006). Additionally, from 1994, a new currency was adopted in Brazil and the economy was stabilized.

A revitalization process was, therefore, undertaken to enhance productivity and quality up to world's standards. Attracted by incentives provided by the Brazilian government, new automakers started manufacturing in the country and competition increased. From 1991, the year in which the aforementioned process of discussion started, to 1996, one year after the third and final meeting was held and the final agreement was settled, the production of vehicles in Brazil expanded 87.9% (Figure 1). Workforce productivity has also greatly increased in the period, as shown in the following figure.

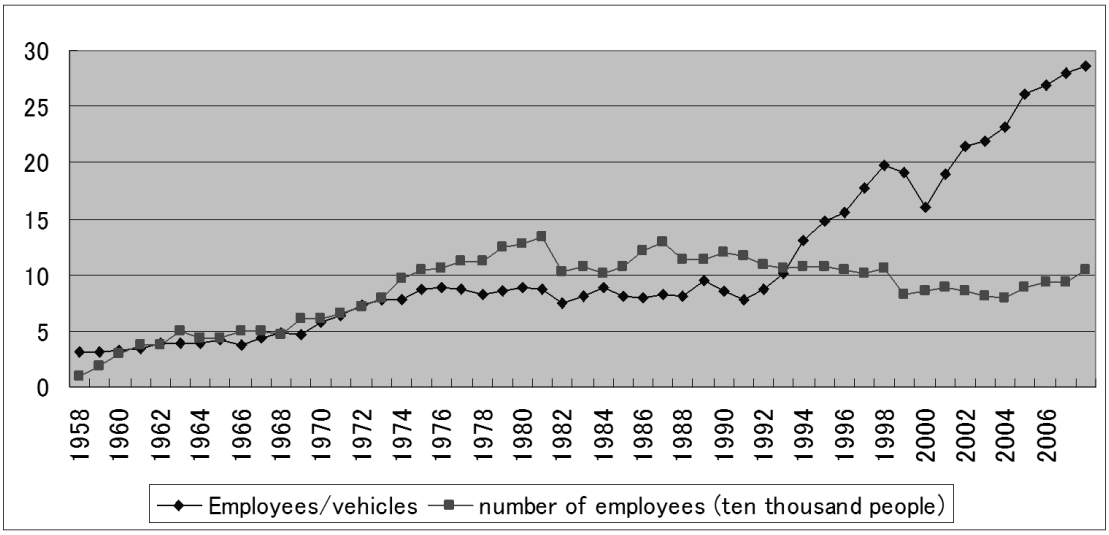

Figure 2. Employment and productivity in the Brazilian automobile industry 1958-2007 (Anfavea, 2008)

Brazilian government's trade barriers have allowed small inefficient auto parts manufacturers to sell low quality products at high prices. From the 1990s, such firms faced international competition and were forced to improve quality and reduce prices in order to survive. The stabilization of the economy and appreciation of the Brazilian currency from 1994 represented another challenge for domestic auto parts producers. These macroeconomic changes resulted in a shift in the ownership of firms in the auto parts sector and the participation of foreign capital increased from 48.1% in 1994 to 81% in 2007 (Sindipeças, 2008). In fact, after the opening of the Brazilian market, transnational first-tier suppliers entered Brazil and opted to vertically integrate their operations, due to the low efficiency and quality of domestic firms. By purchasing or taking control of key domestic auto parts producers, a few first-tier suppliers dominated the majority of the Brazilian auto parts market (Ó hUallacháin and Wasserman, 1999).

2.1 The Brazilian Automobile Industry after the Mid-1990s

The first new trend observed in Brazil from the mid-1990s is the greater participation of states other than São Paulo in vehicle production. After significant investments by transnational automakers to construct new factories in other states, São Paulo's share in the production of vehicles decreased from 74.8% in 1990 to 43.7% in 2007 (Anfavea, 2008). One of the main reasons for this geographic relocation of automakers' facilities is the incentives provided by Brazilian states and municipalities, especially tax exemption and donation of land, to attract investment into their localities. Automakers were also attracted by other factors such as the reduction of labour costs, adequate infrastructure, and less influence of labor unions (Botelho, 2002).

Another trend observed from the mid-1990s in the Brazilian automobile industry is the adoption of new manufacturing arrangements between automakers and their supply chain. From this period, transnational automakers started to radically transfer most production-related activities to first-tier suppliers and implemented organizational changes to better cope with this new tendency. Brazil was one of the first countries in which Western automakers started adopting such new arrangements. For instance, General Motors gathered all but one of its first-tier suppliers in its plant located in Gravataí (Rio Grande do Sul) and Ford constructed an industrial condominium in Camaçari (Bahia), in which the suppliers were placed around the car assembler (Teixeira and Vasconcelos, 1999; Ramiro, 2002; Garcia, 2005).

A manufacturing arrangement creating a higher level of interface between automakers and first-tier suppliers was implemented in 1996 by Volkswagen in Resende (Rio de Janeiro). Volkswagen transferred most of its production related activities to eight subcontractors that shared the same plant: Iochpe-Maxion, Rockwell, Remon, MWM, Cummins, Eisenmann, Tamet and VDO. The production system was divided into various stages, each managed by one of the subcontractors. Volkswagen performed only 15-20% of all the activities, but was responsible for coordination and for testing the trucks in the final stage. The first-tier suppliers were not only responsible for manufacturing the subsystems, but also for assembling the final truck (Pires, 1998; Teixeira and Vasconcelos, 1999).

The aforementioned arrangements share several similarities. In all of them, automakers were outsourcing a great volume of activities and focusing on single sourcing, while first-tier suppliers were responsible for manufacturing and delivering subsystems, rather than only components. These are actually the main features of the production system called modularization, which is being increasingly used by Western automakers in Brazil.

Modularization can be defined as "building a complex product (…) from smaller subsystems that can be designed independently yet function together as a whole" (Baldwin and Clark, 2003). A subsystem or module is "a unit whose structural elements are powerfully connected among themselves and relatively weakly connected to elements in other units" (Baldwin and Clark, 2000). Thus, in this production process, the product is divided into subsystems and the responsibility for producing and designing each module is transferred to first-tier suppliers. The connectivity between modules is standardized and therefore each supplier can concentrate on improving its own module.

The main threat of the adoption of modularization for the Brazilian automobile industry is knowledge partitioning because, by focusing on their role as coordinators and radically transferring the design and production of modules to first-tier suppliers, Brazilian automakers are failing to promote knowledge sharing within their supply chain network. Accordingly, due to the lack of significant R&D activities and the dominance of transnational automakers in Brazil, knowledge partitioning may hinder the creation of a competitive advantage in manufacturing, and local factories might be outrun by other developing countries with more attractive manufacturing conditions, and, in particular, lower labour costs. This problem of knowledge partitioning is further worsened by the adoption of a Western pattern of supply chain management, in which automakers and suppliers do not see themselves as collaborators and each of them undertakes unilateral efforts

to reduce their own cost, to raise their own short-term profits and to transfer the risk to the other party. In such type of relationship, firms tend to "engage in a hard commercial bargain to obtain competitive prices" (1992).

2.2 Supply Chain Management in the Brazilian Automobile Industry

Womack et al (1991) contends that the use of just-in-time manufacturing by U.S. automakers was a way of shifting the burden of inventories to suppliers rather than a comprehensive attempt to implement the Lean Production System. Mudambi and Helper's (1998) study of the U.S. auto industry shows that the alteration of formal contracts to promote long-term relationship between automakers and first-tier suppliers were not followed by the creation of informal commitments. This led to a "close but adversarial" pattern of relationship, in which the two sides tend to view each other as adversaries despite their formal agreements and automakers constantly try to "take advantage of competitive weakness of the suppliers to reap short-term gains".

Furthermore, by adopting modularization, Western automakers wanted to take advantage of suppliers' lower labour costs and to cut investment cost and risks by giving more important responsibilities to suppliers (Takeishi and Fujimoto, 2001).

Fujimoto (2007) contends that "Japan's automakers, led by Toyota, thrived largely on the strength of excellence in manufacturing integrity", while Ford and General Motors pursuit a modular-oriented strategy from the very early days of the U.S. automobile industry, with the Model T. In fact, Japanese automakers have succeeded in maintaining a high level of knowledge sharing within their supply chain network regardless of task partitioning. Although tasks were divided among first-tier suppliers, which were responsible for designing and producing modules even prior to the West, Japanese automakers have always conceived the production process as an integral one, demanding constant and close interactions among all firms in the supply chain network.

Hence, both the partial implementation of Lean Practices (i.e., implementation only at the organizational level and not jointly with the supply chain) and the use of modularization in the West were not a shift towards a more integrative approach to supply chain management, but actions to reduce costs and increase short-term profits. Due to the strong presence of Western automakers in Brazil, the pattern of supply chain management tends to follow the Western approach.

In his study of Volkswagen's plant in Resende, for instance, Correa (2001) contends that the choice for modularization was a way to share the risk with first-tier suppliers and use their

expertise, because this automaker was in a vulnerable position after terminating the joint venture with Ford (Autolatina, 1987-1995).

Arkader's (2001) research conducted in the late 1990s in Brazil demonstrates the discrepancy between the perspectives of automakers and suppliers. According to her, while the suppliers asserted that the attitude of automakers during negotiations was intransigent, and based on a win-lose perspective and on lowering prices rather than improving productivity or building a long-term relation, the automakers stated that they were moving towards the creation of a Lean supply chain network, focusing on nurturing long-term partnerships with their suppliers.

Moreover, a comprehensive study conducted by Salerno et al (2002), involving 224 firms in the Brazilian automobile industry, acknowledges that although automakers when contracting a supplier consider other factors such as financial capacity, ISO quality standards certification and historic background of previous purchases, the final decision is made mainly based on price. They also state that it is not uncommon for automakers to terminate a contract before its term when they find another supplier offering better prices.

Another evidence of the lack of integration in supply chain management in Brazil is that most of the new facilities of first-tier suppliers built close to automakers' plants only perform the very last activities of subsystems' assembling. In the case of General Motor's plant in Gravataí and Ford's industrial condominium in Camaçari, for instance, the engines of the vehicles were produced in their first-tier suppliers' factories located in São Paulo (in São José dos Campos and Taubaté, respectively), although these two suppliers also had factories located in the vicinity of the automakers' plants. This shows that first-tier suppliers were reluctant to make large investments relying solely on its commercial relationship with one automaker (Salerno et al, 2002). In fact, task partitioning without initiatives to promote a consistent information sharing process may result in knowledge partitioning, despite geographical proximity. Therefore, supply chain management in Brazil is characterized by a high degree of task partitioning. Knowledge partitioning, on the other hand, is not necessarily taking place. Modularization is leading to knowledge partitioning in the country because automakers are focusing on their role as coordinators, radically outsourcing activities to first-tier suppliers, and neglecting the need to promote integration.

3. Case Study

The findings of this paper presented on the subsections below were drawn from a case study conducted from October 2006 to October 2008 in MMC Automotores do Brasil Ltd (MMCB), a Brazilian limited liability private company that assembles Mitsubishi vehicles focused on the upper classes. MMCB was founded in 1996 and is located in the municipality of Catalão (Goiás). In 2007, the company had 1,974 employees, a total area of 650,000 square meters and assembled 25,844 vehicles. This company was chosen for study because it illustrates two trends in the Brazilian automobile industry from the mid-1990s onwards: it is a factory located far from the metropolitan region of São Paulo and its first-tier suppliers deliver subsystems, following the tendency towards the adoption of modularization. Cotril Motors Ltd and Tokyo Comércio de Veículos Ltd, MMCB's dealers located respectively in Goiânia (Goiás) and Brasilia (Distrito Federal), were also surveyed to analyse their relationship with the automaker and the degree of information exchange.

Several MMCB suppliers were located in Catalão, such as Still Revest Ltd, a firm that produced steel equipment to be used in the paint shops of the assembler; PPG Industrial do Brasil Ltd, a company specialized in producing paints for automobiles; Fórmula R Pneus, the tyre supplier; and HPE – High Performance Equipment, a firm owned by MMCB and specialized in making changes in Mitsubishi models to improve their performance in rally competitions. Moreover, although the plant was owned by MMCB, employees from Weldmatic Automotives Ltd, RCM Engineering & Industrial Solutions Ltd and MVC Componentes Plásticos Ltd worked inside the factory. Weldmatic Automotives Ltd supplied equipment and offered assistance for welding operations; RCM Engineering & Industrial Solutions Ltd provided consultation services to improve the efficiency and reduce manufacturing costs; and MVC Components Plásticos Ltd designed and delivered plastic components for automobiles at MMCB's assembly line. During the fieldwork survey, the author could observe the activities of these suppliers and their interaction with MMCB.

Nonetheless, most of the components used by MMCB were imported from the plants of Mitsubishi Motors Co. Ltd located in Japan or Thailand. Mitsubishi Motors had two plants in Thailand (MMTh and MMTh Engine Co., Ltd) that, in 2007, produced 165,853 vehicles, of which only 26,887 were sold in the domestic market. In Japan, Mitsubishi had three plants for vehicle production (Nagoya Plant, Mizushima Plant and Pajero Manufacturing Co., Ltd – PMC), one for engine production (Powertrain Plant Kyoto, Shiga) and one for transmission production (Powertrain Plant Kyoto), which produced a total of 875,698 and exported 614,448 vehicles (66,158 of which to Central and South America) in 2007 (Mitsubishi Motors, 2008). During the interviews

conducted in MMCB, the logistics manager mentioned that the relationship between MMCB and the Japanese Mitsubishi Motors Co. Ltd was restricted to commercial transactions, i.e., no financial aid was provided and no joint problem-solving initiatives were implemented.

For the case study, interviews were also conducted in the Ministry of Development, Industry and Foreign Trade, and in the Brasilia office of Anfavea (Brazilian association of automakers), with the purpose of analysing the relationship between the Brazilian government and automakers, especially regarding the negotiation process and the level of information exchange.

3.1 Main findings

3.1.1 Emphasis on Coordination rather than Integration in Supply Chain Management

The importance of integration in supply chain management is being overlooked in the Brazilian automobile industry, as demonstrated by the case study. MMCB's key first-tier suppliers were located abroad, especially in Japan, and the factory was sited in an area remote from the industrial centres of Brazil. Around 50% of the components came from Japan and Thailand by ship, arriving 120 days after being ordered at the port of Santos (São Paulo), approximately 770 km from Catalão. Components purchased from local firms had to be ordered 45 days in advance and they were delivered in a warehouse located in Osasco (São Paulo), 690 km from Catalão. Suppliers delivering parts directly to the factory were a minority. As a result, the company had to keep a huge inventory to avoid the risk of stopping the assembly line. MMCB had 2 days of stock for imported components and 5 days for domestic ones. Additionally, MMCB kept an approximate 15-day stock of imported components in its Osasco's warehouse.

The company did not share information with suppliers to replenish components as they were used in the assembly line, demonstrating the lack of effort in introducing just-in-time manufacturing. The *kanban* system implemented in the automaker's plant, therefore, was not complemented by an efficient process of information exchange with suppliers and just-in-time deliveries, which resulted in huge inventory costs and low productivity.

Due to the low level of production volume and this unsatisfactory implementation of the *kanban* system, workers waiting idly inside the factory were observed during the fieldwork survey. This shows the low commitment to *kaizen* activities and the lack of effort to reduce non-value-added tasks. Additionally, excessive inventories may have been concealing problems in the production process. The distance between MMCB and its suppliers hindered joint initiatives towards problem-solving and was an obstacle to just-in-time deliveries. As a consequence of this

overall lack of integration in supply chain management, the company was not taking advantage of opportunities in the domestic and regional markets.

An integrative approach to supply chain management motivates continuous improvements through joint quality control efforts. Just-in-time manufacturing presupposes a low level of defective parts, which demands an intense monitoring of suppliers. In the long run, however, it decreases the need for final inspection and results in quality improvements. Since defects in components or delays may cause the stoppage of the production process, the whole supply chain network must be commitment to quality standards and punctual deliveries. In the absence of such an integrative approach in the factory, MMCB still had to conduct a thorough inspection after the assembling process and to keep large inventories.

Although it was said that workers at MMCB were trained to perform different tasks and rotated regularly to several shops in the factory, such a multi-skilled workforce was not being utilized appropriately. One of the reasons for training workers to execute several tasks is to achieve a greater level of flexibility, as they can be transferred to other stations or even perform several tasks at the same station as a way to control fluctuations of demand. The fact that idle workers could be observed in the factory reveals that the multi-skilled workforce was not being efficiently used to cope with fluctuations in the volume of production.

Fieldwork data also showed the low level of information exchange between MMCB and its dealers. There was no joint effort towards decreasing the gap between production and demand, due to the lack of a consistent process of information exchange between the dealership network, the Department of Sales and the factory. The manufacturing process started before the Department of Sales informed the sales forecast. Dealers were not directly and formally involved in the process of sales forecasting and kept large stocks at their lots. Since dealers represent potentially a reliable source of data about customers' preferences, this low level of information exchange smothers a direct channel of communication with the final customer. While under the Lean Production System dealers are responsible for collecting data on consumers' preferences and such information becomes inputs for product development, in MMCB they only conducted surveys on customers' satisfaction. On top of that, no significant information was exchanged about new models being released or future changes in existing models, because MMCB assumed that this could affect the sales of cars already in stock at dealer's lots. The lack of surveys to access the preferences of consumers and the impossibility to provide up-to-date information about new models had a negative impact on the capacity of dealers to provide a high quality service for customers, especially

when one considers that MMCB is focused on the upper classes, which are more demanding in the fulfilment of their needs.

Furthermore, although there was an effort to adopt Visual Management within the factory, information available to blue-collar workers was insufficient, and the largest source of data was only accessible to managers, through a real-time on-line system. This system showed all necessary information for monitoring the production process, such as: the number of FTT (First Time Through) cars; the number of defective cars; the stage that each car was at and the stage it should be at the assembly line; the total number of produced cars; and the total number of cars that were already finished and ready to be sold. Nonetheless, for blue-collar workers, real-time information was provided only through a large signboard at the end of the assembly line displaying the number of produced cars and the expected productivity for the whole day and through boards scattered in the factory showing the correct way to assemble parts. By overlooking the importance of blue-collar workers' training and by not providing the necessary real-time information for the shop floor, the company was losing latent possibilities in terms of continuous improvements, quality control and defect prevention. In the absence of significant R&D activities in the Brazilian automobile industry, developing manufacturing capacities is paramount for creating a competitive advantage.

3.1.2 Insufficient Channels of Communication between Public and Private Sectors, Resulting in Inefficient Policies to Nurture Automakers with Low Production Volume

The interviews conducted at the Ministry of Development, Industry and Foreign Trade and at Anfavea showed that this Association was crucial in advancing the interests of automakers in negotiations with the central government. It was said that the Brazilian government did not negotiate directly with automakers and conferred the uppermost priority in negotiating directly with Anfavea. The association, on its turn, tried to represent the consensual interests of its members and did not include individual demands of automakers in negotiations with the government.

Thus, the case study showed that Anfavea played a pivotal role in advancing the demands of automakers in negotiations with the Brazilian government. Nonetheless, the sole use of this pattern of negotiation tends to distort the perception of the situation of automakers with low production volume in Brazil. This becomes evident when one considers that four automakers (Ford, General Motors, Volkswagen and Fiat) are responsible for approximately 82% of the entire vehicle production in the country (Figure 3). An overall rise in productivity of the Brazilian automobile industry conceals the existence of a large number of firms that are not achieving a considerable

volume of production to reap enough benefits from economies of scale. The surveyed company MMCB, for instance, produced approximately 25,000 vehicles in 2007 and if it were to maintain the same pace of expansion since its foundation, it would take several decades to reach a satisfactory productivity level. Table 1 reveals that the majority of automakers in Brazil reported productivity levels below 5% of the national total production, 7 of them (including MMCB) below 1%. Therefore, although the successful revitalization of the Brazilian automobile industry in the 1990s attracted several automakers to the country, it is important to create conditions to ensure that such firms will not withdraw from the country, if the economic conditions were to change.

Table 1. Vehicle production per company in 2007 (Anfavea, 2008)

Company	**Production in Units**	**Percentage on National Production**
Volkswagen	844,178	28.36%
Fiat	717,839	24.11%
General Motors	576,952	19.38%
Ford	313,237	10.52%
4 main automakers (total)	2,452,206	82.37%
Mitsubishi	*25,844*	*0.87%*
Agrale	*6,157*	*0.21%*
Honda	*106,027*	*3.56%*
International	*1,144*	*0.04%*
Iveco	*6,214*	*0.21%*
Mercedes-Bens	*67,360*	*2.26%*
Nissan	*9,111*	*0.31%*
PSA Peugeot Citroën	*119,439*	*4.01%*
Renault	*97,458*	*3.27%*
Scania	*18,406*	*0.62%*
Toyota	*55,974*	*1.88%*
Volvo	*11,810*	*0.40%*
Others (total)	*524, 944*	*17.63%*
TOTAL	2,977,150	100%

The economic expansion of the Brazilian economy and the recognition by several scholars of the greater role the country is expected to play in the international arena in the near future (Wilson and Purushothaman, 2003; Nayyar, 2008) created an environment of optimism and propitious for attracting investment, but, at the same time, concealed several structural problems.

In fact, the analysis of the performance of the Brazilian automobile industry in the past few years reveals great reliance on the domestic market. Although vehicle exports have increased, especially in the early 2000s, it is still narrow if compared to domestic sales (see Figure 1). This represents a threat to this industrial sector due to the domination of transnational firms. Wade

(1990) acknowledges the importance for developing nations to invite transnational companies into their countries to develop knowledge intensive industrial sectors. Nonetheless, he stresses the need to persuade such firms to adopt export-oriented strategies, as a way to stimulate them to use up-to-date technology and to constantly raise productivity and quality standards to offer competitive products to the international market. In the absence of efficient export-oriented policies in the history of the Brazilian automobile industry, transnational automakers did not have to adopt up-to-date technology, but rather only basic expertise and skills to address the demand of the incipient domestic market, resulting in the stagnation of this industrial sector in the 1980s.

In fact, import restrictions were the main policy adopted by the government to protect firms producing in Brazil. However, the use of protective measures without a broader policy framework to nurture the growth of these firms and to promote the economic development of the sector allowed companies with low technological content to prosper by supplying low quality vehicles to consumers with incipient demands. Because the Brazilian domestic market was large, incipient, and overprotected by governmental import barriers, there was no motivation for firms to enhance their quality or to adopt up-to-date technology. Although several changes have been introduced to enhance productivity and quality of the Brazilian automobile industry since the mid-1990s, at the time of the case study the market was still protected by import tax, and automakers were still primarily focused on the domestic market.

For the aforementioned reasons, it is necessary for the government to engage in more active and direct negotiating with private firms, adopting proactive policies to promote higher levels of growth in the Brazilian automobile industry. Since the Brazilian government has only restricted channels of communication with automakers, i.e. via Anfavea, the interests of automakers with low production volume in the country were not being met. MMCB can be regarded as an example, since the company had low productivity and limited resources to expand at a faster pace. In fact, MMCB personnel acknowledged that the demand for Mitsubishi vehicles in the domestic market was greater than MMCB's production capacity. The Mercosur regional market also represents a still unexplored opportunity for the growth of the company. Consequently, MMCB was expanding at a slow pace and was not taking advantage of latent opportunities in both domestic and regional markets. In fact, there is a low percentage of inhabitants per vehicle in the Brazilian domestic market, which represents a great opportunity for expansion. In 2004, according to Sindipeças' (2006) database, there were 8.1 inhabitants per vehicle in Brazil. The rate is also low in other South American countries (16.8 inhabitants per vehicle in Colombia, 10.3 in Venezuela, 7 in Chile and 6 in

Argentina). On top of that, in 2007, MMCB reported domestic sales of 4,845 Mitsubishi imported vehicles (Anfavea, 2008), which represents further evidence of the increasing demand in the domestic market for Mitsubishi models.

To increase the factory's output to a significant level, however, a closer relationship with its key first-tier suppliers is necessary. For this purpose, the involvement of the Brazilian government is of great relevance, in order to provide favourable conditions for the production of Mitsubishi engines as well as other subsystems domestically. Hence, by using only one channel of communication with automakers, the government is not properly addressing the demands of automakers with low production volume and it is questionable whether they will have a sustainable position in the long run.

The case study also showed that MMCB was attracted to Catalão mainly due to fiscal incentives and lower labour costs. MMCB received fiscal incentives from the local government, especially the exemption of a value-added tax on the circulation of goods called *ICMS* and the reduction of the import tax. Therefore, it could be argued that a number of automakers operating in Brazil do not have a competitive advantage in manufacturing and are merely taking advantage of a favourable environment. Under such terms, a slowdown in the Brazilian economic growth would result in the contraction of the automobile industry and a new period of stagnation.

Furthermore, this policy of granting tax exemptions to attract automakers to regions remote from Brazilian industrial centres also shows a still inefficient pattern of collaboration between public and private sectors towards the achievement of high level of industrial growth. The case study conducted in MMCB illustrates the efforts of local governments to attract investment to their municipalities in order to promote regional growth. Several other states in Brazil offered tax exemption as a way to attract automakers to their localities from the mid-1990s onwards. However, in some cases automakers were not followed by their first-tier suppliers, because incentives were rarely granted to subsidize the construction of suppliers' new plants. On top of that, since supply chain management in Brazil follows the Western approach and is focused on short-term relations, first-tier suppliers were reluctant to invest in new facilities that would create a greater dependence on a single automaker. As a result, this policy of tax exemption increased the geographic distance between automakers and first-tier suppliers, further decreasing the level of integration in the supply chain network. The following are some of the negative consequences of this lack of integration: high inventory costs, low productivity, incomplete implementation of the *kanban* system, and the necessity to increase final inspection of assembled vehicles. For public policies to be more effective,

a partnership between the local government and the automaker should be made, to attract key first-tier suppliers to the region and promote a higher level of integration in the supply chain network. In this manner, regional development will be promoted without jeopardizing the integrity of supply chain networks.

4. Conclusion

This paper identifies two bottlenecks for steadier growth in the Brazilian automobile industry: (1) Automakers are emphasizing coordination rather than integration in supply chain management and, as a result, knowledge is not being shared at the inter-firm level; and (2) Limited channels of communication between automakers and the public sector are resulting in inefficient policies to nurture automakers with low production volume.

In the lack of an integrative approach to supply chain management in the Brazilian automobile industry, automakers, suppliers and dealers cannot jointly pursue a sustainable competitive advantage in manufacturing. Accordingly, these firms have to focus on lower-order competitive advantages such as low labour costs, which have proven to be unsustainable in the long run, since they result in a slower pace of technology and productivity improvements. The failure to adopt an integrative approach, therefore, leads to stagnation and makes it unfeasible for domestic firms to survive global competition without governmental protectionist measures. Thus, the lack of integration results in an overall slower pace of development.

References

Anfavea. Brazilian Automotive Industry: A History of Challenges 1957-1994. Anfavea: São Paulo, 1994.

Anfavea. Rumo ao futuro: Os Acordos Setoriais Automotivos de 1992, 1993 e 1995. Anfavea: São Paulo, 1995.

Anfavea. Brazilian Automotive Industry Yearbook 2008. Anfavea: São Paulo, 2008.

Arkader, R. The perspective of suppliers on lean supply in a developing country context. Integrated Manufacturing Systems, 12 (2): 87-93, 2001.

Baldwin, C.Y. and Clark, K.B. Design Rules: Volume 1 – The Power of Modularity. MIT press: Cambridge, 2000.

Baldwin, C.Y. and Clark, K.B. Managing in an age of modularity. In: Garud, R., Kumaraswamy, A. and Langlois, R.N. Managing in the Modular Age. Blackwell: Oxford, 2003.

Botelho, A. Reestruturação produtiva e produção do espaço: o caso da indústria automobilística instalada no Brasil. Revista do Departamento de Geografia 15: 55-64, 2002.

Conner, K.R. and Prahalad, C.K.. A resource-based theory of the firm: knowledge versus opportunism. Organizational science 7 (5): 477-501, 1996.

Correa, H.L. The VW Resende (Brazil) plant modular consortium SCM model after 5 years of operation. Proceedings of the Twelfth Annual Conference of the Production and Operations Management Society, Orlando, 2001.

Cusumano, M.A. The Japanese Automobile Industry: Technology & Management at Nissan & Toyota. Harvard University Press: Cambridge, 1985.

Dore, R. Stock Market Capitalism – Welfare Capitalism: Japan and Germany versus the Anglo-Saxons. Oxford University Press, New York, 2000.

Dyer, J.H. Specialized supplier networks as a source of competitive advantage: evidence from the auto industry. Strategic Management Journal 17: 271-291, 1996.

Dyer, J.H. and Nobeoka, K. Creating and managing a high-performance knowledge-sharing network: the Toyota case. Strategic Management Journal, Special Issue 21: 245-367, 2000.

Evans, P. Embedded Autonomy: States and Industrial Transformation. Princeton University Press, Princeton, 1995.

Farris, J.A., Aken, E.M.V., Doolen, T.L. and Worley, J. Critical success factors for human resource outcomes in kaizen events: an empirical study. International Journal of Production Economics 117: 42–65, 2009.

Finep. Relatório Setorial Final: Autopeças, 2006. In: http://www.finep.gov.br/PortalDPP (accessed: 15 May 2008).

Fleury, A. and Fleury, M. T. Competitive Strategies and Core Competencies: Perspectives for the Internacionalisation of Industry in Brazil. Integrated Manufacturing systems, 14 (1): 16-25, 2003.

Flynn, B.B., Sakakibara, S., Schroeder, R.G.., 1995. Relationship between JIT and TQM: practices and performance. Academy of Management Journal 38 (5): 1325-1360.

Fujimoto, T. The Evolution of a Manufacturing System at Toyota. Oxford University Press: New York, 1999.

Fujimoto, T. Competing to be Really, Really Good: The Behind-the-scenes Drama of Capacity-building Competition in the Automobile Industry. International House of Japan, Tokyo, 2007.

Garcia, S.R. Global e local: o novo pólo automobilístico de gravataí e suas implicações sociais. XXV Congresso da Associação Latino-americana de Sociologia – Desarrollo, Crisis y Democracia en America Latina: Participación, Movimientos Sociales y Teoría Sociológica, Porto Alegre, 2005.

Imai, M., (1986). Kaizen: The Key to Japan's Competitive Success. McGraw-Hill: New York.

Kemppainen, K. and Vepsäläinen, A.P.J. Trends in industrial supply chains and networks. International Journal of Physical Distribution & Logistics Management 33 (8): 701-719, 2003.

Koike, K. Understanding Industrial Relations in Modern Japan. Macmillan press, London, UK, 1988.

Lieberman, M.B., Demeester, L. Inventory reduction and productivity growth: linkages in the Japanese automotive industry. Management Science 45: (4): 466-485, 1999.

Liker, J.K. The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer. McGraw-Hill: New York, 2004.

Mitsubishi Motors. Facts & Figures 2008. In: http://www.mitsubishi-motors.com/corporate/ir/share/pdf/e/fact_2008.pdf (accessed: 16 August 2009).

Mudambi, R. and Helper, S. The 'close but adversarial' model of supplier relations in the U.S. auto industry. Strategic Management Journal 19 (8): 775-792, 1998.

Nayyar, Deepak. China, India, Brazil and South Africa in the World Economy - Engines of Growth? UNU-WIDER, Discussion Paper, 2008.

Ó hUallacháin, B. and Wasserman, D. Vertical integration in a lean supply chain: Brazilian automobile component parts. Economic Geography 75 (1): 21-42, 1999.

Pires, S.R.I. Managerial implications of the modular consortium model in a Brazilian automotive plant. International Journal of Operations & Production Management 18 (3): 221-232, 1998.

Ramiro, D. A maior aposta da Ford: uma fábrica e um carro novos são as armas da montadora para crescer no Brasil. Veja Magazine 1749, 1 May 2002. http://veja.abril.com.br/010502/p_108.html (accessed: 9 June 2006).

Sako, M. Prices, Quality and Trust: Inter-firm Relations in Britain & Japan. Cambridge: Cambridge University Press, 1992.

Salerno, M.G., Marx, R., Zilbovicius, M., Graziadio, T., Dias, A.V.C., Muniz, S.T.G., Garcia, R.C., Lima, J.C.S., Iveson, S., Hotta, M.A. and Soares, R. A nova configuração da cadeia automotiva Brasileira: pesquisa desenvolvida junto ao BNDES. Escola Politécnica da Universidade de São Paulo: São Paulo, 2002.

Shapiro, H. Engines of Growth: the State and Transnational Auto Companies in Brazil. Cambridge University Press: New York, 1994.

Simon, H.A. Bounded rationality and organizational learning. Organizational Science, Special Issue 2 (1): 125-134, 1991.

Sindipeças. Brazilian Auto Parts Industry Performance 2006. Sindipeças: São Paulo, 2006.

Sindipeças. Brazilian Auto Parts Industry Performance 2008. Sindipeças: São Paulo, 2008.

Takeishi, A. Knowledge partitioning in the interfirm division of labor: the case of automotive product development. Organization Science 13 (3): 321-338, 2002.

Takeishi, A. and Fujimoto, T. Modularization in the Auto Industry: Interlinked Multiple Hierarchies of Product, Production, and Supplier Systems. Institute of Innovation Research Hitotsubashi University, Tokyo, 2001.

Teixeira, F.L.C. and Vasconcelos, N. Mudanças estruturais e inovações organizacionais na indústria automotiva. Conjuntura e Planejamento 66: 17-24, 1999.

UNDP. Capacity Assessment and Development in a Systems and Strategic Management Context. Technical Advisory Paper No.3, Management Development and Governance Division Bureau for Development Policy, 1998.

Wade, R. Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization. Princeton University Press: Princeton, 1990.

Wilson, D., Purushothaman, R. Dreaming with BRICs: The Path to 2050. Goldman Sachs, Global Economics Paper 99, 2003.

Womack, J.P., Jones, D.T. and Roos, D. The Machine that Changed the World: The Story of Lean Production System. 2 ed. HarperPerennial: New York, 1991.