Typologies of Hybrid Supply Chains in Emerging Economies:

The Case of Supply Processes in the Mexican Automotive Industry

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Abstract

The competitiveness of supply chains is intimately tied to the local context they are located in. In order to identify potential factors articulating the dynamic competitive advantage, we propose a framework of analysis hybrid supply chains from a holistic point of view.

Keywords: Dynamic competitiveness; holistic approach; supply chain management; systemic feed-backs.

In a highly effective supplier integration process, the local business environment in which the plant is located becomes crucial for sustainable competitive advantage. This is mainly true in cases where the firms have to face the complexity caused by dynamic interactions between local and global supply chain entities. In the new production systems, the capability to compete on time is leveraged by the sources of knowledge or key information that a firm needs to stay competitive. However, they are available outside the company itself. The evidence presented in this paper shows that firms have to achieve advantage by leveraging knowledge and skill taking into account the variety of linkages between OEMs and local suppliers.

The purpose of our work is to show an analytical model that tries to serve as a tool in the identification of relational factors, articulating the dynamic competitiveness of an automotive cluster. It sustains that it is possible to generate economic benefits of a systemic nature, which, according to Dyer and Singh (1998), can be called relational rent. The systemic intelligence model that is proposed here is based on the ability to gain relational profits through the systemic articulation of the specific competitive advantages of each of the members in a supply network. According to Gereffi, et al. (2005) "the value chains are not static and they depend on the details of how interactions between value chain actors are managed". The right integration of competitive advantages is a fundamental part in the dynamic development of differentiation competencies. In fact, we argue that performance in a global supply chain can be leveraged through a hybrid process integration of local supply chain partners.

The rest of this paper is organized as follows. In the next section, the existing literature on the supply strategies used by the automotive participants when searching

for a better competitive position in the market is discussed. Then we will discuss the methodology employed. The case-study and the findings are presented by first developing and discussing a typology of supply strategies and their morphological differences, which are linked to the classification developed. Finally, conclusions and future work are presented.

LITERATURE REVIEW

This section reviews the literature and shows a reference framework from a global perspective. The main objective is to understand the dynamic approach that automotive companies in Mexico are adopting in theirs supply strategies.

From a traditional point of view of plant localization, competitiveness is a static matter. Only cost reduction, government subventions or advantageous access to certain markets can provide economic benefits. Nevertheless, in an uncertainty environment, this focus condemns competitive viability in the long run of supply networks. On the other hand, from a dynamic viewpoint, it is through innovation in different processes within the supply chain and the capability for integrating different structures of production systems, where new and specific competitive capabilities can be created in the long term.

In reality, the competitive environment is a system with dynamic complexity. It results in constant combinatory evolution that includes industrial systems and the local environment in which they are immersed. This process of reconfiguration holds the paradigm that all organizations possess a temporal set of competencies, of which only a part have a strong differentiation value in the market (Hamel and Prahalad 1990). Certainly, high competitive companies like Toyota or Honda have demonstrated in the

past few years that all competitive advantage is temporary and should be subjected to a constant process of adjustment. In fact, unpredictable demand and more competitive markets become the norm.

Although there are a large amount of studies related to the development of global supply chain strategies, in many cases only a few key factors to market success are taken as a basis. The structure of demand is not the same in all competitive contexts. Generally, the importance of local differentiation factors is not adequately valued when building a competitive advantage in a global logistics network.

Some authors (Christopher 2000; Christopher and Towill 2001; Mason-Jones et al. 1999) estimate that the strategies of agile supply chains are appropriate when faced with the need for quick answers to changes in demand and when the level of customer service is a key factor for market success. Similarly, other authors (Holweg and Pil 2005; Miemczyk and Holweg 2004; Womack, et. al. 1990) put emphasis on the fact that "Lean" type supply chains are adequate when we need to eliminate waste and when product cost is a key factor for success with the consumer. Other more specific conceptual developments seek to integrate the advantages of both previous focuses, resulting in a hybrid approach (Naylor et al. 1999; Vonderembse et al. 2006). In our days, considering only certain market-driven factors in a standardized way may not be enough to develop effective logistics strategies in order to provide the benefit of local competitive advantages. Other authors (Bhatnagar, Jayaram and Phua 2003; Bhatnagar and Sohal 2005; Bowersox and Closs 1996; Ferdows 1997; Khurana and Talbot 1998), from a multidimensional approach, consider that the performance of a supply chain is affected by regional factors, beginning with the responsiveness of production systems of local suppliers with which production sites are operating.

Today it is clear that the configuration of supply networks according to local context and the related sourcing decisions are sources of potential global competitive advantage. Nevertheless, our review of literature and research found important gaps in analyses about hybrid supply processes from a principle of co-evolution between the industrial system (supply network) and the business climate system (local conditions). Another issue not examined in previous research is about the local key determinants of automotive system dynamics from a logistics point of view in an emerging economy as Mexico, a key player in the NAFTA area. While there is a trend to broaden the scope of the standardized models by incorporating a few market drivers, there has been limited attempt to identify different local variables in order to conceive specific and original logistics strategies. Thus, considering a multidimensional approach, the question arises if the typology of hybrid supply strategies and production systems in their current organizational format can support a dynamic competitiveness currently needed by global assembly plants located in Mexico.

METHODOLOGY

In accordance with Jankowicz (2000), the most pertinent research methods and techniques depend on the problems and the objectives fixed. In this paper, based in an exploratory investigation, our main objective was to identify and study the factors that impel dynamic competitiveness in automotive supply chains in order to build an analytical model. Considering the originality of the question studied, we used a qualitative research approach. Because it is flexible, it was applicable to the deep analysis of the different aspects of a phenomenon not yet established in literature. In fact, “a case study is an empirical enquiry that (1) investigates a contemporary

phenomenon within its real life context, especially when (2) the boundaries between phenomenon and context are not clearly evident" (Yin, 2003, p.13).

Our decision to adopt a case-study based approach following an established framework (Eisenhardt 1989; Yin 1994) was driven by two main factors. First, case-based research in operations management and logistics research is well established (Ellram 1996; Meredith 1998; Voss, Tsikriktsis and Frohlich 2002). The second motivation was the lack of previous automotive research linking feedback between the industrial system and local conditions from a global standpoint. Consequently, a qualitative research approach was more appropriate for going deeper into different aspects of this new focus of analysis (Ghauri and Gronhaug 2005; Maxwell 1998). According to Meredith (1998), an exploratory case approach is an appropriate alternative where "the variables are still unknown and the phenomenon not at all understood".

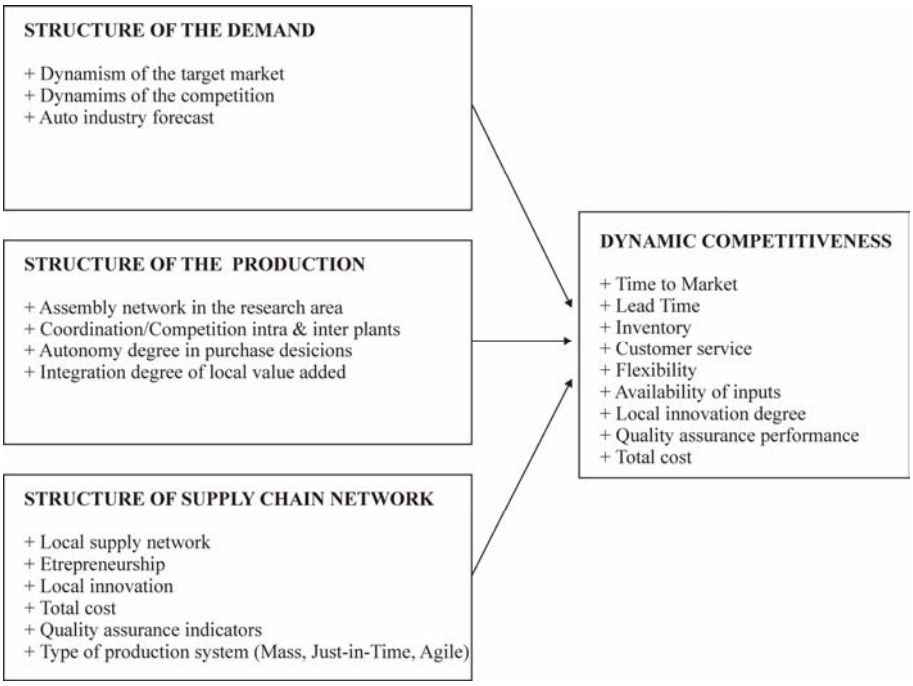
Operationally, the research went along an abductive or hybrid process apt for the decoding of complex systems (Thiétart 1999). A multi-method triangulated research approach was developed, comprised of both qualitative and quantitative methods (Jick 1989). In consequence, the integration of the area of study observed and the research into theorical knowledge took place simultaneously all the way through the investigation.

In the first phase we performed a qualitative analysis using exploratory interviews involving 15 experts in order to understand the internal processes of the automotive system and the local system. In this way, starting with a global approach, we descended in our analysis until we were able to trace a level of local study that would give us a better understanding about our research problem. Thus, we identified a

research framework. It showed that the dynamic competitiveness from a logistics point of view is impacted significantly by the feedbacks between the following three main factors (See figure 1): a) Structure of the demand; b) Structure of the production and c) Structure of the supply network.

FIGURE 1

RESEARCH FRAMEWORK



In the second phase, we developed process mapping research strongly influenced by the systems approach (Ackoff 1971; Bertalanffy 1968; Durand 1979; Sterman 2001). Our interest was in decoding the set of privileged ties that make up the structure within the organizational architecture of the automotive supply chains studied.

The third phase included 22 semi-structured interviews with a structure of questions based on the research framework. It was applied to executives of assembly

plants, Tier 1 and Tier 2 suppliers, as well as to service providers and experts in the academic and governmental areas. The objective of this phase was to understand the systemic feedbacks from a qualitative viewpoint.

Given the importance of assembly plants and Tier 1 suppliers within the automotive value network, field observation was based on a representative sample. This was mainly because of the cluster effect that they generate on the local economic environment. This approach was set up when two conditions were present:

1. A large population of actors, which caused problems in qualitative data collection for each unit analyzed.
2. It was more important to obtain a global understanding of the automotive system behavior in the region.

The research was based on in-depth process mapping at the regional logistics operations, complemented with a total of 35 semi-structured interviews in the same number of different automotive companies. In a later step, and through recurrent identification of actors, we defined a final sample of 18 main actors that are directly involved in the evolution of the automotive value network being studied. Of these, 4 are assembly plants, 7 are Tier 1 suppliers, and 9 are Tier 2 suppliers. The companies analyzed are found in the central-western region of Mexico. This region is made up of the states of Jalisco, Guanajuato, Michoacan, Zacatecas, San Luis Potosi and Queretaro.

ANALYSIS AND FINDINGS

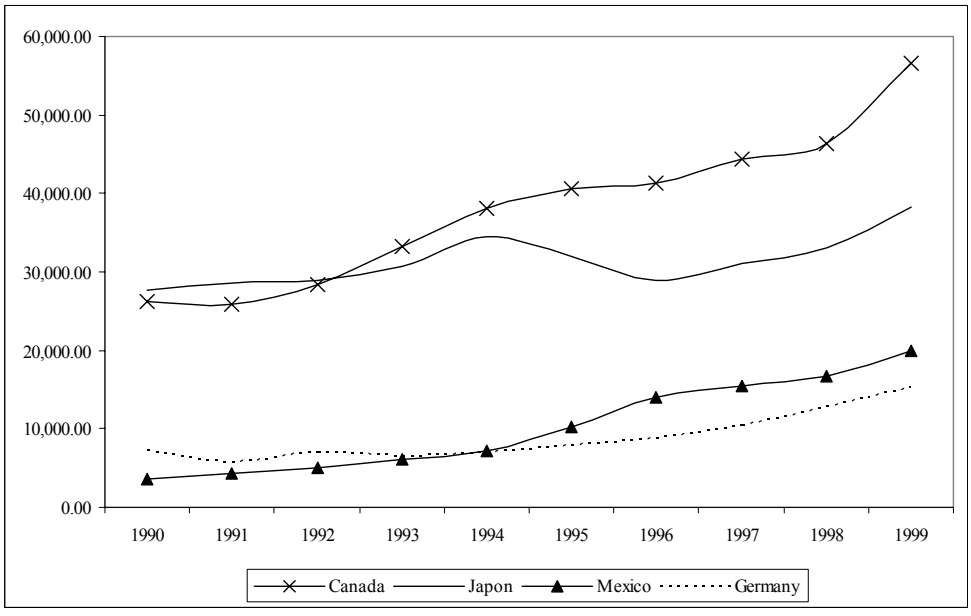
The objective of this section is to analyze our findings based in a research framework and methodology approach explained in the previous section. For this purpose, we first present a brief description of the research context. In this way, a

connection is made between the bibliography used for our research and our field work. Second, we are also presenting the observational model used and the key performance factors identified in the supply chains studied. Finally, we have done an analysis that links global supply chains to the local system through local suppliers.

Among the emerging automotive countries, the Mexican automotive industry has achieved an important position in economic benefits as well as productive flexibility and quality (J.D. Power and Associates 2003). These aspects have made Mexico the third most important vehicle exporter to the US market (U.S.D.C. 2003) and sixth in the world as to dollar value of production (WTO 2003).

FIGURE 2

U.S. AUTOMOTIVE IMPORTS

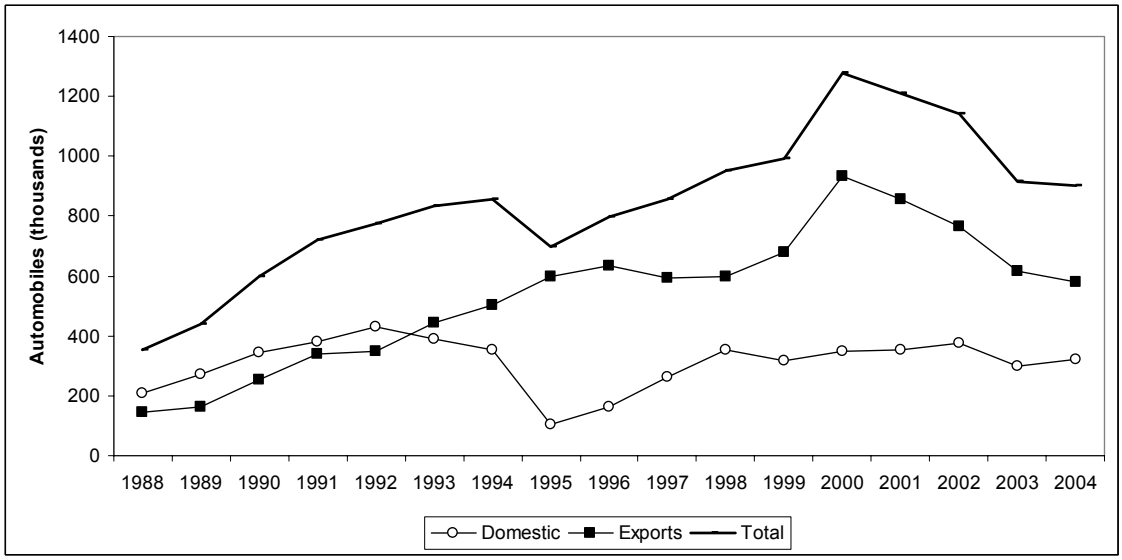


Source: U.S. Department of Commerce 2003

Considering both the assembly of automobiles and the manufacturing of auto bodies, motors, parts, accessories and rubber products, the automotive industry represented 14.4% of the GNP in 2004 for Mexican manufacturing. At the same time, this industry represents 21.9% of the total value of Mexican exports and employs 19.8% of the people working in the manufacturing sector, accounting for more than 1 million jobs (INEGI 2004). Since 1989, the year in which the signing of the automotive decree marked the change in the policy of substitution of importations to the promotion of exportations, through the year 2001, the production of automobiles nearly tripled, from 438,620 to 1,208,994 units (See Figure 2).

FIGURE 2

TOTAL AUTOMOTIVE PRODUCTION BY MARKET TYPE



Source: AMIA 2005

Since NAFTA was put in effect in 1994, the majority of production was destined for exportation. After an economic crisis that took place in December of 1994, the

internal demand was reduced and the exportation focus became much more important in the productive strategy of automotive firms installed in Mexico.

Evolution of sources of competitive advantage

At the beginning, the automotive localizations looked for the installation of production sites that maximized strategies for intensive use of inexpensive labor and plant capacity. Even though this strategy continues, the evolution within this industrial system has obligated assemblies to look for other options. Thus, in a second phase, investments were made that reinforced the first strategy and, at the same time, improved production quality and flexibility (Carrillo and Ramírez, 1997; Carrillo and Lara, 2003; Layan 2003). The objective was to reduce the impact of uncertainty in demand and thus improve the global financial performance of the value chain.

Using a sustained exportation strategy, the automotive OEM with their plants in the North of the country, looked to be close to the main market, and at the same time to facilitate interaction with plants located in the South of the US. In a third and current step, there is a slow integration of the national production into global supply, production and distribution networks. The search for logistics relational rents has become an important factor of competitive advantage.

Currently, the Mexican automotive supply chain is made up of: a) 13 international vehicle assembly companies; b) 345 Tier 1 suppliers; c) 655 Tier 2 and Tier 3 suppliers. In fact, of the 1,000 auto part supply companies, only 30% are run with Mexican capital (INA 2004).

Types of supply processes

One of the main consequences of the competitive environment in the automotive industry is the dynamic structure of the supply chains. There are ever more suppliers called in to make up more links in the supply chains. Therefore, suppliers must constantly develop capabilities in order to be quicker in getting involved in the automotive growth.

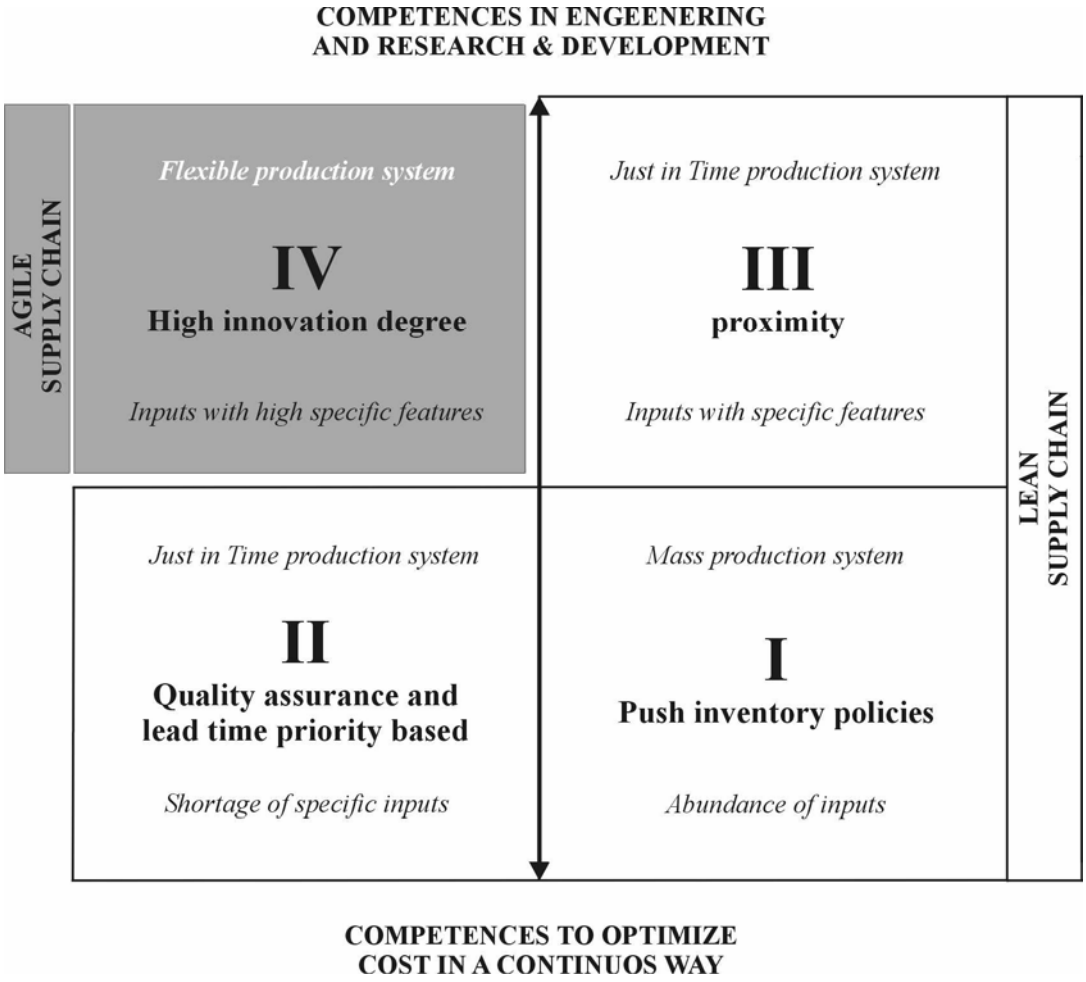
Among the main three elements repeatedly mentioned by the managers interviewed were: a) Capability of engineering and developing new products; b) Capability to adequately satisfy demand; c) Capability to optimize costs in a continuous manner (See Figure 3).

In fact, there are four types of supply processes according to two essential classifications: a) the availability of materials, supplies, components or systems; b) the quality of the logistics system in its responsiveness to demand. From this standpoint there is a direct correlation between the degree of specificity of inputs and the degree of incidence of local competitive advantage in the global supply chain.

First, the geographic dimension, which involves specificities due to: a) taking advantage of competition in price or technology over products of a certain region (Zone I); b) use of materials from a specific origin in order to guarantee the quality (Zone II); c) limits related to the transportation of products. This is the case of heavy or very large products that must be delivered just on time and which require assembly processes near the assembly plant (Zone III).

FIGURE 3

TYPOLOGY OF SUPPLY PROCESSES



Second, the technological dimension, which involves specificities with high added value to be perceived by the end customer and that involves: a) proximity, whether it be cultural, organizational, geographical or strategic, where the reduction of transaction costs is the main objective (Zone III); b) the degree of innovation of a product or the relative specificity in the compliance with specific regulations (Zone IV).

Types of links to the local system

Through field work we were able to see the existence of 4 relational focuses that guide assembly plants in their interaction with suppliers (See Figure 4). In the first place, for goods with low differentiation value that are supplied by mass production systems with the capacity for constant cost reduction, the supply process is guided by **opportunistic behavior** (Zone α). In this zone we find the majority of Mexican SME (small and medium sized enterprises) participating as suppliers within the automotive supply chain. The relational dependency of international OEM with respect to this type of supplier is minimal. The competitiveness in the supply process is based on the consolidation of competitive advantages based on low cost. A purchasing company based only on this type of competitiveness is known, according to Veltz (1993), as a nomad company, since its degree of commitment-dependency with the local system is minimal.

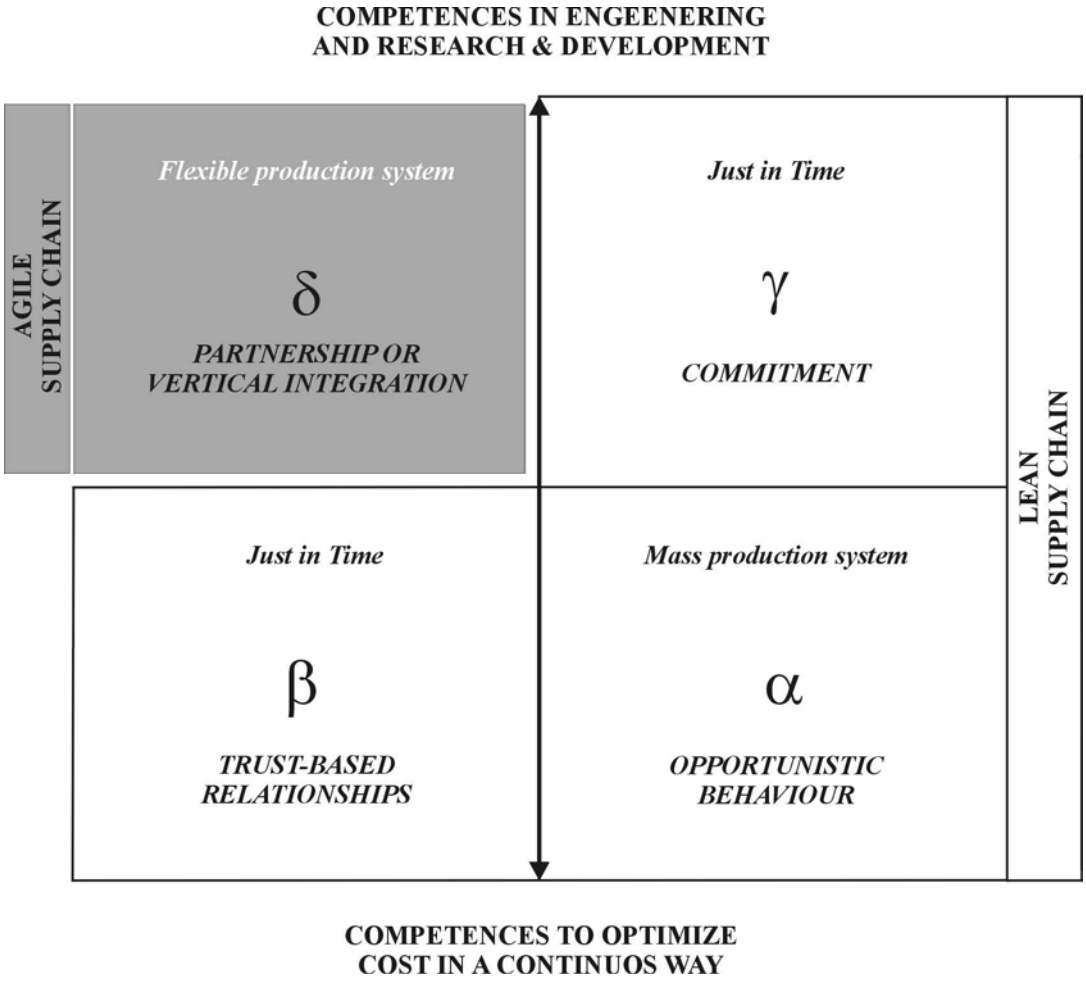
In second place, we identified a supply process in which the relative specificity of products obliges the establishment of **trust-based relationships** (Zone β). In this case, organizational, geographical and cultural proximity are essential for participating in the supply chain. The bonds of trust between customers and suppliers are the result of an important relational frequency through time. This type of supply process is based on the stability of the conditions of trust that have strengthened the relationship (price, quality, compliance, etc.).

In third place, we identified a supply process in which abundance is circumscribed to a geographical region and in which the relationship between those involved is guided by **commitment** (Zone γ). In this case, the purchasing company establishes stable relationships within a framework of trust that allows them to pass

from a process of purchasing based on best price to the forming of a bilateral relationship that ensures price, quality and frequency in supply. We should mention the important role that cultural proximity between actors and limited temporality of the contractual relationship has in the internal processes of the companies surveyed.

FIGURE 4

TYPE OF LINKING WITH THE LOCAL SYSTEM



In fourth place, when special characteristics of components are involved, the supply process is based on **partnership** (Zone δ). This process is the result of the

integration of products that have high differentiation in innovation, which gives an important level of added value to the final product. Due to this, the control that the assembly plant exerts on this supply process is the highest observed.

Of the different types of links between the industrial system and the local system observed, this research identified that the competitive factors needed to take part successfully in a global supply chain within the automotive sector depend greatly on the type of link between OEMs and the local productive networks. Four types of links are possible: a) opportunistic; b) trust; c) commitment; d) alliance. Consequently, our findings prove that there exists a relational variety (trust-based relationships, commitment, partnerships) inside the relational model (development model) detected by Flynn et al. (1996).

In the first case, the integration of supply chains based on OEM opportunistic behavior (selection model) requires for Mexican SME various elements of differentiation in order to become competitive: a) the continual reduction of production costs; b) the high performance of the regional logistics systems; c) the trustworthiness of information systems and strategic watch; d) the centralization of the purchasing function; e) the implementation of performance indicators common to all local actors involved.

First, the logistics system helps to strengthen the coordination and cost competitive advantage through on time deliveries to the customer's assembly line. Information systems facilitate functional integration in the supply chain. Second, the strategic watch systems support analysis of the evolution of buying prices, technological tendencies, and location of clients and suppliers. It increases the negotiation capacities and the networking effect of local actors. Finally, the centralization of purchasing,

inscribed in this opportunistic focus, is a factor that may increase competitiveness and negotiating capacity for small local actors.

In the second case, the trust-based relationships, the OEMs that we analyzed, look for profitability based on a constant volume of production, as well as higher flexibility in production processes. From this standpoint our work verified that one of the elements of success necessary (in order to be accepted in this kind of relational model) is the capacity to react quickly to demand with high quality products at competitive prices. Nevertheless, within this type of relationship an important barrier to cooperation, identified in the past by Belzowski (2005) and verified in our study, is the barrier that comes up when a Tier N supplier is directly elected by the assembly plant and communication is established between them. Sometimes the Tier N does not respond to directives set forth by the Tier 1. This reduces the flexibility and coordination within the supply chain management of the Tier 1 supplier and consequently affects the global performance of the value chain.

In the third case, relationships based on commitment are found in companies whose products have greater level of engineering and respond to a more dynamic market. These companies integrate supply chains with a higher degree of variability in the demand. As a measure of prevention when faced with the uncertainty that is part of this type of relationship, companies establish stable relationships within a defined legal framework. Competitiveness is ensured only if the costs linked to the establishment of stable relationships are recovered through demand on the part of the final consumer of the products on top of the category. In reality, it is the technological specificity of the final products that favors the integration of more stable relationships in which the degree of innovation in engineering and development of new products is important.

This relational type of integrating a supply chain is pertinent to innovative products that require adopting efficient organizational forms that are compatible with the purchasing companies, forming relational proximity.

In the fourth case, relationships based on partnerships, local companies interested in integrating supply chains for highly innovative products must develop capacities for anticipating market evolution. In this case the constitution of synergetic networks is a significant approach.

Due to the fact that industrial systems become more and more complex and that the market environment becomes more and more unstable, industrial systems must simultaneously face competition based on time, price, availability, and quality. If we add to this the relational instability of the local network, the complexity increases.

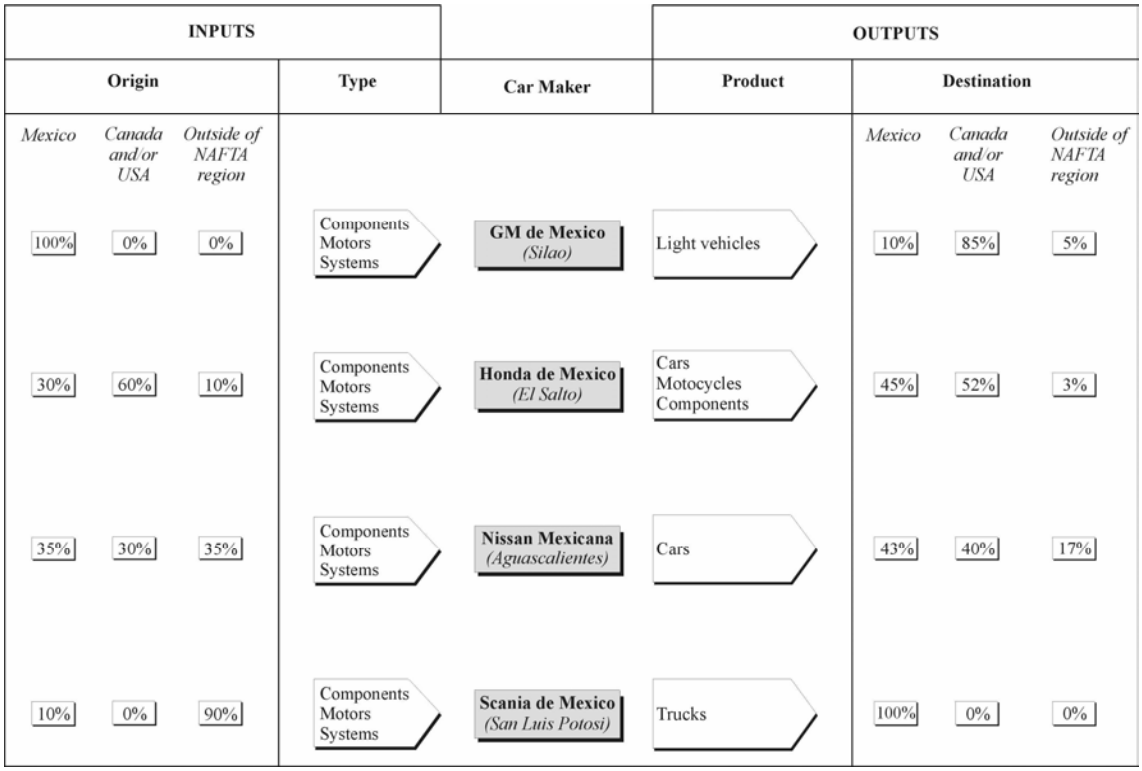
As a result, automotive companies generalize the imitation of best practices as a survival strategy (Vega-Redondo 1999). Nevertheless, the variety of possible solutions that allow competitive integration of a supply chain requires a wider focus as to the context of competition where participation is present. In this way, it is more important to consider the wide range of factors that allow total supply cost reduction than to just consider the lowest purchase price per component acquired. A balance must be found between components supplied locally and those imported from other countries.

The advantages of forming local supply networks seem evident. In actuality, assembly plants located in Mexico comply simultaneously with the denominations of local content and globally preferred suppliers. The lack of competitive Mexican suppliers strengthens the tendency to put small international companies in close proximity to assembly sites or to use suppliers from other parts of the world. In the

assembly plants observed, the percentage of imported components is very high, but mandatory for the ensuring of site competitiveness (See Figure 5).

FIGURE 5

LOGISTICS MAPPING OF THE ASSEMBLY COMPANIES STUDIED



In the case of Mexican SME, which represents 48% of the automotive companies in the country, the participation in the automotive value chain is only 1% (See Table I). For them, the identification of factors which allow them to form part of a larger number of global supply networks is a first and vital step in the construction of systemic intelligence in the Mexican context. This means that a pro-active focus in relational operations is important.

TABLE I

PARTICIPATION OF MEXICAN SMALL ENTERPRISES IN THE AUTOMOTIVE VALUE CHAIN

AUTOMOTIVE INDUSTRY IN MEXICO	Economic Units	Production total	Value added
		Million of US Dollars ($ 1 US = 10.8 peso MX)	
Personnel	**1 410**	**$ 5 983**	**$ 1 585**
0 –10	48 %	1 %	1 %
11 – 50	27 %	1 %	2 %
51 – 250	16 %	6 %	7 %
251 – 1000	7 %	17 %	20 %
1001 – Plus	2 %	75 %	70 %

Source: INEGI 2004

In reality, there are different factors that reduce the capacity for developing local competitive advantages in the global supply chain of OEMs installed in Mexico. First, the short term relationships between certain supply chain actors. Second, the great lack of interest on the part of OEMs to understand the problems of local suppliers. Third, there is great variability in the demands of OEMs on suppliers. Fourth, the poor interest on the part of SME suppliers to invest in innovation.

Two of the main general lines of action that are still needed in the base of small Mexican suppliers are: a) developing a culture of total quality and innovation as a

dynamic business development lever; b) establishing a focus of supply chain collaboration in operations management.

DISCUSSION AND MANAGERIAL IMPLICATIONS

The main contribution of this study leads to several important insights for manufacturing firms that participate in complex industries. Automotive industry illustrates that for assembly products a diversity of supplier relationships is required. Faced with the hypercompetitive economic context organized in the automotive networks (D'Aveni 1994), it is not only necessary to have better organized hybrid processes, but it is also necessary to dynamically integrate the set of differentiated advantages that local actors can contribute to the competitiveness of any industrial system. According to Eisenhardt and Martin (2000), in moderately dynamic markets, the evolutionary emphasis is on variation. Our analysis indicates that SME in emergent markets should identify the relational approach of their clients in order to focus on efforts for developing specific advantages. Switching suppliers often becomes a competitive strategy only for firms based in static advantages (transport cost, government subsidies, exchanges rates, labor rates and taxes).

Through the revision of the bibliography, we can see that although there are an important number of studies related to the development of strategies for global supply chains, in many cases only a few key factors for market success are taken into account. The importance of the local differentiation factors in the building of a dynamic competitive advantage of a global logistics network is still not fully appreciated by the automotive members in Mexico.

Taking the automotive industry as a case study, this work presented an analysis framework that serves as a tool for the identification of factors that allow the articulation of dynamic competitiveness, a framework designed from a systemic intelligence approach. The tendency towards flexible organization in production obliges automotive companies to adopt a systemic approach in which logistics competencies are a strong differentiation factor.

Due to the abandoning of the mass paradigm of production in favor of a paradigm focused on Time to Market, deep seated modifications come about in the organization of value networks and in the way inter-company cooperation is handled. In fact, our investigation verified that the dynamism in the automotive supply chain does not go without change and depends on the conception, organization and putting into practice of the chain through interactions between local and global actors, as well as on the way in which information technology facilitates these interactions (Gereffi et. 2005).

Due to the fact that the competitiveness of SME is intimately linked to the attractiveness of the territory where they are located (Carayon 2003), a systemic approach that integrates the evolution of the automotive industrial system, as well as the local territorial system is basic for the development of dynamic automotive competitiveness. These results should provide useful guidelines for managers contemplating improvements in supply chain performance as well as for local agencies contemplating investments in the improvement of business climate.

Future directions

Future research could involve expanding the processes described for this work. Due to the fact that the concept of supply chain is a global focus, it is important to

determine the factors that define the link with the local context of the rest of the logistics processes (production and distribution). First, a complete analysis of these two processed with our quantitative data and then a focus that integrates them through analysis of the decision making process, will allow us to understand and constitute better strategies for the integration of local competitive advantages into global supply networks. Second, as a result of this analysis and from a systemic point of view, the development of a causal model with a system dynamics approach will allow us to establish, evaluate, and simulate the potential relationships between the supply practices and the dynamic competitiveness of the different types of companies linked to the given supply chains.

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