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Exploring variables of transaction costs in Brazilian automotive supply chains

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To cite this document:

Jonas Lucio Maia Aline Lamon Cerra Alceu Gomes Alves Filho, (2010), "Exploring variables of transaction costs in Brazilian automotive supply chains", *Industrial Management & Data Systems*, Vol. 110 Iss 4 pp. 567 - 590

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# Exploring variables of transaction costs in Brazilian automotive supply chains

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variables of  
transaction costs

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Received 10 July 2009  
Revised 21 September 2009  
Accepted 19 January 2010

## Abstract

**Purpose** – The purpose of this paper is to shed light on the “automaker-supplier” relationships that exist in a supply chain of the Brazilian automotive sector, based on assumptions and variables of transaction cost economics (TCE).

**Design/methodology/approach** – The paper explored case studies carried out at an automotive engine manufacturer and six of its suppliers, applying semistructured interviews.

**Findings** – The findings indicate that automakers seek to utilize a form of hybrid relationship with their suppliers, which sometimes resembles competition and at other times cooperation; asset specificity tends to be greater in the first-tier of the supply chain; and asset specificity seems to be mediated by aspects such as the amount of production destined to the manufacturer, the objective of maximizing return on previous investments, and the configuration of higher value-added supply operations.

**Practical implications** – The results corroborate that close, long-lasting, and trustful relationships tend to reduce transaction costs and improve performance, but in some cases, “latent competition” may also lead to reduced costs; managers should not undervalue the self-reinforcing effects of asset specificity in a context of shared investments; and business strategy should guide every decision made inside supply chains in order to align supply and operations priorities.

**Originality/value** – Considering the deep restructuring process that Brazilian automotive industry has experienced, this paper brings its contribution in using TCE tools to analyze relationships inside an engine-producing supply chain, dealing with the links between TCE and supply chain management.

**Keywords** Transaction costs, Supply chain management, Automotive industry, Brazil

**Paper type** Case study

## 1. Introduction

Relationships between automakers and their suppliers have been changing since the 1980s, in large part due to the dissemination of Japanese industrial practices in the western hemisphere (Alves Filho *et al.*, 2004). Within the context of this new relationship pattern in Japan's automotive industry are the partnership relations among firms in the supply chain (Dyer and Ouchi, 1993; Liker and Wu, 2000).

Pursuant to these changes in the practices of companies, various approaches have been employed to analyze supply chains and the relationships among companies. Each of these approaches stems from distinct areas of knowledge, e.g. economics, sociology, business administration, among others, which have different presuppositions, applications, and focuses of analysis.

One of these approaches is transaction cost economics (TCE), which assumes that the transaction should be the basic unit of analysis. TCE seeks to examine how partners in a



Industrial Management & Data  
Systems  
Vol. 110 No. 4, 2010  
pp. 567-590

© Emerald Group Publishing Limited  
0263-5577  
DOI 10.1108/02635571011039034

transaction protect themselves from the risks associated with exchange relationships and choose structures of governance aimed at minimizing the costs incurred when goods and services cross organizational boundaries (Klein and Shelanski, 1994, p. 2 *apud* Farina *et al.*, 1999).

Shifting from the theoretical to the empirical focus of this study – Brazil's automotive industry, the following paragraphs provide a brief overview of the importance of such industry.

Quantitatively, a straightforward analysis of statistical data issued by the Brazilian Association of Automotive Manufacturers (Anfavea, 2009) indicates the relevance of local automotive industry. In 2008, the automakers set up in the country operated 40 production plants that employed about 1,12,000 people and produced 3.2 millions of automobiles. With these production levels, Brazil is ranked the sixth largest producer in the world, and the biggest manufacturer in Latin America, producing 47 percent more cars than Mexico (the second one). The suppliers that belong to this industry are also very relevant, according to the Brazilian Association of Autoparts Industry (Sindipeças, 2009), once that in 2008 the companies presented total revenues of US\$39 billions and employed 208,000 people.

Qualitatively, with the economy opening in 1995, the Brazilian automotive industry has experienced important changes, such as deep technological update of existing plants; the set up of new automakers in regions without tradition in the local industry; and a process of consolidation and “denationalization” of auto suppliers (Cerra *et al.*, 2009). Also, directly related to the engine segment inside this industry, it is worth mentioning two phenomena specific to Brazilian scenario:

- (1) the utilization of low-displacement 1000cc engines in the early 1990s, and their recent derivations (1300cc and 1400cc); and
- (2) the bi-fuelled engines (called “flex” engines in Brazil),

which can operate and maintain appropriate performance levels when fuelled by gas, ethanol, or any mixture of both.

Also, as Maia *et al.* (2005) point out, the pattern of relationships among companies in this industry shows differences and specificities inherent to each relationship in terms of the supply chain structure, the closeness of the relationships, and the activities developed within their context, among other aspects.

Thus, the question to be examined here is: “Considering the relevance and diversity of Brazil's automotive industry supply chains, how can TCE contribute to analyze and explain, at least partially, the configurational aspects of the chains, as well as the operations developed and decisions taken within them?”

In this context, the purpose of this work is to shed light to the “automaker-supplier” relationships that exist in a supply chain of the Brazilian automotive sector, based on the assumptions and variables of TCE. This main objective can be subdivided into at least three secondary objectives:

- (1) portray the various aspects relating to the relationship between companies, such as clients serviced, suppliers utilized, products transacted, autonomy and technological content, etc.;
- (2) examine the “environmental” issues of TCE – asset specificity, complexity, uncertainty, and frequency – in these relationships; and

- 
- (3) broach the “behavioral” aspects of TCE – imitated rationality and opportunism – in these relationships.

The next section offers an explanation of the concepts of TCE. This is followed by a discussion of the method utilized and of the case studies themselves. The last section presents the final remarks of this paper.

## 2. Transaction cost economics

Until the 1930s, the theory of economics recognized the existence of various types of costs, but was rooted in the belief that the economic costs associated with purchase and sales transactions were negligible compared to production costs (Fiani, 2002).

This predominating view only began to change after Ronald Coase’s pioneer article, “The nature of the firm,” was published in 1937. According to Azevedo (1996), Coase claimed that the exchanges, the establishment of agreements or the result of any transaction between economic agents involved costs, which could involve the garnering of information or the negotiation and establishment of an agreement between the parties. These costs were generically called transaction costs, and studies were initiated about the conditions in which such costs would cease to be negligible and become an important element of analysis in the decisions of economic agents (Fiani, 2002).

Thus, in a practical definition, transaction costs are costs incurred in making economic exchanges to a unit outside the organization. Seeking a more formal description of transaction costs, we can present them as the:

[...] *ex-ante* costs of outlining, negotiating and safeguarding an agreement, above all the *ex-post* costs stemming from problems of adaptation that appear when the execution of a contract is imprecise as a result of delays, errors or omissions (Azevedo, 1996, p. 221).

The determining factors of transaction costs are the hypotheses of asset specificity, complexity and uncertainty, frequency of transactions, bounded rationality and opportunism. The first three refer to environmental aspects, while the last two cover behavioral issues (Williamson, 1985).

“Bounded rationality” argues that individuals, though intentionally rational, encounter limitations in accumulating, processing, and transmitting information. Hence, due to the limited rationality of decision-makers, the asymmetric distribution of information, and the inability to completely specify the behavior of agents in the presence of multiple contingencies, TCE considers that all contracts are incomplete and therefore subject to renegotiation and possible opportunistic behavior (Leiblein and Miller, 2003).

With regard to “opportunistic behavior,” it is held that there are no restrictions for the selfish behavior of economic agents, which means that the parties may take (unfair) advantage of a negotiation, imposing losses on their counterpart(s) in the transaction. One party may behave unethically before the transaction goes into effect (*ex ante* opportunism) or the unethical behavior may occur during the term of the contract (*ex post* opportunism).

Opportunistic behavior, according to Judge and Dooley (2006), cannot simply be assumed in studies based on TCE – it is necessary to analyze and evaluate the real possibility of this behavior. These authors state that the possibility of opportunistic behavior in alliances between companies can be reduced by:

- equal investments in the alliance;
- the establishment of contractual safeguards; and
- the mutual trust of the partners in the relationship.

Bounded rationality and opportunistic actions increase transaction costs, and these costs grow as the “asset specificity” and “uncertainty” involved in the transaction increase (Grover and Malhotra, 2003). “Asset specificity” refers to the assets which, when utilized for a purpose other than the one originally agreed to, lose value, and therefore they consist of durable investments committed to a specific transaction. According to Palmatier *et al.* (2007), specific assets reduce the motivation for opportunistic behavior and the possibility of threats of exchange, which, in turn, tend to minimize the need (and costs) of monitoring performance and safeguard assets.

As the asset specificity increases, more complex structures of governance (i.e. more complex contracts) are required to mitigate fraudulent actions involving profits on specific assets (Williamson, 1985). The greater the specificity the greater the risks and problems of adaptation; hence, the higher the transaction costs.

Williamson (1979) *apud* McNally (2002) identified three types of asset specificity:

- (1) *Site specificity*. This refers to the situation in which successive stages of production that are by nature immobile are located close to others to improve coordination and save inventory and transportation costs.
- (2) *Physical asset specificity*. This refers to specific capital investments (i.e. customized machinery, tools, etc.). This allows, for example, for product differentiation and can improve quality, increasing the product’s integrity.
- (3) *Human asset specificity*. This refers to the specific know-how accumulated by the people involved in transactions of long-term relationships (Kulkarni and Fiet, 2007).

Three other types of asset specificity are considered by Williamson (1991, p. 281):

- (1) *Dedicated asset*. This refers to an investment whose return is related to a particular transaction, and is individually relevant.
- (2) *Brand specificity*. An example are franchises, which involve transactions based on the concession of the use of a given brand by third parties.
- (3) *Temporal specificity*. The value of a transaction depends on the time in which it is processed.

The characteristic “uncertainty” of a transaction can be a determinant in the choice of a governance structure. The role that uncertainty plays is that of revealing the limits of bounded rationality, thereby evidencing the incompleteness of contracts (Farina *et al.*, 1999).

The “frequency of relationships” also has an impact on transaction costs. Repetition of the relationship may enable the parties to learn about each other (reducing uncertainty), create a reputation around a brand (generating a specific asset) and, in some cases, create a trustworthy commitment to the continuity of the relationship (Farina *et al.*, 1999).

Thus, the principal issue that TCE works on, according to Williamson (1994), is the alignment of transactions (which differ in their attributes) with governance structures

(which differ in their costs and competencies). There are three forms of governance (Barney, 1999; McNally, 2002): spot market (transactions involving the instantaneous transfer of products or services), vertical integration or hierarchy (a mechanism utilized to manage economic exchanges inside the boundaries of the firm), and hybrid (a mechanism used to manage economic exchanges through subcontracting, alliances and franchises, among others, combining aspects of market and vertical integration).

### 3. TCE and the relationships in automotive supply chains: empirical evidence

Based on empirical evidence, this section attempts to illustrate practical applications of the TCE elements introduced in the previous section to studies about automotive supply chains.

In order to frame all the contributions such studies may bring, we revisit the supply chain management (SCM) model proposed by Alves Filho *et al.* (2004). The authors, after having conducted a deep review of the literature synthesized a model that groups SCM main assumptions under four related subsets, to mention:

- (1) competitive environment, with competition taking place among entire chains;
- (2) organizational strategic alignment and profit sharing;
- (3) chain configurational structure; and
- (4) relationships between companies belonging to the chains.

For the sake of scope, we will primarily deal with items (3) and (4), but the impact on (1) and (2) should not be ignored.

In his study of intercompany relationships in the automotive industry, Dyer (1997) did not find that transaction costs necessarily increase as asset specificity increases. The author made an exploratory study involving transactions of 50 suppliers with automakers in the USA and Japan. The Japanese group (Toyota and Nissan) presented greater asset specificity and lower transaction costs than the American group (Chrysler, GM, and Ford). This was attributed to the following factors:

- the Japanese engage in repeated transactions with a smaller number of suppliers when compared with the Americans;
- high volumes of exchanges among the parties involved in the transactions;
- extensive intercompany information and reduced information asymmetry;
- good reputation and trust: non-contractual safeguards; and
- investments in co-specialized assets, involving long-term relationships with greater interdependency among the parties involved in the transactions.

Folta's (1998) studies point to similar results. According to the author, the higher the degree of asset specificity the closer the relationship between the company and its suppliers tends to be. According to Combs and Ketchen (1999), when both companies in a cooperative agreement invest in specific assets, the assets form a reciprocal dependence that encourages each partner to avoid opportunistic actions.

Making the connection with the SCM model presented in the beginning of this section, these studies could verify that intense relations, based on trust and information sharing (a relational chain variable) with a smaller number of suppliers (structural



chain variable, explicit mentioned by Dyer, 1997) does not increase transaction costs even in situations of high asset specificity.

For Dyer (1996), transactions involving specific investments are more likely to result in competitive advantages when the parties involved have developed safeguards whereby they can control opportunism at a relatively low cost and the tasks/activities are characterized by a high degree of interdependence.

The duration of the relationship is also an important factor. Lorenzoni and Lipparini (1999) argue that, over time, repeated transactions between companies lead to lower transaction costs, enabling the economic actors to gain advantage by subcontracting suppliers that develop their own competencies. For Swaminathan *et al.* (2002), the benefits of a long-term relationship stem from three related sources: the development of knowledge of each partner, the development of trust, and the development of relationships of specific routines.

Dyer and Chu (2000) conducted a survey involving buyers and suppliers in the automotive sector of Japan, the USA, and Korea. Their findings revealed that the institutional environment strongly influences the development of interorganizational trust, but the companies' specific practices may be of greater significance, for the survey indicated that Japanese manufacturers transplanted to the USA built higher levels of trust with American suppliers than American manufacturers themselves. These authors stated that the main determining factors are the assistance provided to suppliers, long-term relationships, and the buyers' supplier selection process.

Once again sketching the links between TCE and the SCM model, the studies presented in the last four paragraphs focus on the built of trust in intercompany relationships (a relational chain variable) and the impact on competitive advantage (the second subset of the model – strategic alignment and profit sharing). In buyer-supplier relationships, trust can be an important source of competitive advantage (Dyer and Chu, 2000) because:

- it allows for lower transaction costs (Dyer, 1996; Zaheer *et al.*, 1992);
- it facilitates investments in relationships that involve specific assets (Dyer, 1996); and
- it leads to better performance of information sharing routines (Fruin, 1992; Clark and Fujimoto, 1991; Nishiguchi, 1994).

Kotabe *et al.* (2003) examined relationships between buyers and suppliers of the automotive sector in Japan and the USA, analyzing two forms of knowledge exchange involved in these relationships:

- (1) exchanges of technical know-how; and
- (2) exchanges involving technology transfers.

The results of their survey indicated that the duration of the relationship is not significant in exchanges of technical know-how, unlike technological exchanges, in which the positive effects increase hand-in-hand with the duration of the relationship. Their empirical analysis confirmed that the transfer of knowledge can be associated with improved supplier performance in both the countries studied.

This last study also explores the links between relations (relational variable) and competitive advantage (strategic alignment and profit sharing). Long-lasting relations tend to increase supplier performance by fostering the transfer of knowledge.

Generally speaking, the articles analyzed in this study describe empirical researches that can illustrate supply chain characteristics relating to the aforementioned elements of TCE.

#### 4. Research method

The research strategy adopted here was the case study since. Hence, in order to allow for cross-comparisons among the relationships analyzed, we conducted during the period 2006-2008 a multi-case study with seven companies (an engine manufacturer and six suppliers).

The sample was selected intentionally to find companies that, though belonging to the same chain, presented relationships with different characteristics. Thus, the intention here was not to obtain generalized findings but to direct the contribution of the TCE to elements of the relationship pattern found in automotive chains.

Data were collected by means of interviews that lasted for about 1 hour and the number of interviews varied from one company to another according to the amount of time set aside by the company for this study. At the companies, the interviewees were preferentially those connected to operations, product technology, processes, and management, i.e. directors connected to the technological area, industrial directors, and purchasing managers.

Although we do not intend to describe the research tool in detail, it is worth mentioning that we used a questionnaire formulated from the review of the literature, whose questions were divided into two parts, the first involving the supply chain structure and the second dealing with aspects of the relationships between companies in the chains (considering the model proposed by Alves Filho *et al.* (2004) and presented earlier in this paper). Permeating both parts of the questionnaire were questions aimed at investigating not only general aspects such as clients, suppliers, products, autonomy and technological content, etc. but also elements involving TCE, principally from the standpoints of asset specificity, power relations, and frequency of relationships. Regarding asset specificity, we sought both to identify such characteristic and also to understand contextual factors that lead to such specificity. Regarding power relations, questions were developed to perform a cross-check to effectively assess the balance of power between companies.

We chose to focus on the TCE aspects of asset specificity and frequency because we believe they would be more plausibly identified by direct questioning of the interviewees. Questions involving opportunism, uncertainty, and limited rationality were left for an interpretive analysis by the researchers, based on the set of data collected during the field survey.

Data gathered during the interviews were transcribed and analyzed with the support of common qualitative analysis techniques, such as coding and content analysis. Also, whenever possible, we sought to combine such information with secondary sources, such as corporate websites, sector reports, etc. and also with previous work conducted by our research group inside the same industry.

The information obtained from the companies are described and compared in tables in the following section.



## 5. Case studies

The case studies were carried out at an engine manufacturer of the Brazilian automotive sector and at six of its suppliers, whose privacy will be maintained by referring to them hereinafter as “manufacturer” and suppliers “A,” “B,” “C,” “D,” “E,” and “F.”

The manufacturer produces automobile engines (the 1.0 to 1.8L and the 1.8 to 2.4L family of engines), involving a wide range of products. Starting in the year 2000, the plant received investments aimed at increasing its production capacity. It operates three shifts per day and has no idle capacity for Family 1, of which it manufactures about 1,700 engines/day. The production volume of Family 2 engines is about 300/day, although the plant’s installed capacity is for 700.

Supplier “A,” a multinational branch belonging predominantly to the electronic segment, manufactures fuel injectors, acceleration valves, fuel pumps, etc. Noteworthy among its products is its bi-fuel engine software. Although the installed production capacity of the unit studied here is approximately 25,000 components per day, its current production volume is approximately 16,000 components per day.

Supplier “B,” a multinational branch of the metal components segment, belongs to both the first and second tier of suppliers, although our sample does not include an auto parts company that is its client. “B” manufactures gearboxes, chassis and suspensions, oil pans, and products added to engines (e.g. engine covers). Its production capacity is 50 tons/day but it operates with about 20 percent of idle capacity.

Supplier “C,” unlike the other companies of this study, has 100 percent of national capital and belongs to the metal components segment. It has been machining products such as exhaust collectors and engine flywheels for the manufacturer since 1994. Other products it makes are cylinder heads, engine blocks, and crankshafts, piston rods, etc. It has an installed capacity of 17,000 parts/day in three work shifts. However, its production volume in 2006 was 15,000 parts/day.

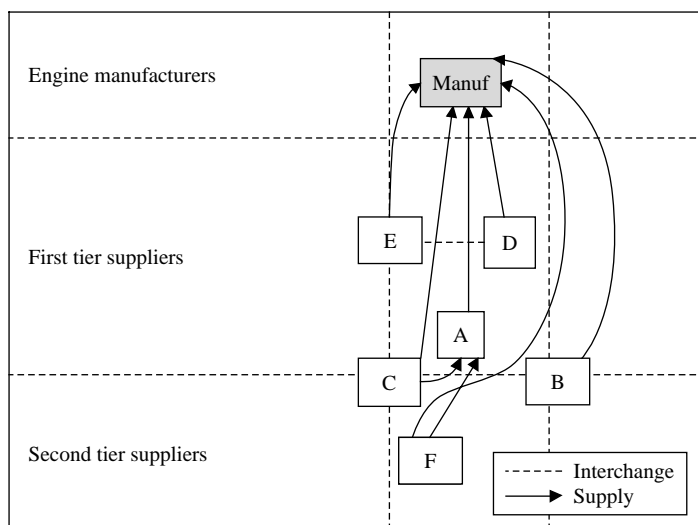
Supplier “D” is also a company of national capital belonging to the metal components segment. In its automotive line, its main products are engine flywheels and racks-and-pinions. The company’s production capacity is 3,000 flywheels/day, in three shifts. Production currently stands at 2,300/day.

Supplier “E,” a national company belonging to the metals segment, produces supports, brake pads, and flywheels. Its installed production capacity is 2,000 tons/month, in three shifts, which corresponds to 2,500 flywheels/day. Its current production is 1,600 tons/month (about 2,000 parts/day) in three shifts.

Supplier “F” is a branch of a multinational of the automotive sector whose production in Brazil is concentrated in a single plant. Currently, it has the capacity to produce filters and components using any thermoplastic material (ABS, polypropylene, polyethylene, polyvinyl chloride, and polycarbonate). The company did not reveal its installed production capacity.

Figure 1 shows the relationships found among the four companies of the case study.

To allow for a cross-analysis among the companies, we chose to present the data here in tabular form rather than discussionally. Table I summarizes the main information about the companies of this case study, focusing on general strategy and context issues, as well as aspects regarding the structure of the supply chain they are involved. Table II summarizes the information concerning relationships among the four companies studied, based on concepts of TCE.



**Figure 1.**  
Companies of this  
case study

## 6. Analysis of the case studies

The companies chosen for this case belong to the automotive sector, specifically manufacturing car engines. As mentioned earlier herein, the sample was not chosen randomly; instead, we sought to identify companies whose cases presented significant differences. Therefore, their capital is of different origins, the manufacturer and suppliers “A,” “B,” and “F” being multinationals while the others are national companies. The companies are of different sizes, with the manufacturer and supplier “C” ranking as large, “A,” “B,” “D,” and “F” medium sized, and “E” small.

From a general standpoint, the manufacturer and suppliers “A” and “F” used only one supplier per component, but the manufacturer and supplier “A” have other developed suppliers. Thus, both companies can take advantage of closer relationships with fewer suppliers to increase the degree of cooperation with their suppliers and gain competitive benefits such as information sharing (Fruin, 1992; Clark and Fujimoto, 1991; Nishiguchi, 1994) and easy investing (Dyer, 1996).

Developed suppliers that are not actively supplying serve as safeguards against opportunistic actions on the part of current suppliers. In case of supply problems, the manufacturer and company “A” can transfer their sourcing to the developed suppliers. In addition, the fact that there are companies qualified to take over the supply gives the manufacturer and company “A” bargaining power, which can be utilized in this situation to inhibit the opportunistic behavior of suppliers when they demand price increases or alter previously agreed upon supply conditions. In the case of supplier “F,” there is no need for supplier development since its main raw material (thermoplastics) can be considered a commodity and several other companies in the market are able to supply the manufacturer’s needs.

Flexibility, an aspect strongly emphasized by the interviewees, has an impact on the structure of the supply chain and on the relationships among the companies it comprises. Hence, a strategy the automaker under study has apparently adopted is to develop close ties with suppliers and pass on to them the need for flexibility.

**Table I.**  
Relevant aspects of the  
companies of this study

	Manufacturer	Supplier "A"	Supplier "B"	Supplier "C"	Supplier "D"	Supplier "E"	Supplier "F"
<i>Strategy and context</i>							
Capital resources	Multinational branch	Multinational branch	Multinational branch	National	National	National	Multinational branch
Activities of the group in Brazil	The company operates four plants in Brazil. Engine manufacturing is concentrated in the plant of this study, while other plants produce transmissions and automobiles	Several plants and divisions in Brazil	Single plant	Single plant	Single plant	Single plant	Single plant
Employees (approximate numbers)	The entire plant has 1,900 employees	The division of this study has 430 employees	450 employees	1,200 employees (the number increased along with product diversity and number of clients)	720 employees	505 employees	70 employees
Supply relationships among the companies studied	The six direct suppliers studied here consider the manufacturer an important client, but for suppliers "A" and "D" the manufacturer is their principal client	Supplier "A" destines 90 percent of its production volume to the manufacturer of this study	Supplies both to the manufacturer of this study and to auto parts manufacturers, although this sample contains no auto parts company	Machines the engine exhaust collectors and flywheels for the manufacturer. Supplies the metallic part of the butterfly valves to supplier "A"	The main client is the manufacturer, who purchases the cast brake pads from other suppliers (e.g. "E") and sends them to supplier "D" to produce the flywheel sets	The main client is the manufacturer. Its products pass through supplier "D"	Its main client is company "A," to which it supplies butterfly valves and cams

(continued)

	Manufacturer	Supplier "A"	Supplier "B"	Supplier "C"	Supplier "D"	Supplier "E"	Supplier "F"
Technological autonomy	It has autonomy to develop new engines based on existing ones, as well as for process innovations. Its autonomy from the foreign headquarters has increased substantially thanks to the technological developments achieved by the Brazilian branch	It has autonomy to develop new products based on existing ones, as well as for process innovations in production processes. Its autonomy from the foreign headquarters has increased substantially thanks to the technological developments achieved by the Brazilian branch	Receives the product designs and investments needed for production tooling from its clients. Has autonomy to generate production process innovations. The plant stands out from headquarters for working with other types of materials (magnesium alloy)	Receives the product designs from clients and adapts them to existing processes. However, the processes were initially transferred by clients (including the machines)	Receives the product designs from clients. Has autonomy to generate innovations in production processes	Receives the product designs from clients and adapts them to existing processes. Has autonomy to generate production process innovations	In most cases, receives the product designs from clients, makes improvements and adapts them to existing processes. Supplier "A" does not allow changes in its product designs. Only one product is developed locally, destined for the Mercosur auto parts aftermarket (fuel filter)
Outsourcing	In-house casting of some components (engine block, cylinder head, exhaust collectors, crankshaft, overhead camshaft, and piston rod), but it intends to outsource. Other components are cast externally (e.g. by supplier "C")	It outsources foundry and machining, as well as some components (e.g. electric cables)	The main raw material is aluminum. In addition it purchases small parts (pins, etc.), which it calls added products	Raw materials such as aluminum and cast iron, and simple parts such as screws, gaskets, etc	Purchases steel and the cast iron disc	Raw materials	Plastics for the automotive industry, thermoplastic resins, non-ferrous metals

(continued)

Exploring variables of transaction costs

Table I.

Table I.

	Manufacturer	Supplier "A"	Supplier "B"	Supplier "C"	Supplier "D"	Supplier "E"	Supplier "F"
Technological content of engine components	The technology of some of the components is the domain of suppliers (e.g. electronic components, brakes, etc.). The design of other products is the property of the manufacturer and that of the process is the responsibility of the supplier (e.g. gears, crankcase, etc.). There are also cases in which the manufacturer transfers the design of the product and the process to the supplier (e.g. exhaust collector, crankcase, etc.)	The company dominates the technology of the products it supplies to the automaker(s). It has autonomy to develop new products based on specifications imposed by engine manufacturers when the latter launch new products. Similarly, it passes on specifications to other suppliers to develop new products adapted to its own. In the case of bi-fuel technology, the product required innovations in other parts of the engine	The company is responsible for the production processes of the products whose designs are transferred by the clients	The manufacturer of this study, among others, "C" to supply it with products following the specifications of its headquarters. To this end it invested in machines and equipment, quality standards and qualified staff to work at the supplier's facilities until the supplier became qualified for production	The company is responsible for the production processes of the products whose design is transferred by the clients	The company is responsible for the production processes of the products whose design is transferred by the clients	Over time, the company has expanded its technological activities considerably. At first they were all carried out at headquarters. The branch gradually acquired its current know-how to alter product designs and make innovations in production processes, in addition to one case of a locally developed product
<i>Supply chain structure</i> Clients	The group's auto manufacturing units in Brazil and several others abroad	The main client is the manufacturer of this study	Automakers and auto parts manufacturers	Automakers and auto parts manufacturers	The main client is the manufacturer of this study	Automakers. The manufacturer of this study is the main client	The main client is supplier "A," but it also supplies the manufacturer of this study
Number of suppliers (estimated)	100 It intends to reduce its supplier base, strengthening its relations with a smaller number of suppliers	176 72 are located in Brazil and the remainder abroad	10 Among them, three supply aluminum alloys, the main raw material	42	7	60	50

(continued)

	Manufacturer	Supplier "A"	Supplier "B"	Supplier "C"	Supplier "D"	Supplier "E"	Supplier "F"
Size of principal suppliers	Large companies, most of them subsidiaries of multinationals	Large companies, most of them subsidiaries of multinationals. About 5 percent of the companies located in Brazil are of national capital	Most of them are medium-sized companies of national capital	Varies from large companies (raw materials) to family owned companies	Small companies providing foundry services and a few large steelworks that supply raw materials	Large companies that supply raw materials such as pig iron, scrap, alloys, etc.	Multinational companies with quality certifications
Criteria for supplier selection and evaluation	Quality, technological capacity, services, and prices are equally important	The same criteria against which they are evaluated, namely, quality, technological capacity, services, and prices	Price	Price and quality	Not informed	Not informed	Cost and quality
Number of suppliers per outsourced component	Usually one supplier for each item	Usually one supplier for each item	It has three suppliers of aluminum, and one supplier for per component	The number varies. For raw materials (aluminum, cast iron) it has up to four suppliers	Depends on the item purchased. Two steel suppliers and five suppliers of cast components	Depends on the item. Five suppliers of iron, three of scrap, two of alloys, etc	One supplier per item
Contracts with suppliers	Formal contracts, but there are also informal orders (due to the great flexibility of mix and volume)	Formal contracts	Formal supply contracts	Formal contracts and informal orders	Not informed	Not informed	Informal contracts

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Table I.



**Table II.**

Relevant aspects of the relationships among the companies of this study

	Manufacturer's relationship with supplier "A"	Manufacturer's relationship with supplier "B"	Manufacturer's relationship with supplier "C"	Manufacturer's relationship with supplier "D"	Manufacturer's relationship with supplier "E"	Manufacturer's relationship with supplier "F"	Relations between "A" and "C"	Relations between "D" and "E"	Relations between "F" and "A"
<i>Supply chain relations</i>									
<i>Asset specificity</i>	High asset specificity. The introduction of bi-fuel led to adjustments in parts of the engine. Supplier "A," in the development phase, is testing its product at the manufacturer and, should a problem be identified, the two companies will solve it jointly. In this phase, there is extensive exchange of information	Moderate asset specificity. When the manufacturer develops a new engine, it passes on the design of the product to supplier "B," who analyzes the viability of its production on the existing production lines and implements the necessary adaptations	High asset specificity. The manufacturer invested in physical equipment, and (machines, tooling) and human assets (technology, information, and engineers from the manufacturer working at the plant of supplier "C"). "C" develops production processes to manufacture the product	Moderate asset specificity. Same as with supplier "B"	Moderate asset specificity. About 60 percent of the production volume of "E" goes to the manufacturer of this study. Before it reaches the automaker, the product passes through supplier "D," who adds the rack to the disk and makes the final assembly	Low asset specificity. The manufacturer passes on the design of the product and the volume is relatively low	Low asset specificity. When "A" recently began its relationship with supplier "C," the latter was at a stage where it already possessed the know-how of its plant's production processes	No commercial relationship. There is an interchange of parts mediated by the manufacturer of this study	Low asset specificity. Supplier "A," one of the main clients of "F," requires that the product designs it transfers are not changed

(continued)

Relations of power between the companies	Manufacturer's relationship with supplier "A"	Manufacturer's relationship with supplier "B"	Manufacturer's relationship with supplier "C"	Manufacturer's relationship with supplier "D"	Manufacturer's relationship with supplier "E"	Manufacturer's relationship with supplier "F"	Relations between "A" and "C"	Relations between "D" and "E"	Relations between "F" and "A"
	Supplier "A" dominates the technology of the products it delivers to the manufacturer. It supplies the manufacturer almost all of its production volume	The manufacturer transfers the designs of its products, as well as those of other clients (automakers and auto parts manufacturers). Most of the company's billings come from automakers	Because it invested in supplier "C" and transferred its product design, the manufacturer has a high bargaining power with the supplier. Supplier "C" is gaining greater autonomy, for it has expanded its client base and already owns the know-how of its processes	The same relationship as with supplier "B," but in this case the manufacturer is the main client of supplier "D"	Supplier "E" is a national firm supplying most of its production volume to the manufacturer, who has transferred its product design to the "E." The manufacturer must therefore wield considerable power over the supplier	The manufacturer exerts strong pressure upon supplier "F"	The volume of parts exchanged is not significant for "C"	There is no relation of power between "D" and "E"	"A" exerts strong pressure upon "F"

(continued)

Table II.

Table II.

Frequency of relationships	Manufacturer's relationship with supplier "A"	Manufacturer's relationship with supplier "B"	Manufacturer's relationship with supplier "C"	Manufacturer's relationship with supplier "D"	Manufacturer's relationship with supplier "E"	Manufacturer's relationship with supplier "F"	Relations between "A" and "C"	Relations between "D" and "E"	Relations between "F" and "A"
	Supplier "A" can be considered a spin-off from the manufacturer, so their relations were very close. The manufacturer delivers engines to the automaker on a daily basis. It places orders to its suppliers every 15 days and receives components daily	Receives orders from the manufacturer every 2 weeks and makes daily deliveries	Their relationship started in 1994, when the manufacturer outsourced its machining operations. Deliveries to the manufacturer take place daily	Daily deliveries	Daily deliveries	2 to 3 deliveries per week	Has only recently begun supplying to "A," 3 or more deliveries per week	No commercial relationship	3 or more deliveries per week

With the exception of “F,” all the companies of the cases studied here opted to use formal contracts to govern their supply transactions, even though the orders may be placed informally. Thus, and in agreement with Barney (1999) and McNally (2002), the companies choose a hybrid structure of governance through formal subcontracting, seeking to combine positive aspects to the other two forms of governance: market and vertical integration. Supplier “F,” on the other hand, has opted for a spot market relationship with its suppliers: since its raw material is a commodity, the companies can seek out any agent in the market to obtain its products.

The companies thus attempt to align transactions that differ in terms of their attributes with governance structures that differ in costs and competencies (Williamson, 1994). With the exception of the relationships between the manufacturer and supplier “F,” supplier “A” and supplier “C,” and supplier “F” and “A,” the relationships between the companies appear to be long term. As highlighted by Helper (1987) and cited by Swaminathan *et al.* (2002), long-term relationships with suppliers may show better performances than short term ones when:

- the products are complex;
- technology undergoes constant changes;
- there is a complicated interaction among the components; or
- when the commercial relationship requires specialized human skills.

Some of the relationships presented here seem to directly corroborate the first three aforementioned conditions. Insofar as the complexity of products and the interaction between components is concerned, we found that when the engine manufacturer develops a new product, the first tier (direct) suppliers are given the necessary specifications to develop components adapted to the new engine. Similarly, the first tier suppliers pass on specifications for the production of components destined for the new parts to some of their own suppliers (second tier suppliers of the automakers).

Another possibility is joint product development (co-design), in which the design of the product involves investments in technological capacitation on the part of both parties involved in the relationship. This process appears to occur in the manufacturer’s relationship with supplier “A,” due to the need for close involvement of the parties of the transaction in the development of electronic and flex-fuel injection systems: on the one hand, the supplier dominates the technology embedded in the product to be supplied, while, on the other hand, the manufacturer dominates the product in which the electronic injection system will operate. This therefore necessitates a great deal of joint work and significant exchange of information to ensure the success of the design.

The third aspect discussed by Helper (1987) *apud* Swaminathan *et al.* (2002) refers to technology. At about 45 percent of the suppliers in the chain, including supplier “A” of the sample, although the component’s technology is proprietary of the supplier, the work of “applying” it is coordinated by the manufacturer’s engineering sector, which also establishes the standards of approval for each component.

There are cases in which the supplier, because of its limited technological capacity, is given the design of the product by the manufacturer, and it is then up to the supplier to adapt the design to its production process. In this group of suppliers, which comprises suppliers “B,” “D,” “E,” and “F,” the product development activities are

restricted to innovations in production processes. Examples of components in this case are crankcases, engine add-ons (e.g. engine covers), exhaust collectors, etc.

To understand the effects of asset specificity on the transactions analyzed, a subjective scale was created based on a comparison of the perception of the levels of specificity in the different cases analyzed here. The intention was to base this scale on several criteria such as:

- volume of investments made to render the supply of a given product viable;
- the easiness with which this product could be supplied to another company should the initial supply agreement be cancelled; and
- representativeness of the supply *vis-à-vis* the company's production.

In the case of the relationships between the manufacturer and suppliers "A," "B," and "D," the companies involved are well-known organizations and, above all, enjoy a mutual reputation built up over the years. Although the relationships between the manufacturer and suppliers "A" and "B" are relatively recent in Brazil, in their countries of origin these relationships have existed for much longer.

It should also be kept in mind that the manufacturer has a certain amount of knowledge of the processes and forms of production of the components supplied by these suppliers, although it does not possess the necessary technology to produce them. To a certain extent, this reduces the complexity involved inasmuch as it reduces at least the information asymmetry regarding the technologies involved and the productive process.

In the case of the assets involved, particularly in the relationships between the manufacturer and company "A," there is a high level of physical asset specificity, as discussed by Williamson (1979) *apud* McNally (2002). Although the technology of flex-fuel and electronic injection systems is dominated by the suppliers and theoretically applicable to the engines of any automaker, there is an expensive process of adaptation and calibration of these systems to the current engine design, which ends up increasing the specificity of the assets.

Since a substantial part of the production of "A" is destined to the manufacturer, any unethical behavior would cause the supplier to lose an extremely significant portion of its sales. On the other hand, inappropriate conduct on the part of the manufacturer would force it to purchase components from one of the only two other companies available, which would render the manufacturer even more vulnerable to opportunistic attitudes.

Moreover, in this sector there is a strong identification between the automakers and their suppliers of electronic parts for engines, given that these pairs usually come from the same countries of origin, where they already have extremely solid relationships. An example of this is the relationship between the manufacturer and supplier "A," and it is worth noting that "A" originated from a spin-off from the manufacturer and that this relationship of historical identification carries weight in the continuity of the relationship.

In the case of the manufacturer and company "B," the asset specificity can be considered moderate. Although there is investment in specific tooling to manufacture the products transacted in this relationship, the low technological content of the supplied parts ends up reducing this specificity. Should a detrimental action mar this relationship, the manufacturer could have its products supplied by other

companies, and although it could lose a significant source of income, supplier “B” would go on to fabricate other products to meet the needs of different clients.

Upon examining the relations between the manufacturer and supplier “C,” we find a case in which the specificity of physical assets can be considered high, given that the manufacturer practically developed the supplier so that it could produce components according to its specifications. The manufacturer, besides transferring the design of the product, invested in machinery, equipment and production tooling and the manufacturer’s engineers worked at the supplier’s plant, when know-how and production techniques were passed on to the supplier during a period of major information exchange.

However, although asset specificity may be high, the possibility of opportunistic behavior by the supplier can be considered low, since the manufacturer itself helped develop the supplier and therefore retains knowledge about the process, thus reducing the asymmetry of information between the partners. In addition, one must consider that given the manufacturer’s investments, any possible unethical behavior would deteriorate the return on the investment; and the supplier would also not be interested in losing its supply to one of the largest automakers installed in Brazil.

On the other hand, the supplier has also sought to minimize the possibility of opportunism in the relationship with this manufacturer by expanding its portfolio of clients. Thus, unethical behavior on the part of the manufacturer would not bankrupt the supplier, which would go on to supply other clients.

The relationships between the manufacturer and suppliers “D” and “E” are quite similar to its relationship with supplier “B.” However, in this case there are two highly relevant factors to consider in our analysis:

- (1) the manufacturer of this study is the main client of these suppliers; and
- (2) although “E” is directly contracted by the manufacturer, its products first pass through supplier “D” for assembly into a more complex module.

Although the asset specificity can be considered moderate in this case – no major investments were made in assets committed exclusively to this transaction – the threat of opportunism is not high. The suppliers have no interest in deceit in their relationships with the manufacturer, given that this is their main client and that neither of them has expanded its client portfolio to reduce its dependence on the manufacturer. Nor is the manufacturer interested in inappropriate conduct, given that it has established an arrangement whereby the products of “E” are assembled by “D,” which then supplies them in a module of higher technological content. By this expedient, the manufacturer avoids the difficulties involved in the operational coordination of this supply. Moreover, the suppliers’ dependence on the manufacturer gives the latter greater bargaining power over these companies in negotiations of process, deliveries, and other conditions of supply.

In the relationships between suppliers, company “E” could have no possible interest in opportunistic behavior towards “D” since that would inevitably lead to the loss of its supply to the manufacturer, which does not want to receive its products directly, but added to the products of “D.” Furthermore, there is no effective commercial relationship between these companies, only a supply relationship connected to an agreement with the manufacturer.

In the relationships between the manufacturer and “F” and between “A” and “C,” the components involved correspond to a minor portion for both the parties involved.



In this case, asset specificity can be considered low, and is influenced mainly by the low technological content of the parts supplied. If any deceptive action were to occur in these relationships, the clients could get other companies to supply their products and, although they would lose a substantial source of income, the suppliers would manufacture products for other clients.

In the case of the relationship between suppliers “A” and “F,” the asset specificity can be considered low, given that the investments in specific tooling for the relationship were not high. Company “A” exerts strong pressure upon “F,” knowing it is the supplier’s main client. For “F,” there is no tendency for opportunism since “A” is its principal client, but there are already signs of new product developments at “F” to minimize its dependence on “A.”

As for the relation between the possibility of opportunistic actions and the specificity of the assets involved, our studies appear to corroborate those of Dyer (1997), Folta (1998), and Combs and Ketchen (1999). Although asset specificity tends to increase transaction costs by increasing the possibility of opportunistic behavior, this relation is mitigated by factors such as complexity and frequency/volume of transactions. With regard to the relationship between the manufacturer and supplier “C,” although there is high asset specificity, the information asymmetry involved is low, since the manufacturer developed the supplier, besides the fact that there are external factors such as maximization of the returns on the manufacturer’s investments.

## 7. Conclusions and final remarks

The study presented here aimed to discuss the relationship between an engine manufacturers and six suppliers (of different tiers), based on the analytical tool provided by TCE. Thus, we considered the various conditioning elements of transaction costs, such as bounded rationality, opportunistic behavior, asset specificity, and uncertainty and frequency of relations. According to the importance of each element, a mechanism is chosen among the forms of coordinating a transaction – spot market, hierarchy, or hybrid forms.

Similarly to other automakers, this manufacturer passed through an all-encompassing process of deverticalization of its production. The production of a substantial part of its engine components was outsourced and only items considered technologically strategic are still produced in-house.

In the cases studied here and possibly in the relationships within this industrial sector as a whole, the issue of deverticalization directly affects the asymmetry of information among the different parties of the transaction. Because the automakers already had a certain knowledge of the production process of outsourced parts before the opportunity for outsourcing became a reality, they can take advantage of this knowledge to reduce the complexity involved and thus inhibit, at least partially, any opportunistic actions on the part of the companies who produce the outsourced parts.

Moreover, the automakers seek to utilize a form of hybrid relationship with their suppliers, which sometimes resembles competition and at other times cooperation. Similarities to cooperation are manifested in the way the manufacturer and company “A” use only one supplier per component to increase the degree of cooperation with their suppliers, facilitating the sharing of information (Fruin, 1992; Clark and Fujimoto, 1991; Nishiguchi, 1994) and investments (Dyer, 1996).

However, the manufacturer and company “A” seek to foment a certain “latent competition” through suppliers they have developed but who are inactive. Should there be a supply problem, the manufacturer and company “A” can shift to the developed companies for their supplies, thereby increasing their bargaining power and reducing the threat of opportunism.

Perrow (1986) mentions the issue of bargaining power, highlighting the greater leverage of larger firms. If the larger company is the buyer, its purchasing power enables it to find another source of supply, and it will probably do so more rapidly than the supplier is able to develop another buyer.

Another finding of our case studies, strongly impacted by the automakers’ process of deverticalization, is that most companies use formal contracts to govern their supply transactions. This fact is strongly related with the choice of the hybrid form of relationship of the manufacturer and its suppliers, since cooperation can bring with it the benefits of proximity, knowledge exchange and dependence that are present in Vertical Integration, while “latent competitiveness” may bring the benefits of price competition and supply conditions inherent to the spot market.

Considering the connection between the possibility of opportunistic actions and the asset specificity involved, our studies here corroborate the findings of Dyer (1997), Folta (1998), and Combs and Ketchen (1999). Although asset specificity tends to increase transaction costs by increasing the possibility for opportunistic behavior, this relation is mitigated by factors such as complexity and transaction frequency.

The case studies reported here add other mediating aspects to the relation of “asset specificity – opportunistic behavior.” Emanating principally from the relationships between the manufacturer and suppliers “C,” “D,” and “E,” in which asset specificity was considered high, other factors should also be evaluated in these situations. These factors include, for example:

- the portion of production destined to the manufacturer;
- the relevance of this portion in the total quantity of the component the manufacturer purchases;
- the objective of maximizing the return on investments (specificity of physical assets) made in the past; and
- the configuration of supply operations of modules with higher added value, which reduced the manufacturer’s work of operational coordination.

The cases studied here also suggest that asset specificity tends to be greater in the first tier of the supply chain than in the other levels. Although all the exceptions to the non-generalization of the results of case studies are valid, the first tier of suppliers contains companies that generally act exclusively in the automotive sector, making substantial investments (be it in production tooling, be it in joint product development and adjustment with the automakers) to render the transaction viable. The second tier suppliers, on the other hand, usually supply clients operating in several industrial sectors, or which do not require heavy investments in tooling since they produce technologically less complex components.

Hence, considering the work here presented, we would like to summarize main managerial implications.

First, our results corroborate with most papers presented in the literature and summarized in Sections 2 and 3, that close, long-lasting and trustful relationships (supply chain relational issues) tend to reduce transaction costs and improve performance (supply chain strategy-related concerns).

However, and leading to the second point, there is a tendency in SCM literature to suggest that close, collaborative and long-lasting relationships will always lead to superior results (Christopher, 1997). However, one should not accept this recommendation as a “general truth” once that, as the case here presented suggests, there is also value to be captured using competition among suppliers (as supplier “F” does) and by developing “latent competition” (as both the manufacturer and supplier “A” does). Competition may lead to reduced prices when asset specificity is low; whereas “latent competition” may impose control on opportunism of in-charge suppliers when asset specificity is moderate to high.

Third, managers should not undervalue the self-reinforcing effects of asset specificity in a context of shared investments. Close and trustful relationships create a context where buyer and supplier may take on projects of joint investments that, once made, will reinforce the duration of such relationships for the sake of maximizing return on investments.

Fourth, business strategy should guide all the decisions made inside the context of supply chains. Although cost reduction tends to be a general goal, flexibility of new product introduction made the manufacturer to develop relationship with supplier “A” where this aspect may be considered more relevant than pure costs. Although we consider risk of opportunism to be low, this is a relation of high asset specificity and with a power balance more favorable to the supplier than in any other relation.

It should also be kept in mind that the suppliers of the manufacturer studied here are not exclusive, since they participate in several chains in the automotive sector. Since it is necessary to distinguish the influences each automaker exerts upon its suppliers, we propose a future study to compare the standards of relationships of certain suppliers who simultaneously supply different automakers, in order to elucidate the particular aspects of the relationship that are affected by the different strategies employed by the automakers.

Asset specificity, albeit mediated by other issues cited here, could also be the object of future studies aimed at gaining a more thorough understanding of its conditioning factors. Past investments, characteristics of the process that render assets specific, and other points, could also be examined in greater depth.

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This article has been cited by:

1. Kuen-Hung Tsai, Mu-Lin Tsai, Jiann-Chyuan Wang. 2012. Supplier collaboration and new product performance: a contingency model. *Industrial Management & Data Systems* **112**:2, 268-289. [[Abstract](#)] [[Full Text](#)] [[PDF](#)]