

MANUFACTURING STRATEGIES AND WORK ORGANIZATION IN AN ENGINE SUPPLY CHAIN

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RESUMO

Novas formas de relação entre empresas clientes e fornecedoras têm sido implantadas, levando a diferentes tipos de arranjos físicos nas cadeias industriais e alterando o seu desempenho produtivo e econômico e o seu gerenciamento, entre outros. Este texto discute a relação entre as Estratégias de Manufatura e as formas de Organização do Trabalho adotadas por uma montadora de motores de veículos e nove de seus fornecedores, examinando como as decisões da fábrica montadora influenciam as decisões destes fornecedores. As informações analisadas foram obtidas em entrevistas com gerentes responsáveis pelas áreas de manufatura, qualidade, logística e recursos humanos. Observou-se que as prioridades competitivas dos fornecedores são fortemente condicionadas pela estratégia da empresa cliente e que, embora exista uma tendência em direção a uma forma específica de organização do trabalho, o ritmo de mudança nesta área muda de acordo com as estratégias de manufatura de cada fornecedor, sua política de recursos humanos, a situação do mercado de trabalho e o poder relativo dos sindicatos.

ABSTRACT

New types of relation between buyer and suppliers companies have been implemented, leading to different kinds of physical arrangement in industrial chains, and changing their economic and productive performance, the supply management, among others. This article discusses the relationship between Manufacturing Strategies (MSs) and forms of Work Organization (WOs) adopted by an engine assembler and nine of its suppliers, examining how the specific decisions of the assembly plant affects the decisions of those suppliers. The analysis has been carried out based on information collected from interviews with the managers responsible for the areas of manufacturing, quality, logistics and human resources. It was observed that suppliers' competitive priorities are strongly conditioned by the buyer's strategy and that, although there may be a general trend towards a form of work organization, the pace of change in this area alters according to the suppliers's own manufacturing strategies, their human resources policies, the situation of the job market, and the relative power of the workers' unions.

PALAVRAS-CHAVE

Estratégia de manufatura, organização do trabalho, indústria automobilística, prioridades competitivas, cadeia de suprimentos.

KEY WORDS

Manufacturing strategy, work organization, automobile industry, competitive priorities, supply chain.

INTRODUCTION

Brazil's automotive industry has been the subject of studies on a variety of relevant and current themes related to the management and organization of production and work and the management of supply chains. In the mid-90s, following its recent restructuring, with the introduction of the new legislation on foreign trade and investments, called the "New Automotive Regime" and the expectation of market growth in Brazil and the Mercosul countries, several automakers that, up to that time, had not yet established themselves in Brazil began manufacturing vehicles in this country while others, already established in Brazil, modernized their facilities and built new plants.

Several of these new plants were set up in regions far from those that had traditionally received such investments, producing a significant spatial reorganization of the industry in Brazil, particularly if one also takes into account the investments of autoparts suppliers.

In this context, new buyer-supplier arrangements were proposed and implemented, which in turn led to the proposal of several kinds of physical arrangement of the new industrial chains, their economic and productive performance, the new buyer-supplier relations, the forms of supply management, among others.

In this article, we discuss some of the relationships between Manufacturing Strategies (MSs) and forms of Work Organization (WOs) adopted by companies in the same industrial chain. We focus more specifically on the relations between an automaker – an engine manufacturing unit located in the state of São Paulo, Brazil – and nine of its direct suppliers, examining how the specific decisions of that assembly plant affects the decisions of those suppliers.

The discussion of the relations between MSs and WOs in this paper is based on the case studies of ten companies (an engine assembler and nine of its suppliers). These studies were carried out based on information collected from interviews with the managers responsible for the areas of manufacturing, quality, logistics and human resources¹. The remaining sections of this article discuss the main configurations of the buyer-supplier arrangements in the new industrial chains of the sector; the principal characteristics of the supply chain analyzed here; an analysis of the information collected from the engine manufacturer and its nine suppliers and the main remarks concerning the relations between manufacturing strategies and forms of work organization in this chain.

NEW PLANTS AND SUPPLY CHAINS

The sectorial agreements of 1992 and 1993 marked the beginning of a reversal of the stagnation period that the automobile industry had experienced throughout the 80's. In 1995, the Automotive Regime (a set of legislative measures for the automotive industry) was created to attract investments to the sector. This new policy reduced import taxes on equipment, raw materials and components to 2%, progressively reestablishing these taxes in subsequent years. The Regime also relaxed the requirement of the index of component nationalization from 80% to 60% (Bedê, 1997). The main objective of the regime was soon achieved and several investments were made in new factories and in the modernization of some of the existing ones. Investments in new automobile plants were made by

¹ This piece of research was financed by FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo).

automakers such as Honda, Renault, Chrysler/Daimler, Mitsubishi, which imported CDKs, Land Rover, Audi, Mercedes-Benz, PSA, and by those already established in the country, such as Volkswagen, Fiat, Toyota, GM, and Ford. As a general rule, the new plants were not located in the traditional automobile poles, such as São Paulo's ABC area. This situation opened up new possibilities for automaker-supplier arrangements involving the physical configuration of new industrial chains, their economic transactions and productive operation, supply management, etc.

Those chains are defined (designed) in the negotiations between buyers and their major suppliers, especially at the time when new plants are being established, and their main characteristics derive from the levels chosen from two principal variables, i.e., outsourcing of the main components or product subsystems (automobile or engine) and partnerships between the buyer and its suppliers in the chain. The basic types of chains vary from the traditional chain, in which the automaker is vertically integrated and few subsystems are manufactured by suppliers, to the modular consortium, in which the production process is divided into modules and the suppliers' workers act directly in the automaker's plant, making the final assembly of subsystems and assembling them in the final product. The automaker's level of outsourcing, the degree of collaboration between assembler and suppliers and the physical (and organizational) proximity between buyer and suppliers increases progressively as the organizational model passes from the former to the latter type of chain.

The different choices made jointly by automakers and their suppliers have led to different automaker capacities to control the variables that are fundamental to their performance, such as those related to prices (and costs), quality, logistics and technology. There is a tendency in the sector – partially determined by the new configurations of industrial chains – for increased control over these variables on the part of buyers in their respective chains. An attempt can also be seen on the part of buyers to organize and hierarchize their suppliers into tiers and to exert direct control over suppliers in second and third tiers.

Several mechanisms in Brazil's automotive industry contribute to increased buyer control over the supplier. Some of these mechanisms, particularly those widely disseminated in the industry, will contribute, in part, to a certain degree of behavioral homogeneity in the automobile and autoparts sector. On the other hand, those mainly related to the automakers' strategies will require that companies comprising industrial chains play differentiated roles.

From the latter standpoint, with regard to the set of mechanisms involved in the automakers' decisions, the different existing forms of production and work organization must be considered. Several aspects of manufacturing and technology strategies, organizational structure and information systems, quality and logistics management, the level of manufacturing automation, as well as work organization and trade union relations, all must be taken into account.

This article deals with some of the aspects more closely related to the Manufacturing Strategies (MSs) and Forms of Work Organisation (WOs) of the companies of a given supply chain.

PRINCIPAL CHARACTERISTICS OF THE SUPPLY CHAIN STUDIED

This work analyzes an engine factory established in the state of São Paulo. The factory was built initially to produce small size engines for automobiles, but subsequently it began to produce other types of engines, thus increasing its product mix. Today, the factory is staffed by approximately 450 people

and by 250 supplier employees (from several service areas), and produces 1200 engines in 2 daily shifts.

The plant can be considered as situated in an intermediate position between the two extremes of the spectrum of the modular consortium and the traditional, vertically integrated chain configuration. It uses an intermediary level of outsourcing (mid-way between the modular consortium and the traditional chain), and its level of cooperation with suppliers is also intermediary in that there is no single supplier with a long-standing relationship, though no more than two suppliers are selected for each item.

The factory produces a set of engines, with the manufacturing process comprised of a machining block stage and two engine assembly stages. The installed equipment incorporates up-to-date technology with a high level of automation for Brazilian standards. The processes at other Brazilian engine manufacturers were more vertically integrated.

At the plant, as mentioned earlier, several activities are outsourced, e.g., the toolshop, internal transportation of materials, external logistics, waste control, part of the human resources management, the cafeteria, etc. Among the possible explanations for this high level of outsourcing was the urgent need for the establishment of an engine-manufacturing unit for popular cars.

With such a high level of outsourcing, the initial investment was much lower, causing it later to suffer a lesser impact than other automakers from the fluctuations of the automotive market. This level of outsourcing and the company's supply policy determine the characteristics of the factory's supply chain. Some of these characteristics are: (i) with the exception of the cylinder head, the remaining engine components can hardly be considered subsystems (as in the case of a vehicle, which can be subdivided into subsystems and modules); (ii) some of the service suppliers (productive and administrative) work at the factory's facilities; (iii) in some cases, among the suppliers selected by the automaker to supply a given item, one is a major supplier with consolidated technological capacity while the other is a minor supplier located relatively close to the buyer; (iv) because the chain operates exclusively in the metallo-mechanical field, it is a relatively short one with only four levels, i.e., scrap, foundry, part, assembly; (v) the logistics of the plant is outsourced, which means that an outside company carries out its transportation; (vi) in the case of small volume items from suppliers located close to the plant, the company's logistics is based on the "milk run" system.

PRODUCTION PRIORITIES AND WORK ORGANIZATION IN THE ASSEMBLER AND IN SOME OF ITS SUPPLIERS

This article contains information regarding the engine manufacturer and nine of its suppliers that the authors deemed the most relevant for the discussion of the relationships between production strategies and forms of work organization. In interviews with production and human resource managers at the nine companies, we attempted to identify the companies' competitive priorities during the 1997-2000 period.

Our analysis of the companies' production priorities was based on the list proposed by Garvin (1993). The information pertaining to the engine manufacturer is first presented discursively, after which the most important information for the intended analysis is given in Tables 1, 2 and 3.

In the case of the engine manufacturer, we concluded that the company's major efforts during that period focused on programs to improve Quality, reduce Cost and increase Flexibility.

The quality programs that stand out are aimed at ISO and other certification for scrap and rework reduction, audits and supplier development.

Table 1 – Supplier Profile

Company	% National capital	Number of employees at company and plant studied	Types of products manufactured	Distance from supplier to buyer	% of production supplied to engine manufacturer	Logistics of delivery system
A	100	100 to 300	Castings	up to 200 km	> 50%	Milk run
B	100	over 3000; 300 to 500	Castings	200 to 400 km	< 20%	direct delivery
C	0	500 to 1000; 100 to 300	Machined subsystem and assemblies	up to 200 km	20 a 50%	Milk run
D	100	300 to 500	Machined subsystem and assemblies	over 400 km	> 50%	Pick-up by the engine manufacturer.
E	0	500 to 1000	Machined subsystem and assemblies	up to 200 km	< 20%	Milk run
F	0	1000 to 1500	Machined parts	up to 200 km	20 a 50%	Milk run
G	0	1000 to 1500	Machined parts	up to 200 km	< 20%	Milk run
H	0	1500 to 2000;	Machined parts	up to 200 km	< 20%	Milk run
I	100	500 to 1000;	Machined parts	up to 200 km	< 20%	Milk run

In addition to the last two sets of above-mentioned programs, the cost reduction programs include reductions in technical assistance-related costs, a continuous improvement program implemented in the manufacturing cells and monitored by the ABC cost system, a stock reduction program and a program aimed at reducing annual training time (following the first years of intensive training after the plant began its operations).

The greatest effort in regard to increased flexibility concerns logistics management, with the implementation of the external JIT; human resources management, with the implementation of the "hour bank"; and the reform of the manufacturing process sectors for the production of other types of engine.

The company then organized the work so as to respond to the demands formulated in its competitive priorities. To increase the capacity for teamwork and speed up the solution of quality-related problems, the work is organized in cells, each consisting of about twelve workers. Each worker is allocated to a workstation that serves as a reference, but the workers are gradually trained to work at all the workstations in their cell. There is no additional pay for this increasing skill profile. Frequent meetings at locations close to the cell are held to ensure proper follow up and supervision of the operations. The groups are encouraged to solve day-to-day problems autonomously and they also meet weekly to discuss less urgent issues.

Table 2 – Engine manufacturer and supplier production priorities

	Production priorities	Main action programs
Engine manuf.	Quality (Q), Cost (C), Flexibility (F)	Q certifications, scrap and rework reduction, audit and development of suppliers, reduction of technical assistance and continuous improvement costs
A	Q, Delivery (E), C	Certifications, scrap reduction, stock for ready delivery, cost reduction program
B	C, Q, Service (S)	Quality conformance, materials-related cost reduction, reduction of stocks, improved productivity
C	Q, C, E	QFD and SPC, certifications, development of suppliers, materials and overhead-related cost, reduction of machine setups
D	Q, E, C	Certifications and audits of parts, processes and products, process improvements, PPC program
E	C, Q	Reduction of bottlenecks, reduction of setups, kaizen, cells, certifications, quality conformance
F	C, E, Q	Mini-plants, lean manufacturing, new equipment, lead-time reduction, reduction of scrap
G	C, Q, E	ABC cost, new processes, multi-task skills, product development, lead-time reduction, increased productivity
H	C, E	Control of the productive process, MRP, operational training and higher productivity, lead-time reduction
I	E, F, Q	Implementation of cells, management of bottlenecks, multi-task skills, certifications

The minimum level of education required is complete middle school; all the leaders, who are paid by the hour, are university undergraduates and some of them hold graduate degrees. Training is considered very important, which suggests that the company wants its employees to remain and develop reasonably long careers committed to the organization.

The company has adopted the strategy of preventing the emergence of an active trade union, hiring workers with little factory work experience. There is no “metalworkers’ culture” with a combative workers’ trade union in the region, which favors the implementation of new organizational arrangements and new forms of industrial relations. Moreover, salaries in the region are on average

45% lower than those in the ABC region (state of São Paulo), the traditional vehicle-manufacturing center.

Table 3 - Engine manufacturer and supplier work organization

	Basic forms of work organization	Minimum level of education	Required attitude and existence of qualification program	Continuous improvement program and employee participation
Engine manufacturer	Cells with 12 workers and internal maintenance	High school	Involvement and multi-task skills; intensive training	Under the responsibility of the cells, relatively high employee autonomy to solve problems
A	Individual workstations	No requirement	Absence of requirements & qualification program	No program/participation
B	Cells (mini-plants), operate as teams	Trade school	Involvement and intensive training	Program of innovation by workers' groups
C	Cells	Middle School	Involvement and multi-task skills; intensive training	Group improvement program
D	Mini-plants	Middle School	Training program	No program/ participation
E	Cells	Middle School	Involvement and multi-task skills; intensive training	Improvement program (SPC), interfunctional teams
F	Mini-plants	Middle School	Team involvement, intensive training	Improvement program
G	Cells	Middle School	Involvement, training programs	Management-guided improvement program
H	Cells in foundry shop	High School	Intensive training	Group improvement program
I	Cells	Middle School	Training program	No program/participation

A similar analysis was carried out considering the MSs and WOs characteristics of the nine suppliers selected for this study. Tables 1, 2 and 3 provide the main information gathered at these companies.

As can be seen, some of the most important suppliers are among the nine suppliers studied here (from the standpoint of the importance of the items they produce). These nine suppliers are very different in terms of size, the origin of their capital, the parts they produce and their technological capacity. Nonetheless, they can be classified in two groups: (1) major suppliers, multinationals with strong technological capacity, and (2) minor suppliers, national companies with little technological capacity. The only exception is company B, which is relatively large and has good technological capacity, although it is a national company.

With regard to MSs, it was observed that Cost reduction, conformation to Quality and timely Deliveries in the correct quantities are among the priority dimensions of the engine manufacturer and most of the

suppliers of this study. These may be considered very basic dimensions that every supplier should meet, but they are also strongly conditioned by the market and by the buyer's specific strategy.

Flexibility is important, in some cases, and tends to be given increased emphasis in the supply chain the more flexible the buyer is. It was found that the engine manufacturer recently extended its product mix, but some of the suppliers choose to keep stocks of finished products (which enables them to fill orders promptly) rather than increase their manufacturing flexibility. The engine manufacturer also demands flexibility because it confirms (or modifies) its orders only one day prior to the delivery date. Flexibility is also a trend due to market fluctuations and the intensification of new product launches.

It was observed that the buyer's different demands (such as audits and recommendations, for instance) and its MS condition the suppliers' MSs. This influence is stronger the lower the supplier's technological capacity, the smaller the supplier's size, the higher the proportion of its production destined to the buyer and the higher the degree of partnership between them (or the more they share the risks). These suppliers have to accept the recommendations of engine manufacturer. On the other hand, in the case of large suppliers that normally supply several automakers, their strategies must generally be compatible with their customers' demands, but they have a considerably greater power to make autonomous decisions.

A tendency for suppliers to organize their production processes in cells or mini-plants was also observed, in a scheme similar to that of the buyer, although no indication was found that what leads to this is anything like an intra-chain isomorphism. Rather, it is a general trend that changes according to the company's manufacturing strategy, its human resources policy, and the situation of the job market and the trade and workers' unions. Half of the researched suppliers expect and demand a certain degree of employee involvement and identification with the company, and some of them have programs in which the worker participates actively in ongoing improvements, although management defines most of these programs and employee autonomy is restricted.

Apparently, the importance of labor for the company's performance is higher in the case of the suppliers than in that of the buyer.

It can be stated that, within each company, MS influences (but does not determine) the type of WO adopted. The latter is partially determined by the local conditions of the job market and the workers' unions, as mentioned earlier. However, if the MS does exert any influence on the WO inside each company, it is to be expected that the buyer's MS will, even if only indirectly, have some measure of influence on the suppliers' WO.

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References

BEDÊ, M. A. A política automotiva nos anos 90. (pp.357-387) In: G. Arbix and M. Zilbovicius (org.) *De JK a FHC: a reinvenção dos carros*. São Paulo, Ed. Scritta, 1997.

GARVIN, D. A. Manufacturing strategic planning. *California Management Review*, summer, pp.85-106, 1993.