

Implementation Impact of New Production Management Techniques on the Organization and Work Conditions in Companies of the Automotive Sector in Spain and Brazil*

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1. Introduction

Since the 1980's new production organization measures, work management approaches, and intensive use of new information technologies were introduced in the automobile industry worldwide based on the experience of Japanese industries in this sector.

This new production and work practice, which is called lean manufacturing, can be defined for the purposes of this work as new techniques for the production and development of new products using *Just-In-Time (JIT)* strategy, small batch production, Total Quality, continuous search for improvements and refinements of products, and a more active involvement of the suppliers in the project of the parts they manufacture (Womack *et al.*, 1992; Posthuma, 1993).

Due to the competition of the automotive sector, the necessity of reducing costs and enhance the development of new products, the automobile industries needed to develop new supply chain relationships and a new responsibilities in this productive chain. Among the models developed, the component project transferring, sub-assembling, and the responsibilities for the assembly of those items as well as for the management of the suppliers in the next level of the production chain stand out. With this configuration, the final manufacturer of the automotive sector becomes the assembler of the main parts of the product (Salerno *et al.*, 1998; Costa and Queiroz, 2000; Humphrey and Salerno, 2000).

These new production practices, mainly lean production, have enabled companies to produce more intensively when the demand for their products is high and reduce production when the demand decreases using their production approaches more rationally. This issue has been constantly debated in the automotive sector.

This study is based on the Idea that the mass production has been restructured due to the adoption of new flexible production methods which are based on better responses to fluctuating demand including level and variety of product components. Also, this paper discusses the objectives and procedures adopted by Spanish and Brazilian companies of the automotive sector for processes improvement focused on the dynamics of the organizational integration processes, technical management, and technological innovation competencies that enable those companies to improve work management models and the participation in decision-making on work conditions. The performance level indicates the manufacturing

strategies improvements in productivity, and it should include job rotation and changes in workstation spaces among other issues related to work conditions.

2. Characteristics of the Automotive Industry in Brazil and Spain

Brazil is one of the countries that has set up more automotive industries with the establishing of new and innovating plants and the restructuring and updating of its own plants.

It was in the second half of the 90's that the new production units were set up in Brazil motivated by the market opening, the specific public policies created for this sector, the prediction of the growing economy in Brazil, and, consequently, the demand for automobiles.

Nowadays, almost all major car assembly plants in the world have production units in Brazil. They are General Motors, Volkswagen, Ford, Fiat, Hyundai, Mitsubishi, Nissan, Renault, PSA Peugeot Citroën, Toyota, Honda, Mercedes-Benz, Ford, and VW/Audi.

In 2007, the Brazilian industry produced 2,977 million vehicles, and in 2008, its production was 3,220 million, which represents an increase of 8%. Between 2008 and 2011, the sector plans to invest 20 billion dollars in Brazil (Anfavea, 2009).

The Spanish automotive industry is the major export sector in Spain accounting for more than 25% of the total exports. The majority of the Spanish vehicle production is focused on exporting (82%), mainly to the European Union. Although Spain has become the world's sixth largest automotive producer and third in Europe, considering profits and production volume, the auto parts industry has been facing a globalization process with the presence of the multinational supplying market. On the other hand, the presence of Spanish industries is stronger in the reposition market.

The automotive industry in Spain focuses on the low cost models, i.e. the focus is on meeting the demand for low cost automobiles contributing less to the chain than the more luxurious and expensive automobiles.

On account of this and of the fact that all auto assemblers belong to the same multinational groups, the technology involved is very similar. The auto assembler sector comprises the following companies: General Motors, Volkswagen, Ford, Nissan, Renault, PSA Peugeot Citroën, Mercedes-Benz, Iveco, and Seat.

In 2008, the Spanish industry produced 12% less than in the previous year, 2007. It produced 2,889 million vehicles in 2007 and 2,541 million in 2008 (Anfac, 2009).

3. New Production Organization Model

The new production organization models were developed by several authors based on different successful systems implemented in companies in Japan such as Toyota and Honda. These models have been employed and adapted both theoretically and practically in companies in developed and developing countries, mainly in the metalworking and electrical/electronic sectors, producers of capital goods and durable consumption goods.

It has been widely and hegemonically spread, but it does not mean it has been adopted by all companies or sectors even in the developed countries. According to Hoffman & Kaplinsky (1988), this new system of future model is based on a new work process, on the new electronics-based automation technologies, and on new intercompany relationships.

New ways of production management and work organization are introduced changing the production setting from supply-driven to demand-driven when competition is not focused on lower costs but on product innovation. The need for flexibility motivates the

implementation of the *JIT* system, the multivalent and multi-qualified work, and a new work-administration relationship based on cooperation instead of conflict (Hoffman & Kaplinsky, 1988).

The cooperation between manufacturers and suppliers is necessary due to the need of production planning resulting from the implementation of *JIT* (external extended), the technology progress, which includes products that require coordination between manufacturer and supplier and among suppliers, and from the increasing technology of the products which leads to the need of more coordination.

According to Womack, Jones & Roos (1992), lean production combines the advantages of craft and mass production while avoiding the high cost of the former and the rigidity of mass production. It is a holistic approach based on principles and logics that affect all aspects of the production system. It focuses on solving problems and on achieving the desired quality without redoing much of the work and with continuous improvements.

These authors argue that a production organization model is markedly different from the mass production model. Its work organization is not focused on tasks and workstations. It is structured based on teams of multivalent and multi-qualified workers (every team has a leader), who take over most of the tasks and responsibilities reducing the indirect work drastically.

The productive process is restructured with the implementation of several different systems such as *JIT*, CEP, TQC, the minimum stock level system, CCQ, and a system that identifies flaws and causes. Due to low stock level, production problems are identified and solved, and there is more flexibility because of the variety in the mix production and the reduction of time between the order placement and the product delivery. Together with the organizational changes, high flexibility micro-electronic equipment such as robots, *CAD/CAM* and *CLP* systems among others are employed.

Concerning car assembly plants, according to those authors, lean production leads to a new parts supplying concept. The suppliers are organized in different levels of responsibility. First-tier suppliers participate in the development of new products and organize the second-tier suppliers tied to them. All of these suppliers implement the *JIT* system providing effective fulfilling of the fluctuating market demand.

Some authors point out different aspects of a new production organization model, but they acknowledge such model include significant changes if compared to the mass production model, or Taylorist/Fordist model, which used to predominate. They also state that lean production (post-industrial company, systemofature, or flexible production) considers new elements in the production management, in work organization, in products and processes technology, and in the manufacturers and suppliers relationship.

4. Production Organization and Work Aspects in Brazilian and Spanish Automotive Sector Companies

Study cases were carried out and reference lists and reports were prepared in order to build a relationship between production organization and work in this sector

Besides references lists, case studies were conducted in Spain to complement information gathered from the literature. Reports were presented to production managers as well as ergonomics and workplace safety managers in the following companies: Nissan, John Deere, Nagares, Gestamp, Daimler Chrysler Mercedes, Sogefi Filtration, Faurecia, Gamesa, Lear Automotive (Eeds), Móstoles Industrial, Opel/Gm Zaragoza, Iveco, and Psa/Peugeot Citroen. The first six of these 13 companies were visited.

In Brazil, information was gathered from a literature review and results of the research on production and work (Alves Filho *et al.* 2002 e 2003; Bresciane, 1997; Salerno *et al.*, 2002).

The time spent on the shop floor of automotive sector companies has been discussed, and it has received close attention due to its importance to the production time strategy in relation to the logistics aspects for the companies in the productive chain. In addition, it is equally important to the unions with respect to work conditions aiming at reducing the work period of work shifts and increasing workers responsibilities concerning results and pace of work.

This increased responsibility leads to more diversity and number of tasks in every workstation increasing the rhythm established by the equipment and, consequently, the workload. However, the repetition of tasks during a work shift remains a reality in some workstations, mainly those in which the “*poka-yoke*” system was employed. In the automated assembly chain, there has been an increased number of tasks and constant adaptations of rhythm, and models and versions of the product mix (CC.OO. 2001).

Production flexibility has been provided due to the accuracy and reliability of the information technology which enables the suppliers to acknowledge the needs of the car assembly plants while demanding restructuring of the production scheduling methods, almost in real time, resulting in a redistribution of the work load among the groups and teams of the production and logistics sectors (Perez y Sanches, 2002).

Table 1 shows the data obtained from the companies in Spain indicating that the main productive restructuring concern is the search for competitiveness, and it is not related directly to work condition improvements.

Table 1 – Major improvements and respective operational procedures to enhance productivity in Spanish automotive sector companies (Camarotto, 2007).

Improvements	Procedures
Cycle time reduction	Automation, cell design, Kaisen workshop and MRP
Production capacity efficiency increase	Kaisen workshop, SPC, TPM and Information systems
Workforce productivity enhancement	Employee training, TQM, Kaisen workshop, parts flow
Workforce motivation increase	MRP, ERP, task enlargement, accident prevention , performance measures

Cycle time reduction is an important goal for companies. According to managers, this is due to the constant products and processes changes resulting from car assembly plants and to the pull production systems (*JIT/Kanban*) adopted by the assembly companies which demand the use the same procedures of their suppliers.

Similarly, an increase in the production efficiency and programs development concerning the shop floor workers is due to the fierce competition between Spanish and European assembly companies and, more recently, Eastern Europe assembly companies.

Each procedure indicates that there is no direct relation between the improvement goals and the procedures adopted for such improvement (Table 2). Nevertheless, the procedure “automation” and the improvement goal “cycle time reduction” are exceptions.

Table 2 – shop floor workers training programs in Spanish automotive industries (Camarotto, 2007)

Procedure adopted	Major goals to be reached with the procedures
Operating Personnel Training	productivity enhancement, work relationship improvement, set-up time reduction
Manufacturing Execution Systems (MES)	set-up reduction improvement
Automation	Workstation space reduction, set-up reduction, parts flow simplification,

In those companies, the changes in the production management models do not follow a corporate strategy, but market responses while car assembly companies have corporate programs. These assembly companies focus on costs and delivery putting suppliers in charge of quality

Therefore, delivery is a consequence since the assembly companies penalize delays. While the assembly companies are consolidating the employment of *kaisen* programs and cell designs with multifunctional operators, the suppliers are in the initial stages of lean production with workplace organization (*5S*) and quality control programs.

The work condition improvement processes (ergonomics, workplace safety, and work organization) adopted by the Spanish companies studied follow a productive restructuring pattern typical of the lean production model, widely used by automotive sector industries. One of the most cited programs by the interviewees was setting up work teams in order to implement lean production.

According to Perez y Sánchez (2002), the work teams are prepared to multivalent work based on the socio-technical approach used in Swedish and Dutch automotive sector companies. However, these authors point out the differences in the set up of those teams in Spain due to the different production organization systems in relation to the lean production techniques implemented.

It can be said that none of the companies had made such changes in a structured way, but as a function of the market needs or of a consumer-supplier relationship strategy. Such implementations allowed more autonomy and training to operators although the quality control programs do not have the freedom to suggest work condition (except Chrysler) and workstation cycle changes.

The different systems of job rotation around workstations were sharply criticized by the ergonomics technicians since they do not foresee operation or procedure changes maintaining fast rhythms and movement repetitions.

In the beginning of the 80's, in Brazil, the introduction of Japanese techniques was partial and selective. The external extended *JIT* system of production applied to a few suppliers, mainly in the automotive industry, while the internal *JIT* was widely implemented. Nevertheless, those companies used employ systems similar to *Kanban*, but not *JIT*.

The quality control programs were influenced by the economy fluctuations and labor union contests. The production cells were present in the large and medium scale serial production systems.

The implementation of such techniques has been conservative since the real work continues following manufacturing schedules etc, and the multifunctionality was understood as a

multitask aspect. The quality control programs were used under a conservative modernization perspective since the manuals highlight the Taylorism flaws, but the real work is still taylorized and it became intensive with the implementation of cells and internal *JIT* (Lombardi apud Salerno, 2002).

During the 90's, there were several changes in the work organization in the Brazilian automotive sector associated to lean production practices despite the fact that a number of sectors of companies in the automotive chain still adopt work organization models similar to Taylorism such as work intensive pattern setting, and measurements of time and movement studies (Bresciani, 1997). Thus, at the same time they maintain the traditional line production, new rhythms related to demand fluctuation were developed.

Lombardi apud Salerno (2002) and Assunção (2003) draw similar conclusions about the implications of the productive restructuring of the 90's for the work conditions such as new rhythms tied to the *JIT* production model, new equipment devices, and workers' training. The increase in the work rhythm results from the *poka-yoke* system employed which makes it easier to carry out work making the tasks physically lighter, but increasing considerably the cognitive load based on decision-makings about a variety of tasks.

In such cases, there is a paradox between multifunctionality - making the worker better qualified to take on different tasks and decision-making need with rhythm variation – and the incompatibility with their personal characteristics and necessities to perform tasks. (Assumpção, 1994)

Alceu et al (2003) concluded that work organization methods are heterogeneous. Even in the presence of job rotation the tasks are short cycled and repetitive. However, there are more workers' involvement in the company since they assume the corporation's policies and identify.

The major variations are the companies' experiences of modern practices (cells, job rotation, and vertical job enrichment), qualification, and workers participation and autonomy in the improvement programs. In this restructuring process, the work organization models are influenced by job opportunities and by the union organization established in the region of the suppliers.

5. Final Considerations

In the study conducted with the Spanish companies, it could be noted that technology guides the ways of organizing work since the companies adopt similar technologies, and the cultural and history differences between Brazil and Spain are not evident in the production and work reorganization. These results are in accordance with those of Dejours (1998) e Coriat (1994) about globalization of work organization models.

Nonetheless, it is worth mentioning that in the Spanish companies, there is a greater integration between technology and work regarding the workers knowledge about the production processes since innovations and implementations of new technologies are slower than the restructuring process in Brazil.

The shop floor work teams in Spain are organized in a peculiar way. The leader plays the role of work organizer and represents the team before the production planning technicians. In Brazil, the leader can substitute for a team member (who is absent from work or due to job rotation) playing the negotiator role with supervising

In the Spanish companies studied, there are more multifunctional workers (especial cases are Aernova and Nissan) and job rotation with more frequent and shorter breaks.

The models of engineering methods consist, most of all, of representations that guide the engineering practices. In the designing of a model, there are techniques and practices that come from productive situations and the outcomes are acknowledged. Such contextual appreciation will legitimate the models and reassure the practices. The practices are the bases for designing models which, on the other hand, institutionalize such practices.

The studies about technological changes have been considering workstation spaces with cognitive tasks. Analyzing the introduction of lean production in Spain, Castillo (2000), reports the impact of these changes on the tasks structure, the work increase due to the reduction of permanent workers in production areas, and a cognitive load increase.

According to Garcia (2000), there is widespread dissatisfaction due to fast work rhythms and a decrease in the number of workers associated to the difficulty of changing work environments. The author points out that are improvements for the lean production workers, but these improvements result from labor union actions and not from the model adopted.

Garcia (op.cit) states that some of the changes labor unions and workers negotiate are: a) hiring temporary workers to fill the absence of permanent workers preventing the rhythm increase due to their absence; b) increase in job rotation around different departments and in the in-company training; c) negotiating the speed of the production line and work norms; and d) ergonomic programs design.

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