RECENT TRANSFORMATIONS IN THE MEXICAN MOTOR INDUSTRY[1]

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1 INTRODUCTION

Mexican industry has been undergoing a far-reaching change since 1983, when the government replaced its import-substituting strategy with an industrial restructuring programme aimed at resolving the economic crisis (Wijnbergen 1990). Concretely, the government has encouraged Mexican firms to reorient production to the external market by deregulating the economy. This has obviously modified the long-standing organizational and technological patterns of many manufacturing plants.

The motor industry has played a special role in this programme. Its performance as leading manufacturing exporter and generator of value-added in the past decade has enabled Mexico to become one of the most outward-oriented developing countries (Nunez Peres 1990). In particular, seven assembly and engine plants located in the North after 1980 have been leading the transformation of manufacturing.

The impressive growth of automobile production in the North, which has largely been driven by its integration with the North American market, clearly shows how international competition affects the location and development of Mexico's export facilities. The Mexican motor industry (MMI) is a key case for illustrating two critical aspects of the present Mexican industrial restructuring: (a) new links with the world economy, and (b) the spatial patterns of recent industrialization in Mexico.

This article focuses on the second of these two points. Section 2 highlights the MMI's general performance and also its new locational patterns. Section 3 pays attention to the organizational changes associated with implementation of Just-in-Time/Total Quality Control (JIT/TQC) systems by the most important exporting plants, owned by the Big Three US motor companies (Chrysler, Ford and General Motors) in the North.

2 THE RECENT DEVELOPMENT OF THE MEXICAN MOTOR INDUSTRY

Since 1983, five out of the six transnational motor companies with operations in Mexico have deepened their export-orientation, partly as a reaction to the new needs of the American market but also as a result of the crisis of the domestic market. The weakness of the domestic market caused losses in the industry equivalent to US$1.5bn. between 1981 and 1986 (Shaiken and Herzenberg 1987).

The government stimulated an export orientation by a process of deregulation, enacting two decrees in 1983 and 1989 which promoted the exports of components and finished vehicles. The 1983 decree increased local content requirements and obliged firms to balance their imports and exports. This forced firms to export. The 1989 decree (i) reduced the local content requirement, (ii) abandoned the requirement that Mexican motor parts be incorporated into vehicles and (iii) allowed firms with trade surpluses to import vehicles. These decrees put government-industry relations on a new footing. The government's economic policy was adjusted to the productive needs of the motor industry for the first time (Samuels 1990). In particular, the Mexican subsidiaries of the Big Three US motor companies benefited greatly from the new legal initiatives because the two decrees allowed them to establish five engine/assembly plants in the North. This is the largest export complex in Mexico.

The five plants expanded passenger car exports twenty-fold between 1983 and 1987. In 1985 the export value of engines was nine times the export value of passenger cars, but by 1987 the ratio was 1 to 1. By exporting 78 per cent of all engines and 92 per cent of all automobiles produced between 1983 and 1987, the five American plants turned the chronic deficit of the motor industry as a whole into surplus. Exports rose from US $483.1 mn in 1983 to US $3204 mn in 1987. In 1983, exports of all vehicles reached only 3.3 per cent of sales in Mexico, but by 1987 this

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had increased to 39.7 per cent. All but 5 per cent of these exports went to the USA.

Chrysler and Ford increased their export ratios from 4 per cent in 1977 to 66 per cent in 1987, while for GM the figures were 4 per cent and 44.1 per cent respectively (AMIA 1991). In contrast, Nissan concentrated its efforts on the domestic market, where with VW it is the main producer and employer in the assembly industry. Just recently these two firms, along with Renault, have been exporting engines (and automobiles in VW's case) to their parent companies, but to a lesser extent than the American subsidiaries.

The export boom started in 1983 with greatly increased export of engines. The Ramos Arizpe complex[2] more than doubled its production of engines in relation to 1982, and in the same year Ford's new engine facility at Chihuahua came into operation. By 1985, the plants established or expanded in the early 1980s by GM, Chrysler Ford and VW were exporting 1.3 million engines for passenger cars to the USA and Germany. Four years later, with the installation of other engine plants in Aguascalientes (Nissan) and Durango (Renault), and the maturation of previous investments, exports rose to 1.6 million units, equivalent to 20 per cent of the US market for engines (Carrillo 1990). Currently, the total export capacity of all these firms amounts to 2.5 million engines per year.

Assembly of vehicles was also greatly expanded. Between 1985 and 1987, Ford-Mazda built a new plant at Hermosillo, as did Nissan at Aguascalientes. VW also expanded its plant at Puebla, as did Chrysler at Ramoz Arizpe. Of these new investments, the Ford facility at Hermosillo was the most significant. It had a capacity of 135,000 finished vehicles per year, and in 1987 it accounted for 42.6 per cent of Mexican exports of built-up cars. The performance of Ford-Hermosillo plant along with the explosive growth of VW at the end of the past decade, increased total car exports from 141,492 units in 1987 to 249,926 units in 1990.

2.1 Changes in the Regional Location of Firms

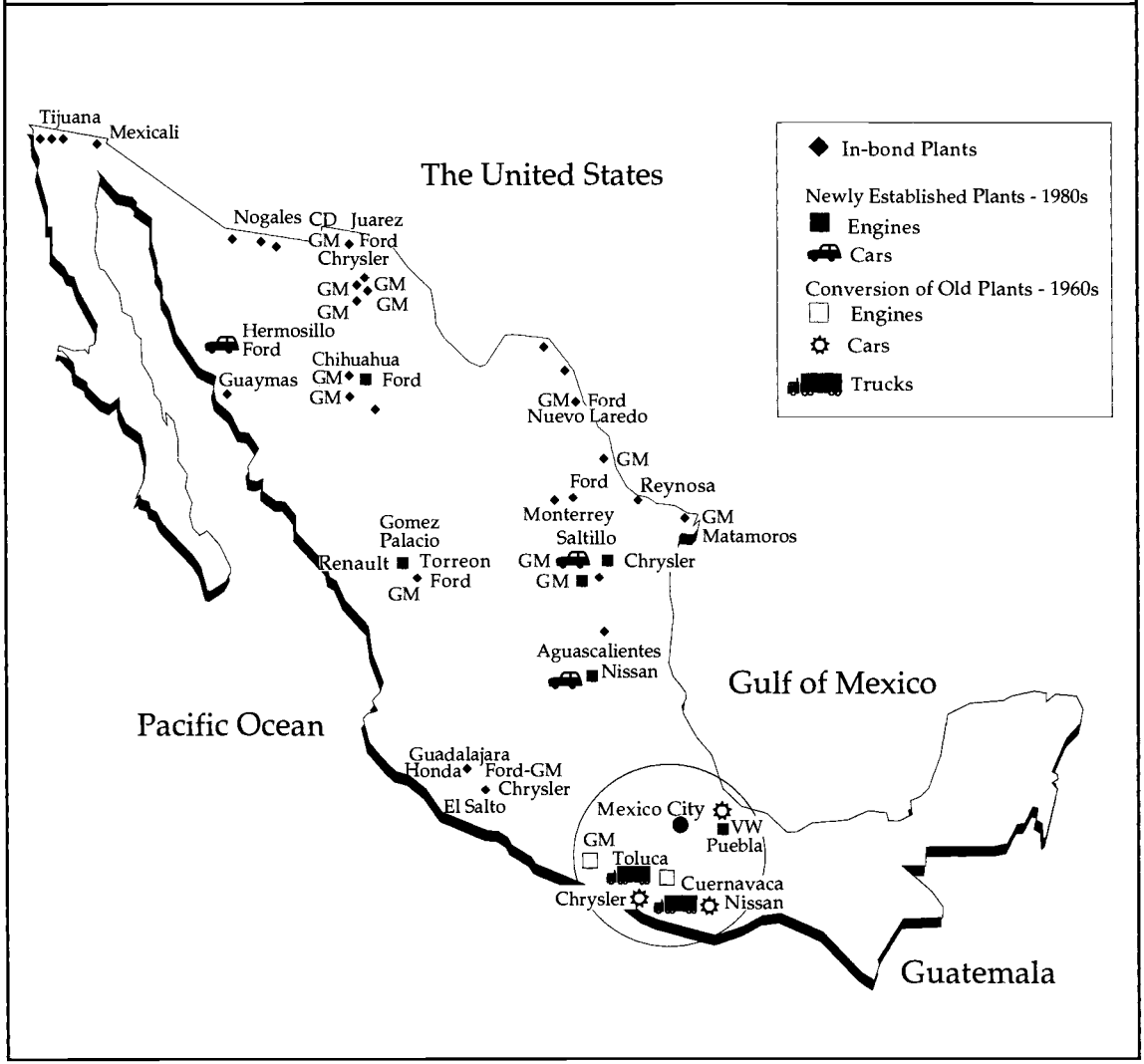
The concentration of these new plants in the North of Mexico has transformed the MMI's geographical distribution. During the first 50 years of its existence (1925-1977), assembly plants were concentrated in or near the main industrial cities, which gave rapid access to mass markets. The transnational companies in the industry placed their own supplier networks close by, because only in the centre of Mexico could they find an existing industrial base. The closing down of three firms built during the 1960s at some distance from Mexico City, and the motor parts producers' desire to save transportation costs, ended by concentrating even more facilities in the Centre (Bennett 1986). From 1962 to 1977, almost 80 per cent of motor vehicle production was located in Mexico City and Toluca.

Figure 1 shows the impact of the location of plants for export in the North. These plants are mainly located in greenfield sites (with the exception of Monterrey) with relatively limited industrial development and weak union organization. In these plants, close links between suppliers and manufacturers are established from the outset because of the intensive application of JIT/TQC concepts. For this reason, the supplier is, generally, located close to the manufacturer, sometimes within a one-kilometre radius. Currently 31 per cent of vehicles and 63 per cent of engines are produced in the northern region of Mexico, whereas 15 years earlier there was virtually no production at all.

Behind this great spatial division lies a new pattern of regional specialization within the Mexican automotive industry. Firstly, plants located in the North produce basically for export: four- and six-cylinder engines, small and medium cars, light commercial vehicles and parts. The plants in the centre of Mexico have specialized in six and eight cylinder engines, medium size cars and heavy duty lorries, mostly for the domestic market. Secondly, there is a minimum exchange of parts and components between both type of plants because of their different degrees of integration with their parent companies. Plants in the North rely much more on imported parts than those in the Centre. Finally, the technical skills of the labour force and the level of automation in the northern plants are considerably greater than in the Centre (Wong-Gonzalez 1989).

[2] This complex is made up of two engine plants (owned by Chrysler and GM) and one assembly plant (GM). It was opened in 1979.

Figure 1: The Geographical Location of the Export-Oriented Plants of Mexico's Car Industry, 1990



3 ORGANIZATIONAL AND TECHNOLOGICAL TRANSFORMATIONS

3.1 New Patterns of Specialization in the Supply Industry

The restructuring of the automotive sector has compelled suppliers to modify their traditional productive specialization. Between 1980 and 1990 the motor parts *maquiladora*[3] plants (APM) drastically changed their productive orientation. Having formerly concentrated on producing electrical systems, they have increasingly engaged in the production of engines and other parts. This rapid transformation has been led by the Big Three US producers who own approximately 25 per cent of the 160 APM plants existing in Mexico and employ 39 per cent of the total labour force working in them. Such a transformation required a greater emphasis on manufacturing as opposed to merely the assembly of wires and harnesses. Engine parts, suspensions and wind-

[3] The *'maquiladora'* are in-bond plants set up in the North of Mexico under an agreement between the Mexican and US Governments.

screens are being produced, and casting and machining processes have been introduced rapidly in factories created by joint ventures between large national producers and the multinational assemblers. Likewise, large Mexican companies have adopted the *maquiladora* regime in order to supply particular products to the assembly plants. In such cases, the national plants quite often receive technology from the terminal plants to help them meet quality requirements (Arjona 1990).

The motor parts industry is made up of producers of (i) 'principal components', (ii) 'parts and systems of low technology' and (iii) 'rough components of low technology' (Booz-Allen and Hamilton 1987). So far, among the firms not operating within the special *maquiladora* regime (the great majority of Mexican firms), only the producers of 'principal components', supplying parts of high- and medium-technology directly to the assembly plants, have undergone important changes in their productive activities. There are some 40 firms of this type. The rest of the manufacturers (around 360) mostly offer 'mature articles' to the inward-oriented plants or to the producers of 'principal components' which then do further machining work on them (Unger and Saldana 1989). These products do not change rapidly and do not have a high level of innovation.

To ensure a successful implementation of the JIT/TQC system, the Big Three have adopted stringent criteria to select suppliers. According to the managers interviewed, reliability, cooperation, delivery time, quality and the lobbying capacity of the supplier's parent company in the USA are the key factors for becoming a supplier in the North. Ford's big suppliers belong to the same companies which have kept close contact for a long time with Ford in the USA and Europe. GM and Chrysler in Ramos Arizpe have developed their own network of suppliers by subcontracting plants to powerful economic groups which have already proven to be reliable in past international projects. These plants operate under certain preferential tariff regimes which promote the 'indirect exports' of suppliers. This has rapidly concentrated production among a small number of producers. Eight out of the ten largest suppliers of the whole MMI are placed in the North. These top firms now account for 50 per cent of exports and 20 per cent of the domestic output of the motor parts sector.

For other producers, the chances of supplying the outward-oriented plants depend greatly, therefore, on their links with these major suppliers of 'principal components'. In practice they decide how many other suppliers will be included in any productive project. National suppliers contracted by outward-oriented plants may not have another affiliate and are, therefore, disadvantaged when in competition with transnational component suppliers who can provide parts for the major motor companies in different countries. In fact, only a few Mexican companies can successfully survive as independent suppliers, depending on a monopolistic position in the domestic market. The remaining Mexican first-tier suppliers have relations with transnational companies which include subcontracting, technology agreements and joint ventures.

3.2 Application of Flexible Technologies

Suppliers are integrated into the export strategies of the assemblers very unevenly. As a result, only the largest northern facilities have upgraded their productive processes in order to become more competitive producers (Boon and Mercado 1990). A recent survey shows that the outward-oriented plants (assemblers and suppliers) showed a higher index of automation than the inward-oriented ones: 65 per cent of the former's plants were fully automated, whereas 30 per cent of the inward-oriented plants were only semi-automated; the rest presented a low degree of automation.[4]

The outward-oriented plants have also introduced the greatest number of techniques such as deliveries just in time, use of statistical process control (SPC), work teams and Quality Function Deployment. The main reason lies in the advanced JIT/TQC system put into practice by the outward-oriented assemblers. They demand that their suppliers meet a 'minimum level of efficiency' which is based on seven basic operational criteria: quality, productivity, delivery time, safety, group techniques, technical capacity and flexibility. To reach such a minimum, suppliers have to work jointly not only with the assemblers but with their own sub-suppliers as well.[5] Without this cooperation with suppliers, it

[4] The survey included 49 automotive plants (suppliers and assemblers) from both the South and the North. A scale for measuring the degree of automation was constructed, taking into account the use of robots, numerically-controlled tool-machines and automated work stations.

[5] Ford's suppliers in the North used to have 10 meetings a week with the assembler to ensure an accurate application of JIT.

would be impossible for them to meet the seven criteria, since any evaluation takes all the supplier's productive activities into account. This evaluation is 65 per cent based on analysis of SPC and applied continuously by the assemblers. As a result, any supplier performing badly can be dismissed at any time, even though it may have performed well in the past.[6]

This tight supervision of suppliers' performance is aimed at continuously improving their quality and productivity standards, and reducing delivery times. Most of the Big Three's suppliers in the North currently produce, on average, as much as they did three years ago, but they make them in half the time and with half the number of defects. In doing so, first-tier suppliers have had constantly to achieve international standards of efficiency (scrap, re-work, lead-time etc.) no matter how far they are situated from the assembly plants. Suppliers situated 1,100 miles from Ford-Hermosillo, for example, should spend no more than five days in assembling and delivering products required by the plant, with a reject rate of parts no greater than three per hundred thousand. This reject level is one of the lowest in the Ford world system (Sandoval 1988). Similar levels of quality have been achieved at the Ramos Arizpe complex. In these cases, record levels of quality have been achieved by firms halving their levels of scrap and re-work every two years. As a result, the suppliers have obtained the quality awards offered by the Big Three: Q1, Spirit and Pentastar. As a consequence, however, supplies have been concentrated in the larger, transnational supplier companies, as was noted in the previous Section.

It is important to note that the US assemblers do not have a single strategy for their suppliers. Even when they share the same supplier, they may use them in different ways. GM-Ramos Arizpe, for example, takes products from one subsidiary of LSSC with a lower value than Ford-Hermosillo takes from another subsidiary of the same firm. The reason for this is that production at GM-Ramos Arizpe is limited by a production quota agreed between GM in the USA and the Union of Automobile Workers (UAW). The assembly plant is not allowed to produce more than 14 per cent of the GM's total supply of the 'Model A' (its main product). To keep below this limit, GM only takes seat covers from LSSC, rather than the whole seating system, as is the case at Ford-Hermosillo. To minimize the effects of this restriction, GM encourages firms like LSSC to develop a network of local producers of raw materials in which Mexico is more competitive (such as yarn, leather and vinyl). If the costs of these items can be brought down, GM can incorporate more local content without exceeding the restrictions negotiated with the UAW. The absence of such constraints in Ford's case enables the LSSC plant at Hermosillo to practise a more complex JIT/TQC system.

This difference in organizational approaches forces suppliers to comply with the assemblers' requirements in very different ways. Once again, differences between Ford and GM can be seen. Ford Hermosillo imposes delivery requirements which vary according to different categories of supplier. The plant has four types of suppliers: (1) 'Suppliers JIT', (2) 'Total Responsibility Supplier', (3) national suppliers and (4) international suppliers. The 'suppliers JIT' make two deliveries a day and are located near the plant. The same is true of the 'total responsibility suppliers', which must, in addition, work jointly with the manufacturer on the assembly line. This type of supply requires a high level of synchronization between both parties because any deviation from the original specifications means severe punishments for suppliers (20,000 dollars penalty per minute if the assembly line is stopped by a supplier's error). The national and international suppliers practise a system named 'one-day-at-a-time'. In this case JIT deliveries are ensured by delivery every seven or ten days of the quantities of products required daily during a seven- or ten-day period. These are stored in local warehouses or at the port of Guaymas and then delivered to the plant in one-day batches. This mimics JIT delivery.

The Ramos Arizpe complex uses a different system. Suppliers programme their daily production on the basis of a one-week programme. Each GM and Chrysler order amounts, on average, to 12 weeks of a supplier's production. Under this system, the assembler renews its request when finishing the eleventh week, and suppliers always have a week's time to reprogramme their future activities. In practice, deliveries do not always follow this plan exactly. Deliveries have to be made in accordance with the suppliers' daily production matrix. This

[6] Facilities using Quality Function Deployment are also evaluated by foreign customers. Therefore, they have to adopt additional techniques, such as experimental design or laboratory tests, to correct any mistakes detected by customers abroad.

matrix arranges a schedule of up to four deliveries a day. The parts are produced either a day before or as little as four hours before they are delivered.

Many suppliers have difficulties in delivering on time because they are still familiarizing themselves with JIT/TQC systems. These suppliers are mainly Mexican and have no past experience with the motor industry. Prior to being contracted by the assemblers or major component suppliers, they supplied their products - such as garments, leather or yarns - to customers outside of the motor industry. Some of them still deliver their products in large batches, which obliges their customers to keep larger stocks than they would wish.

4 CONCLUSIONS

Although plants for export have been implementing advanced flexible systems in the North of Mexico, they have not yet developed extensive and close corporate relationships inside 'industrial zones'. This is in part because innovation is mainly controlled by the suppliers to the parent companies. Moreover, introduction of JIT/TQC concepts has only been efficiently applied by the biggest suppliers, which do not have explicit subcontracting programmes for national suppliers. Only a few Monterey-Saltillo-based companies organize supply transactions through a multi-layered network of national suppliers. But this is an exception, because these companies have proven to be 'national champions' in products such as steel or glass for a long time. The real problem lies in incorporating into the new JIT complexes those suppliers which do not have links with transnational or large Mexican companies. In these cases, implementation of JIT/TQC takes a lot of time since producers have to reconvert their former craft production layouts. Hence, they are more interested in solving internal manufacturing problems (scrap, re-work, low quality products) than in developing complicated strategies for manufacturing organization (Gomez Aguirre 1990).

Under such circumstances, it is not realistic to say that the new industrialization in the North, follows what Storper and Walker (1989) call, a 'clustering' geographical pattern. The territorial dispersal of plants is still a widespread phenomenon in Mexico, precisely because many automotive firms have not been drawn into the new organizational changes. For this reason, the JIT motor complexes in Mexico should be characterized as a 'semi-clustering' locational model, combining two different models. On the one hand, there is a clustering model, characterized by a strengthening the intra- and inter-corporate spatial linkages, because of the intensive application of JIT/TQC concepts. On the other hand, there is dispersal model in which links between suppliers and users remain unchanged. Spatial decentralization of production is made possible by large stocks of work-in-progress. As a result, the Mexican motor industry is composed of a wide range of factories with uneven technological and organizational development.

The future of this uneven development in Mexico is a question which remains open. Up until now many external factors have favoured the emergence of the clustering model in the North. For example, car design has standardized certain processes and products at the world level, making certain components usable in different models and slowing down the rate at which products and process become obsolescent (Schoenberger 1987). This has enabled Mexico to continue producing components for which it has had a comparative advantage for a long time. The introduction of new technologies and materials has been incremental, allowing Mexican firms to remain competitive. Similarly, the successful displacement of flexible technologies to Mexico shows that the need to be 'close' to markets and suppliers is only relative. Northern Mexico seems close enough for JIT, even when linkages are made with Japan (for supply) and North America (for supplies and markets). The northern plants' performance shows that hybrid forms of JIT can take place in developing countries when productivity and quality are ensured at a lower cost than in developed countries.

These factors should not be overestimated, since in an industrial world dominated by JIT clustering of firms 'only a small advantage can be gained presently through sourcing in low-wages areas' (Womack and Jones 1985: 405). In particular, only a few developing countries can compete successfully in products such as major and minor mechanical components, or in Mexico's case finished parts, on the basis of lower overall costs (Lamming 1989; Sanderson *et al.* 1987). The growth of the Mexican motor industry in the North is heavily dependent upon the productive strategies of the Big Three motor producers in the United States. Mexico's chances of developing producers which are competitive on the world market will diminish substantially if the American subsidiaries start to lose their market share in the USA.

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