TECHNOLOGY AND WORK ORGANIZATION IN
LATIN AMERICAN MOTOR VEHICLE INDUSTRIES*/

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INTRODUCTION

As the major automobile producing countries of Latin America enter the global market, automakers are engaged in a painful and far-reaching process of change. Governments in Argentina, Brazil, and Mexico are opening their auto markets, dismantling decades-old import substitution policies and subjecting their domestic producers to unprecedented international competition. At the same time, automakers are increasingly integrating their local operations into larger regional and global production networks, seeking to achieve new economies of scale and to maximize their exports.

This paper examines the impact of this new globalization on work organization and manufacturing practice in Latin America’s three most important auto producing countries. The focus is on the ways in which major automakers are restructuring their operations; the forces that encourage this transformation as well as the factors that hold it back. In particular, we look at the deployment of new production methods and new technologies in a number of key plants and their impact on productivity and quality. The research is not meant as a direct comparison of the industries in the three countries—the context is too different—but rather as an exploration of important trends in each as governments move from import-substitution strategies to more open markets. This study should be viewed as a preliminary overview of a complex and rapidly changing process; our goal is more to pose the right questions than provide the definitive answers on a transformation that is beginning to unfold.

Automakers in all three countries are anticipating major long-term growth in the domestic market and sizeable increases in exports in the 1990s after what amounted to "the lost decade" of the 1980s. The strategies of the major automakers are shaped by widely differing economic, political, geographical, and historical contexts. What do these overall strategies look like? Auto producers in Mexico are rapidly developing an export capacity—44 percent of total production was exported in 1993—centered on the hotly competitive US market. At the same time, automakers in Mexico are trying to cope with the devastating aftermath of Mexico’s financial collapse which in the short term has virtually ground the domestic industry to a halt. Prior to the collapse of the peso, existing producers such as General Motors and Nissan were investing heavily in new plant and equipment, while a number of new producers such as BMW and Honda were preparing to enter the market. In contrast, automakers in Brazil appear to be carving out a role as major regional exporters—24 percent of production is exported—to the rest of Latin America. Companies are investing heavily in new models and production processes, and are evaluating building new plants. Argentinean firms, the smallest and least competitive, are moving towards greater integration and rationalization with the auto industry in Brazil and currently export 9 percent of their output.

After a brief review of our methodology, we first discuss the changing character of auto markets in the three countries and the regulatory framework that has most recently shaped them. We then focus on changes in technology and manufacturing practice, first exploring larger trends and then focusing on case studies of several plants in each country. We conclude by defining some of the themes the research raised.
I. METHODOLOGICAL NOTES

We conducted field research in Brazil and Argentina during January of 1994, visiting plants, interviewing managers, and speaking with industry association representatives. Additionally, we spoke with workers and union representatives in Brazil. For Mexico, the research for this project is an extension of previously authored studies (Shaiken and Herzenberg, 1987; Shaiken and Browne, 1991; Shaiken, 1990, 1994) which included numerous visits and extended interviews with workers and managers at several locations. Most interviews in all three countries were tape recorded and transcribed for further analysis. As part of our fieldwork, we observed production throughout each plant, and spoke with engineers and managers about technologies already in use and manufacturing systems to be deployed.

1. Site selection

Time and resources did not permit a comprehensive overview of the industry in each country. Instead, we sought two types of research sites: representative plants from the largest producers and plants which were especially advanced. In Brazil, we visited the Anchieta plant of Autolatina, a holding company which joined both the Brazilian and Argentinean subsidiaries of Volkswagen (VW) and Ford in 1986, and now appears to be in the process of unraveling. Autolatina is Brazil’s largest automaker, producing 500,000 automobiles in 1992 and commanding 41 percent of the market. (ANFAVEA, 1993, pp. 71-72). We also visited two General Motors manufacturing complexes, an older plant in Sao Caetano and a newer multi-plant complex in Sao Jose dos Campos, an hours drive from Sao Paulo.

In Argentina we visited Sevel, Argentina’s largest auto producer, which is owned by the Macri Group, the country’s largest industrial and services conglomerate. Sevel manufactures and distributes Peugeot and Fiat autos under license and produced 120,000 units for a 45.5 percent market share in 1992. We also visited Autolatina’s Ford Division which produced 64,000 vehicles and had a 24.5 percent market share, and the corporate offices of GM-Argentina, which will re-enter the Argentinean market during 1994 with truck production from a new plant.

The research on Mexico is largely based on extended studies of the Ford Chihuahua Engine Plant (Shaiken and Herzenberg, 1987; Shaiken, 1994) and the Ford Hermosillo Stamping and Assembly Plant (Shaiken, 1990; Shaiken, 1994). Ford is currently launching a newly designed engine and has installed capacity for 400,000 units annually in the Chihuahua plant. The Hermosillo plant produced almost 120,000 autos for the US and Canadian markets during 1993 which accounted for almost a quarter of Mexico’s export production.

II. CHANGING MARKETS

Markets in all three countries are characterized by a major opening during the 90s after traumatic economic experiences in the 80s. In this section, we provide a brief overview of policy initiatives and agreements in each of the countries that inform the changes now taking place. Two measures, in particular, underscore the magnitude of these changes, vehicle production and exports.

Brazil’s vehicle production peaked at close to 1.2 million in 1980 only to skid to 780,000 one year later, the lowest level for the 1980-1993 period. After limping along for over a decade, production only surpassed the earlier all-time high in 1993 (1.4 million) (ANFAVEA, 1993, p. 65). Argentina’s
vehicle production plummeted from 281,000 vehicles in 1980 to about 100,000 units in 1990 when the industry virtually collapsed. Since then, output has soared to over 342,000 in 1993, an all-time high, surpassing the previous peak of 294,000 units twenty years earlier (ADEFA, 1992, p. 6). Mexico’s production nose-dived from 1981’s high of almost 600,000 units to 285,000 in 1983—a 48 percent drop in two years (AMIA, 1988 and 1994). After this debacle, production has rebounded, reaching almost 1.1 million units in 1992 and 1993. (see Figure 1)

Another indicator of market changes is production of vehicles for export. Exports in Brazil have more than doubled over the period 1980-1993, from 157,000 to 330,000 units, and now account for about one quarter of production (ANFAVEA, 1993, p. 97). Currently, 60 percent of these vehicles go to Argentina and another 20 percent are shipped to other South American countries. Argentina’s production for exports has also experienced explosive growth from a low of 400 units in 1986 to an all-time high of almost 30,000 units in 1993. Mexico began the period with very low production for export, 18,200 vehicles in 1980. The industry went through a far-reaching transformation as a result of the very successful experiences with sited advanced auto production facilities in Mexico. (Shaiken and Herzenberg, 1987; Shaiken, 1990): This led to a de-facto incorporation of the auto industry into the North American market, first under an export-led regime and more recently with the implementation of the North American Free Trade Agreement (NAFTA). During 1993, for example, Mexico’s automotive industry exported 471,912 units—almost 26 times 1980 levels and about 44 percent of production. Almost ninety percent of these exports were destined for the United States or Canada, with only 2 and 7 percent exported to Central and South America, respectively. (see Table 1)

By the year 2,000, some analysts project production levels of close to 2,000,000 vehicles, with about half of the production destined for export. Brazilian industry representatives we spoke with expect similar production levels, with 1.5 million units for national market. Projections for 1995 sales in Argentina amount to 400,000 units. (EIU, 1993a, p. 41)
FIGURE 1
Total Vehicle Production
Brazil, Mexico and Argentina
1980-1993

SOURCES: ANFAVEA (Brazil), AMIA
(Mexico) and ADEFA (Argentina)
<table>
<thead>
<tr>
<th>Year</th>
<th>Brazil Total Production</th>
<th>Brazil Export Production</th>
<th>Brazil Percent</th>
<th>Mexico Total Production</th>
<th>Mexico Export Production</th>
<th>Mexico Percent</th>
<th>Argentina Total Production</th>
<th>Argentina Export Production</th>
<th>Argentina Percent</th>
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<tr>
<td>1980</td>
<td>1165.1</td>
<td>157</td>
<td>13.48</td>
<td>490</td>
<td>18.2</td>
<td>3.71</td>
<td>281.8</td>
<td>3.6</td>
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<td>1981</td>
<td>780.8</td>
<td>212.6</td>
<td>27.23</td>
<td>597.1</td>
<td>14.4</td>
<td>2.41</td>
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<td>0.16</td>
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<td>1982</td>
<td>859.3</td>
<td>173.3</td>
<td>20.17</td>
<td>472.6</td>
<td>15.8</td>
<td>3.34</td>
<td>132.1</td>
<td>3.23</td>
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<td>1983</td>
<td>896.4</td>
<td>168.6</td>
<td>18.81</td>
<td>285.5</td>
<td>22.4</td>
<td>7.85</td>
<td>159.8</td>
<td>5.2</td>
<td>3.25</td>
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<td>1984</td>
<td>864.6</td>
<td>196.5</td>
<td>22.73</td>
<td>358</td>
<td>33.6</td>
<td>9.39</td>
<td>167.3</td>
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<td>29.98</td>
<td>512.8</td>
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<td>33.76</td>
<td>164.1</td>
<td>1.66</td>
<td>1.01</td>
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<td>1989</td>
<td>1013.2</td>
<td>253.7</td>
<td>25.04</td>
<td>641.2</td>
<td>196</td>
<td>30.57</td>
<td>127.8</td>
<td>1.84</td>
<td>1.44</td>
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<tr>
<td>1990</td>
<td>914.4</td>
<td>187.3</td>
<td>20.48</td>
<td>820.5</td>
<td>276.8</td>
<td>33.74</td>
<td>99.6</td>
<td>1.12</td>
<td>1.12</td>
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<tr>
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<td>960</td>
<td>193.1</td>
<td>20.11</td>
<td>989.3</td>
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<td>35.44</td>
<td>138.9</td>
<td>5.2</td>
<td>3.74</td>
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<td>1992</td>
<td>1073.7</td>
<td>341.9</td>
<td>31.84</td>
<td>1080.9</td>
<td>382.5</td>
<td>35.39</td>
<td>262</td>
<td>16.35</td>
<td>6.24</td>
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<tr>
<td>1993</td>
<td>1391.4</td>
<td>330</td>
<td>23.72</td>
<td>1080.1</td>
<td>471.9</td>
<td>43.69</td>
<td>342.3</td>
<td>29.97</td>
<td>8.76</td>
</tr>
</tbody>
</table>

**SOURCES:** Data from ANFAVEA (Brazil), ADEFA (Argentina) and AMIA (Mexico); Percentages calculated by author
1. Country specific changes

a) Brazil

Three major developments have shaped the Brazilian industry in recent years: the opening of the market for imports in 1990, the Automative Protocol signed with Argentina in the same year, and the Automotive Sectoral Agreements between the government, industry and labor first entered into in 1992. Brazil opened its markets to auto imports in 1990 after 18 years of protection for the local industry (EIU, 1992, p. 34). Import duties, however, still apply although they have slid from 60 percent in 1991 to 20 percent in 1994 (Turner, 1994, p. 20).

A second major change was the Automotive Protocol between Brazil and Argentina which began in 1990. The protocol moves toward freer trade between the countries, allowing industry to avoid duplication and rationalize production and distribution efforts. As a result, auto trade has expanded and Argentina has emerged as the most important export market for the Brazilian industry. Moreover, new linkages are being created between Brazilian and Argentinean suppliers (EIU, 1992, p. 34). These exchanges are likely to be further stimulated by the establishment of the Southern Common Market (MERCOSUR) — a common market area among Brazil, Argentina, Paraguay and Uruguay scheduled to begin in 1995.

The third major development was the Automotive Sectoral Agreement (ANFAVEA, 1993, p. 116). When first promulgated in 1992, the agreement provided an aggressive package to stimulate the market, including tax reductions coupled with a drop in prices, a commitment to maintain employment levels, and a pledge to adjust wages according to inflation. A renewal of the agreement the following year added commitments to increase employment by over 90 thousand jobs, an industry-wide pledge to invest an estimated US $20 billion dollars by the year 2000, and a 20 percent real wage hike through 1995 (ANFAVEA, 1993, p. 118).

The highly successful "popular vehicle" regime was officially established in April 1993 for cars with engines less than 1.0-liter. The government slashed taxes from 47 percent to 19.8 percent so the cars could be sold for less than $8,000. As a result about 36 percent of Brazilian car sales are now "popular cars." (Frame, 1994, p. 41).

b) Mexico

The Mexican automotive market has undergone several far-reaching changes during the 1980-1994 period. President Salinas aggressively pursued privatization, deregulation, and trade liberalization schemes, culminating with the implementation of the North American Free Trade Agreement (NAFTA) with the United States and Canada at the beginning of 1994.

The Mexican automobile market has been shaped by several auto decrees mandating domestic content levels — requirements that a certain percentage of the car be built in Mexico. A 1983 Presidential decree upped local content to 60 percent by 1987, and required firms to compensate imports with exports. This strategy sought to establish a positive flow of foreign currency as well as to stimulate continued growth and broader industrial development. As a result, auto makers began investing in high-volume advanced engine and vehicle assembly plants to produce for the US and the world markets. (Shaiken and Herzenberg, 1987, p. 8) The success of early export plants led major auto companies to view expansion in Mexico as an increasingly important component of their overall competitive strategy (Shaiken, 1990, p. 14).
The Salinas administration issued its own automotive decree in 1989, as part of its overall strategy to open the economy. The decree eased restrictions on product lines, made importing finished vehicles easier, and required that 36 percent of a car’s value-added would have to include parts supplied by the domestic parts sector (Shapiro, 1993, p. 230). Under NAFTA, tariffs will be eliminated over a 7 year period, providing a vehicle has 62.5 percent North American content. Announced investments in Mexico total US $1.4 billion for 1994 and, prior to the financial crisis, another US $2.3 billion had been announced for the period 1995-1998. (see Table 2 and Appendix for investment data)

c) Argentina

As in Brazil, recent changes in Argentina’s automotive market have also been characterized by agreements among government, industry and labor, industry-wide government decrees, and multilateral trade agreements. These have resulted in sharp increases in sales and the rationalization of production patterns between Argentina and Brazil.

Two major initiatives provide the context for changes in the 1990s: an industry-government-labor agreement —later institutionalized in Decree 2677— and the implementation of Protocoło 21 with Brazil. These measures sought to further liberalize the automotive market while protecting local industry in encouraging its modernizing efforts. The initial sectoral agreement —later to become Decree 2677—stimulated domestic sales by effectively cutting car prices 35 percent. Manufacturers and distributors cut margins and sales commissions and the government contributed by lowering taxes to 18 percent. Prices, however, remained comparatively high, about 20 percent more than similar cars in Brazil.

<table>
<thead>
<tr>
<th>Table 2</th>
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<td>VEHICLE EXPORTS BY REGIONS</td>
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<table>
<thead>
<tr>
<th>Country</th>
<th>Brazil</th>
<th>%</th>
<th>Mexico</th>
<th>%</th>
<th>Argentina</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>South America</td>
<td>288,242</td>
<td>80.3</td>
<td>32,829</td>
<td>6.9</td>
<td>29,384</td>
<td>98.0</td>
</tr>
<tr>
<td>Central America</td>
<td>2,132</td>
<td>.51</td>
<td>10,228</td>
<td>2.1</td>
<td>52</td>
<td>.1</td>
</tr>
<tr>
<td>North America</td>
<td>6,481</td>
<td>3.5</td>
<td>422,706</td>
<td>89.6</td>
<td>63</td>
<td>.2</td>
</tr>
<tr>
<td>Europe</td>
<td>31,486</td>
<td>12.7</td>
<td>20</td>
<td>-</td>
<td>432</td>
<td>1.4</td>
</tr>
<tr>
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<td>1.8</td>
<td>5,432</td>
<td>1.1</td>
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</tr>
<tr>
<td>TOTAL</td>
<td>331,522</td>
<td>98.8</td>
<td>471,912</td>
<td>97.5</td>
<td>29,976</td>
<td>99.7</td>
</tr>
</tbody>
</table>

Source: For Brazil, data provided by the National Association of Motor Vehicle Manufactures (ANFAVEA); for Mexico, Asociación Mexicana de la Industria Automotriz (AMIA); and for Argentina, Asociación de Fabricantes de Automotores (ADEFA).

Note: Exports may not add-up because of rounding and additional regions of exports.
FIGURE 2
Export Production
Brazil and Mexico
1980-1993

Source: ANFAVEA and AMIA
A commercial partnership between Argentina and Brazil had been in existence through an earlier agreement, Protocolo 21. The agreement sought to integrate the automotive sectors through compensated exchanges between the countries and graded increases in values and quotas (EIU, 1993a, p. 23). The result of this agreement has been the regionalization of investment and rationalization of production processes between the countries. General Motors do Brasil, for example, is re-entering the Argentinean market with the transfer of most light truck model production from its San Jose dos Campos facility outside of Sao Paulo to Argentina. The plant will be located in the industrial city of Cordoba, and GM de Argentina will then supply the Brazilian and other regional markets. Another example of this integration is Autolatina’s transmission and axle plant in the city of Cordoba. The facility has been recently expanded to produce advanced-design transaxles to be used both in Argentina-and Brazil-built Autolatina products as well as for export to Germany. (Ford Motor Company, 1994) This regional integration in the automotive sector is likely to increase as Argentina, Brazil, Uruguay and Paraguay continue the establishment of Mercosur, the Southern Cone Common Market, scheduled for implementation by 1995.

III. CHANGES IN TECHNOLOGY AND MANUFACTURING PRACTICE

1. Brazil

Throughout the 1980s the Brazilian automobile industry "was dead to the world for all intents and purposes," according to the Wall Street Journal (Kamm, 1994, p. 1). This grim assessment was shared by many key figures both within the Brazilian subsidiaries and their parent companies. Roger Smith, the CEO of General Motors during much of the 1980s, reportedly felt that the company’s Brazilian operations represented a "black hole" (Shapiro, 1994, p. 228). A GM executive in Detroit told us that "the report on Brazil at the end of the 1980s was that the country was a mess and the company was a mess" (Sánchez, 1994).

When President Collor began opening the auto market in 1990, this executive continued, "it was a major wake-up call comparable to what the US auto industry went through in the early 1980s" (ibid). The Economist Intelligence Unit argues that "imported cars rapidly unmasked Brazilian cars’ shortcomings in terms of quality, technology and style" (EIU, 1994, p. 73). Imports had already garnered 6 percent of the market by the end of 1993 and some analysts projected 9 percent by the end of 1994. In the highly profitable luxury segment imports accounted for 30 percent of sales.

Historically, Brazilian firms had among the oldest product mixes of any major auto producing country. The GM Chevette, for example, was in production for a remarkable 21 years from 1972 to 1993. The average production run for Brazilian cars was 11.4 years, about triple the US average and 5 times the Japanese average (Kamm, 94, p. 1). In response to the market opening, the industry embarked on a major introduction of new models in the 1990s. "We launched more models from 1990 to 1992 than we did from 1956 to 1990", according to Nelson Tavares, Executive Director for the National Association of Motor Vehicle Manufactures (ANFAVEA), the Brazilian auto industry association. In 1993 alone there were 13 major launches of upgraded versions of existing cars to entirely new models (EIU, 1994, p. 78).

Today Brazil is poised both to meet the needs of a rapidly growing domestic market and to become a major regional exporter. "GM do Brasil can become a regional manufacturing base for this hemisphere, and we are putting plans in place, in fact, to do just that," Mark T. Hogan, president and
managing director of GM do Brasil maintained. "We will be exporting to the rest of South America with our new products as well as to North America and possibly to the rest of the world, including South-east Asia" (EIU, 1994, p. 19). Eventually, Hogan told us, he foresees the possibility of GM alone exporting 100,000 vehicles annually, about 25 percent of its production. The major exception to the regional car strategy is Fiat, which plans to use Brazil as an export platform for unique models produced in Brazil and sold throughout the world. Fiat plans to invest $300 million to bring out its new world car, code-named 178 which will be produced in Brazil, Argentina, and Turkey at a total rate of about 500,000 units annually and will be sold in Latin America, Europe and elsewhere (Turner, 1994b, p. 6).

Today the major auto makers in Brazil reportedly break even once they reach 50 percent of capacity, given the major emphasis on productivity improvements in the last several years. Since firms are now operating at about 95 percent capacity in a boom market, these firms are among the most profitable in the world (Brooke, 1994).

Given the unpredictable nature of the Brazilian economy, however, firms such as GM are cautious about adding additional capacity, despite encouraging sales forecasts for the future. GM recently placed on hold plans for a new assembly plant capable of building 100,000 cars a year, adding about one third to existing capacity (Turner, 1994a, p. 20). Nonetheless, GM plans to invest $2 billion between 1994 and 1999 in its Brazilian operations. (Frame, 1994, p. 3). Fiat will invest $1 billion between 1994 and 1998 to upgrade its Brazilian plants (Turner, 1994a, p. 6).

a) **Quality**

One of the most striking transformations since the opening of the market has been an upsurge in quality. A principal indicator of quality is Things Gone Wrong per hundred vehicles (TGW/100), a measure based on consumer surveys after the car has been sold and in use for three months. This indicator improved between 6 and 13 percent annually for Autolatina vehicles and 8 percent a year on one of GM do Brasil’s most popular vehicles during the 1988 to 1992 period. In sharp contrast, Autolatina’s average annual improvement shot-up by over 35 percent in 1992-93 while GM’s rose by over 30 percent (Autolatina, 1993). Autolatina’s sprawling Taubate plant now ranks second among all Volkswagen plants worldwide in terms of quality and repair areas for defective vehicles in the plant have been slashed by 80 percent (EIU, 1994, p. 77). General Motor’s Vectra surpassed the quality of its Opel twin for four months during 1993. Fiat’s experience has been similar as warranty costs plummeted by over 50 percent during a two year period (ibid). As a result, Autolatina achieved its 1997 quality goals in 1993—four years early—and has begun tightening its future targets considerably. The new 1997 goal, for example, allows 50 percent fewer discrepancies than the old one. Despite these impressive gains, the quality indicators on the imported Honda Civic, an important benchmark for the industry, are still three to four times lower than the best Brazilian built vehicles.

b) **Industrial relations**

Another area of considerable change has been industrial relations. Relations between the auto makers and their unions have improved considerably, in the minds of both company managers and union leaders, although these relations remain adversarial, particularly by the standards of Mexico and Argentina. Salerno points to "an historical inheritance of authoritarian work relations, which is common to all sectors of Brazilian industry" as an enduring problem (Salerno, 1993, p. 8). Speaking about Autolatina he argues that:
This poses difficulties against changing toward less predatory and more decentralized uses of the labour force. The principal factories (based in Sao Bernardo) have strong and representative unions, which question the company’s definitions and procedures for change even regarding the restructuring process itself. (ibid)

Despite these continuing tensions the Industrial Relations manager at General Motors felt that "in the last year the union has matured," meaning that it has become less adversarial. A major component of the change is the fear of what an open market could do to the industry in general and jobs in particular if import penetration continues to increase. "We have taken [the union leaders] to the United States to share what it means to be competitive and, in particular, to show them the plant closings at GM," the industrial relations manager added. "They know [Brazil] won't survive if we don't stay competitive." A senior manufacturing manager at GM concurred, maintaining that "we had severe quality problems and productivity problems. We used imports as one part of the problem with which we could leverage change." Following a similar strategy, Autolatina brought several delegations of union leaders to the US, Germany, and Mexico with a particular emphasis on the flexibility managers enjoyed at the Ford Assembly plant at Hermosillo.

The GM industrial relations manager, as do many managers at GM do Brasil, points as a model to NUMMI, the General Motors and Toyota partnership in Fremont, California that stresses labor-management cooperation as well as considerable shop floor flexibility. The current president of GM do Brasil had been a managing director at NUMMI during the late 1980s, bringing a direct understanding and familiarity with the process. In fact, some managers use NUMMI as a verb, as in "we want to NUMMI-ize our operations." A union leader at GM's giant complex in San Jose dos Campos also agrees that some aspects of the union’s dealings with management have improved. "The relation is much better now than in the past," he commented. "There is more open communication than in the past and more of a process of negotiation," although he emphasized many problems remained from the union’s perspective.

These sentiments were echoed by the Industrial Relations manager at Autolatina who maintained that "one of the biggest changes was with the unions." He elaborated that "both the union changed and the company’s approach changed." As a result, "[Autolatina] succeeded in a lot of things with the assistance of the union or at least without their active resistance." While additional flexibility has been achieved, the introduction of some Japanese-style lean production techniques has proven difficult at Autolatina. "We have had difficulty in introducing new approaches such as Total Preventive Maintenance or Quality Circles," the industrial relations manager at Autolatina admitted. "We are continuing discussions with the union to reach these world-wide standards." From the point of view of unions, these techniques often seem superimposed without serious negotiation. "Japanese techniques are built on controlled Japanese unions and a trust-based relation," a group of union leaders and researchers in San Bernardo told us. "That kind of trust doesn’t exist here in Brazil."

A particularly dramatic change at Autolatina is the decline in the number of person-hours lost as a result of strikes and work stoppages in the last several years. Initially these lost person-hours jumped from 1,840,000 hours in 1990 to 2,158,000 hours in 1991 but then plummeted to 84,000 in 1992, rising slightly to 88,000 through October 1993. Autolatina has sought to use this new atmosphere to gain additional flexibility on the shop floor. The company has adopted a more aggressive outsourcing policy which resulted in the release of 1,335 workers through October 1993. These workers, the company maintains, were transferred to other areas of production. "The numbers may appear insignificant," the Industrial Relations manager commented, "but the precedent is an important one for us." In addition, the
company was able to negotiate an increase in the annual number of hours of overtime from 153 hours per worker in 1991 to 206 hours through October 1993, a 36 percent increase.

c) The Brazilian Industry

While Brazilian auto makers have been able to develop export-level quality in a short period of time, the strength of the overall auto manufacturing base—technology, work organization, productivity, and cost—is a more complex question. On the one hand, cutting edge Brazilian suppliers and manufacturing firms are increasingly achieving world-class quality. One measure of this improvement are certificates of quality issued by the Geneva-based International Organization of Standardization (ISO) which indicate that a firm meets set standards for consistent quality. Today 410 Brazilian manufacturing firms are ISO-certified compared to 18 in 1991. The Government projects that 5,500 companies will achieve this recognition by the beginning of 1998. (Brooke, 1994c, C1). On the other hand, many auto suppliers utilize old technologies and antiquated production techniques. "In the past the economy in Brazil didn't provide the conditions for adequate planning," a manager for strategic planning at Autolatina commented. "Companies chose to keep the same equipment and sought to get the maximum return from it."

The auto makers themselves are now more rapidly introducing both new models and new production technologies from robots to computerized transfer presses but these new systems coexist side-by-side with processes from another era. Two poles of the industry are represented by General Motor's sprawling San Jose dos Campos complex where the company is introducing its new world car called the Corsa and the manufacturing operations at Autolatina's giant Anchieta factories.

d) General Motors

The 35 year old San Jose dos Campos complex covers over 400,000 square meters of production area and employs about 10,000 workers. The complex includes an engine plant, a stamping plant, plastic injection molding, aluminum and iron foundries, and the final assembly of trucks and cars. Clearly, the crown jewel is the new Corsa line, a $300 million investment in a world car. The car which comes in an entry-level "popular version" for about $8,000 promises to be a major success in the market. Six weeks after its launch over 100,000 people had signed up on the waiting list, some paying a $3,000 premium, effectively selling out the first year's production (Brooke 1994c, C1).

The Corsa introduction brings with it major technological and organizational changes in production. The car itself replaces the antiquated Chevette after its marathon 21 year run. Unlike the Chevette which was made without any robots, 55 robots assemble the Corsa, 90 percent in the welding area. Workers on the assembly line are organized into teams—about 150 teams in the assembly and adjoining stamping plant—which meet regularly to discuss production problems and ways to improve quality. An Andon light system allows workers to pull a cord to stop the line when a major quality or assembly bottleneck occurs. "Inspired on 'Japanese model' and on 'lean production concepts' [this] process is in its earlier phases," Fleury observes. "Nevertheless, there seems to exist an initial rupture with the traditional organizational model and the creation of the necessary conditions for the development of a new organizational system, adapted to the Brazilian characteristics" (Fleury, 1993, p. 1).

The Sao Jose dos Campos plant has had some success with continuous improvement groups called Programa de Mejoramiento Continuo (PMC). These groups, which comprise hourly workers, managers, and engineers meet from several weeks to several months to work on production or quality bottlenecks.
Walking through almost all the plants of the San Jose complex, a visitor is struck by large display boards with photographs, tables, and graphs trumpeting the productivity or quality savings of the groups. The gains appear substantive. In the Corsa assembly plant, for example, 1,323 square meters of floor space was saved in 1992 and an additional 746.5 square meters in 1993. In total, 124 continuous improvement projects were completed in both of GM's Brazilian plants in the year ending May 1994, saving $1.1 million in inventory, 63,000 worker hours, and 6,000 square feet of space. (Frame, 1994b, p. 3).

GM also is introducing a "pull system" of inventory management throughout its Brazilian operations. The Purchasing manager describes this approach as a cross between just-in-time and the old heavy inventory system or "JIT with some safety stock." GM went through 14 turns of inventory in 1993 compared to six or seven turns several years ago. In addition, a new training center was built in San Jose for the Corsa and employees were scheduled to receive between 20 and 40 hours of instruction, depending on the area in which they work. Overall, GM has put a major emphasis on training with a target of 50 hours per employee in 1994.

As a result of these new technologies and approaches to work organization, the hours required to assemble a car have been cut significantly from about 30 hours on the old Chevette to about 22 hours on the basic Corsa.¹ Unlike previous models the Corsa is being produced simultaneously throughout the world. First launched in Figueruelas, Spain in February 93 (90 vehicles an hour), production began in Eisenhach, in what was formerly East Germany, in July 1993 (30 vehicles an hour), and in Brazil in January 1994. Plans also call for production of the Corsa in Ramos Arizpe, Mexico. The Figueruelas plant presents a particularly daunting standard by which to measure Brazilian production. The Wall Street Journal termed this new facility "one of the most productive and profitable plants in the European auto industry" (Choi and Vitzthum, 1994). The extent and destination of exports from Brazil will obviously be influenced by what happens at these other sites.

Walking through the rest of the Sao Jose complex, a visitor senses both the strengths and weaknesses of the Brazilian auto industry. The truck assembly plant is going through some of the same technological and organizational changes as the Corsa line. The company introduced work teams in March 1992 and 40 new robots are planned for a new truck model in addition to the 2 currently in use. Low production volumes and many models, however, lead to one of the most serious production problems: part proliferation. The plant manager complained of 10,000 separate parts in the truck area alone. Elsewhere on the site, the engine plant produced 340,000 engines in 1993, about 30 percent of them for export to GM's Pontiac division in the US. The plant uses older transfer line technology on major machining areas for the cylinder head and engine block. In addition, many machining operations employ obsolete hand-loading between machines as well as machine set-ups that predate 1950s style automation. This level of technology achieves surprisingly high quality — managers said the engines produced ranked just behind Germany—but productivity and cost are severely hampered by the dated technology. Improved work organization can result in some gains but it is unlikely to be enough to make the plant world-competitive without major new investment.

¹ A more deluxe version of the Corsa takes about 26 hours and the older Kadett, built on the same line, takes between 25 and 30 hours.
Autolatina

Autolatina must generate its own investment funds internally rather than being able to rely on the global resources of Ford and Volkswagen. In 1992 Autolatina invested $383 million and plans to invest an additional $2.2 billion between 1993 and 1997. While competitors such as GM agree that Autolatina is beginning to move more aggressively in its modernization plans, our sense is that, at a minimum, the merging of two corporate cultures as diverse as Ford and VW has created its own set of problems. Both Ford and VW retain their identities as separate companies with independent nameplates—there is no "Autolatina" vehicle—as well as their own dealer network. "They have not merged the culture of the two companies," one respected industry observer we spoke with commented. "And probably they will never merge these cultures." The combined company has adopted some systems such as quality from Ford and others from Volkswagen, combining in some ways the best of both worlds and in other ways creating new levels of confusion. "We use a Ford motor model to administer German style plants," one labor relations manager commented. In late 1994, reports began surfacing that Autolatina was unraveling and would soon split into its constituent parts. The parent companies themselves admitted that a reevaluation was underway but would confirm little more. (Jackson and Turner, 1994, p. 1) Many of the problems of the new company are illustrated by the Anchieta plant, its largest and one of its oldest production facilities.

The plant is a multi-storied facility which is difficult to restructure along the lines of the latest factories. Autolatina has been slow to introduce new organizational techniques such as cellular manufacturing or just-in-time inventory. "You have a plant that is already established, all the facilities are there, they are designed to operate in a certain system so there is no real change even in small areas," one production manager commented. "We need to wait for a certain moment to make a major investment, and maybe at that point we can change everything." When asked how long it would take to fully implement JIT, this manager replied "it will take some time. I can't tell you how much, but it will take maybe long years before we are completely implemented." Despite these obstacles, Autolatina has nonetheless managed to reduce its inventories from 3 weeks supply in 1991 to 8 days supply in 1992 and, in a number of areas, to as little as 3 days (Salerno, 1993, p. 9).

The difficulties of managing Anchieta are evident in both its vehicle assembly and engine operations. The assembly plant produces 440 cars spread over 9 models on two shifts, utilizing a single robot. Forty percent of the vehicles produced need to be repaired, an unusually high number by global standards today. One research report accurately described the plant as having "a complex production structure, and unfocused production activities" (Salerno, 1993, p. 5).

Anchieta's strength and weaknesses are further illustrated by its engine plant. The plant occupies over 98,000 square meters spread out over two and one half floors. It employs about 1,200 hourly workers who produce 1,800 engines a day. Most of the machinery dates from 1974 and the basic design of the engines produced is over 30 years old. Model proliferation once again is a major hindrance. The plant produces 8 different versions of a critical, difficult to machine part such as the camshaft, 7 different types of cylinder heads, and 5 engine blocks. All these product styles make inventory control far more difficult, so it is not surprising that a three to five day supply of a key part such as an engine block are on hand, rather than inventory levels approaching just-in-time. Given these production realities, quality in the engine plant is surprisingly good. It ranks 13 out of 26 VW engine plants world-wide in terms of quality, although it has a discrepancy rate almost triple the highest ranking VW engine plant in Germany. The possibilities of effective reorganization given the age of the equipment and layout of the plant are clearly limited.
f) Suppliers

The Brazilian supplier base provides about 90 percent of the purchased parts for the domestic auto makers and is significantly more developed than the supplier base in either Mexico or Argentina (Posthuma, 1991). Moreover, the Brazilian supplier industry exports about 20 percent of its production to the US and the European community, according to Claudio Vaz, president of the Sindicato Nacional da Indústria de Componentes para veículos Automotores (SINDIPEÇAS), the Auto Parts Industry Association. Despite these strengths, the auto makers we visited expressed concern about the ability of suppliers to meet the increased challenges of a rapidly growing domestic market as well as the possibility of expanded exports. "We are finding that the big suppliers who are also competing in the international market are keeping up but many of the smaller ones are not," according to the plant manager at Sao Jose dos Campos. "They are not comfortable with investing because of the changes in the economy." To remedy this situation, auto makers such as GM have embarked on major quality and restructuring programs with their suppliers. "Many of our PMC [continuous improvement] programs are conducted with our suppliers, and we have seen improvements in quality and productivity," the plant manager added.

Problems with suppliers have shown up in "crippled cars," vehicles that are assembled without necessary parts which have to be added later. "In December 1993 we were working at capacity and many suppliers cannot keep up with the pace," the plant manager at Sao Jose complained. "About 15 to 17 percent of the cars were 'crippled' which costs us a lot. The problem is with parts shortages, not with the quality of parts." At Autolatina the number of incomplete units was reduced from 21.8 percent in 1991 to about 5 percent in 1992, which is still considerably higher than the .79 percent of Ford's North American Automotive Operations.

Despite these problems, major improvements have been recorded at the suppliers. Annual inventory turns at Autolatina suppliers increased by 11.7 in 1989 to 16.0 in 1992 or by 36 percent while process throughput time shrunk from 116.1 hours in 1989 to 61.7 in 1992. To reduce variation among parts coming from different vendors, Autolatina is in the process of reducing the number of suppliers from 507 in November 1993 to 435 by December 1995.

GM is also in the midst of a major program to become less vertically integrated through increased outsourcing. The company currently outsources about 2,000 parts and wants to increase this to 11,000 in the next 12 to 18 months. This outsourcing will be part of a new "global sourcing" policy in which local suppliers will be challenged to meet the best price on components GM can obtain anywhere in the world. With a world-car such as the Corsa where parts will be produced on several continents, the potential leverage on domestic Brazilian suppliers could be significant. "The 10 percent of parts sourced outside the country have a sizable influence on the 90 percent that remain," according to the purchasing manager.

2. ARGENTINA

Although Argentina is going through a major resurgence as an auto producer, the Argentinean auto industry remains the smallest and least competitive of the three industries we studied. In effect, two industries exist side-by-side. The first is the industry that builds components and vehicles for the domestic market. This industry is composed of old plants, severely dated technologies, and inefficient production processes. The beginnings of a newer, though smaller industry which exports components to Brazil and the global market has developed near Cordoba. Factories such as Autolatina's Transax plant which
produces transmissions and Fiat's Cormex plant which produces both engines and transmissions characterize this part of the industry; a new GM truck plant will soon join the list.

In this section, we focus on the traditional industry, its current condition and prospects for transformation. Mark Hogan, the president of GM do Brasil and a key figure in coordinating GM's reentry to Argentina, feels that the country is beginning to reemerge as an auto producer after virtually disappearing in the late 1980s. He points, however, to three major problems the Argentinean industry now faces: the lack of an effective indigenous supplier industry, poor industrial infrastructure destroyed after years of neglect by military government, and, finally, a cost disadvantage of about 30 percent compared to Brazil. As the Economist Intelligence Unit put it, "the inefficiencies and the structural problems of Argentina's economy substantially inflate the manufacturing costs of its industry" (EIU, 1993a, p. 24).

The cost disadvantage of Argentinean auto makers is rooted in the related problems of inadequate investment and low production volumes as well as more macro causes such as the overvalued peso. Years of economic turbulence in Argentina has made companies reluctant to invest and, instead, far more focused in gaining as quick a return as possible on the capital they already have tied up in the country. A more open market puts severe stress on this type of production base. The Economist Intelligence Unit concludes that "it can be assumed that Argentinean production facilities are now in need of an urgent revamp since the major investments were made in the late 1970s and early 1980s" (EIU, 1993a, p. 23). A 1992 study of the auto industry by the Inter American Development Bank similarly concluded that "the Argentinean industry has scarce resources in terms of competitiveness. Production scale is limited, fragmented and not very efficient; plants and equipment seem to have only been updated in minimal ways" (Chudnovsky, and others, 1992, p. 135). "We have to become more competitive with quality and cost," a Sevel executive told us. "You can do a lot with organization but you need investment." For the investment to be worthwhile, however, sufficient production volume is required. When Argentinean production dipped to 90,000 in 1990 —less than half the capacity of one typical assembly facility in the US— all auto makers questioned whether they should remain as active producers in the country. Moreover, even the current production volume of over 300,000 is spread across far too many models. In this regard, the increased possibilities of a common market with Brazil could prove essential to the growth of the domestic Argentinean industry. Auto producers are increasingly concentrating product or component production in one country. Argentina, for example, is achieving world-class economies of scale in the production of transmissions.

a) Sevel

Currently operating near capacity, production almost tripled from 1990 to 1992 when about 120,000 vehicles were manufactured. The company's General Pacheco facility near Buenos Aires illustrates a daunting set of problems. The relatively low production volumes are spread over a dizzying variety of products both from Fiat and Peugeot. Six final assembly lines produce an equal number of models. The production technology is not simply old but highly inefficient, and at times outright disorganized. Painted bodies and half-finished cars are stored everywhere as cars come off the line because of a lack of parts or for other repair. The wide variety of models also results in a remarkable proliferation of parts. A random check of vehicles indicated considerable fit and finish problems from

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2 These models are the Fiat Uno and Dueno, the Peugeot 504, 505, and 405 and a pickup version of the 505 called the Regatta.
dust in the paint to moldings that don’t line up. A production manager confided that the discrepancies per vehicle were about double those for Fiat in Italy.

The problems in the assembly area were replicated throughout the other manufacturing areas in the plant. In the press shop, for example, older press lines had little intermediate automation. We observed only two small islands of more advanced technology: seven robot welders and plastic injection molding machines.

Sevel is reportedly planning a dramatic reduction in its product mix with the introduction of a new Fiat model, the 178 which is to be introduced at the end of 1995, a $200 million investment. A combination of a simplified process and high production volumes could have a significant impact on productivity and quality for the new model. As it is, however, Sevel’s current production facility is not comparable even with older factories in Brazil.

b) Autolatina

Autolatina is the third largest auto producer in Argentina after Sevel and Ciadea which manufactures Renaults. In a closed market, Ford produced the Falcon from 1961 to 1991 and the streets of Buenos Aires give ample testimony to this long production run. We visited one of Autolatina’s main production facilities near Buenos Aires. As at Sevel, low volume and product proliferation are a problem but not nearly to the same extent. The assembly line, while using little advanced technology, nonetheless appeared well-organized. In the engine plant, however, the machinery and processes were especially antiquated. When asked the age of the machinery, one manager commented “it’s been in Argentina for 31 years but I don’t know what happened before then.” The transfer of engine blocks between machines was done by hand, a procedure that would take one back to the 1930s in the United States. New quality procedures were in place but the underlying technology is so old major investment would be needed for the plant to compete effectively.

Autolatina’s new $250 million transaxle plant near Cordoba reportedly represents a very different production process. The plant whose capacity is 300,000 transaxes a year utilizes advanced machinery and equipment as well as a more recent product design. Hourly workers were trained in Germany and the plant’s output is primarily sent to Europe and Brazil. In 1993, about 85 percent of its production was exported.

Facilities such as this represent an important new trend, in Argentina and Mexico: new plants that rely on young and highly educated workers often with little industrial experience. A combination of schooling and training become central to the plant’s operation and an important criteria for location decisions. The education level of the workforce in the older Buenos Aires complex and the new Cordoba plant makes for a fascinating contrast.

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3 The plant makes the VW Senda, the Gol, and Voyage, and the Ford Escort and Sierra
Table 3
EDUCATIONAL LEVELS FOR HOURLY WORKERS
AUTOLATINA'S PACHECO AND TRANSAX PLANTS
ARGENTINA

<table>
<thead>
<tr>
<th>Educational Level</th>
<th>Centro Industrial General</th>
<th>Transax, Cordoba</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pacheco, Buenos Aires</td>
<td></td>
</tr>
<tr>
<td>Elementary School</td>
<td>49%</td>
<td>6%</td>
</tr>
<tr>
<td>(mostly completed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary School</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Incomplete</td>
<td>26%</td>
<td>31%</td>
</tr>
<tr>
<td>- Complete</td>
<td>19%</td>
<td>29%</td>
</tr>
<tr>
<td>University Degree</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Incomplete</td>
<td>6%</td>
<td>32%</td>
</tr>
<tr>
<td>- Complete</td>
<td></td>
<td>2%</td>
</tr>
</tbody>
</table>

Source: prepared by the author, on the basis of information supplied by Autolatina.

c) Suppliers

The Argentinean supplier base remains less developed than either Mexico or Brazil. When asked about the capability of Argentinean suppliers, Claudio Vaz, the president of SINDIPEÇAS, the Brazilian Auto Parts Industry Association, commented: "Argentina is a beautiful country." He then elaborated by saying that "they suffered 35 years and in this 35 years the [military] destroyed all the industrial base of Argentina." A purchasing manager at Autolatina in Argentina agreed, stating that "[Argentinean suppliers] are not yet competitive with Brazil. We need to improve a lot."

3. MEXICO

The Mexican auto industry has gone through the most far-reaching transformation of the industries in this study. As in Brazil and Argentina, the domestic industry developed as a result of local content legislation. In the early 1980s, Mexico’s five principal auto makers began constructing new export-oriented factories—primarily engine plants—to gain export credits under the country’s import-substitution regime. The success of these plants demonstrated Mexico’s capability as a high tech producer of complex products. More recently, the move toward a more open economy, now symbolized by the North American Free Trade Agreement (NAFTA), has resulted in a major expansion of Mexico’s export potential, primarily to the hotly competitive US market. In this section, we examine the overall dimensions of this change and then briefly focus on several of the newer export plants.

While it is far too early to accurately gauge the impact of NAFTA on auto trade, in the first 10 months of the agreement Mexico recorded a $2 billion trade surplus with the US in the machinery and transport equipment sector, a high value added area which includes the auto industry. This Mexican trade surplus reflected a $2.8 swing from an $835 million trade deficit in 1992.
Table 4
MACHINERY AND TRANSPORT EQUIPMENT SECTOR
MEXICAN EXPORTS, IMPORTS AND TRADE BALANCE WITH THE US
(January-October data in millions of dollars)

<table>
<thead>
<tr>
<th>Year</th>
<th>Exports</th>
<th>Imports</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>14,957.0</td>
<td>15,792.0</td>
<td>-835</td>
</tr>
<tr>
<td>1993</td>
<td>16,927.5</td>
<td>16,109.7</td>
<td>817.8</td>
</tr>
<tr>
<td>1994</td>
<td>21,871.2</td>
<td>19,949.8</td>
<td>1,921.4</td>
</tr>
</tbody>
</table>

Source: US Bureau of the Census, Foreign Trade Division.

During the same period, Mexico exported almost 280,000 cars to the United States, a 40,000 increase over 1993 (USITC, 1994). As a result, Mexico's trade surplus increased by $165.4 million in autos over 1993 to a $2.54 billion surplus in 1994. In automotive engines, the Mexican trade surplus rose from $61 million in 1993 to $373 million in the first 10 months of 1994.

Table 5
MEXICAN TOTAL EXPORTS, IMPORTS AND TRADE BALANCE WITH THE US
IN PASSENGER CARS (HTS 8703)
(January-October data in millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Exports</th>
<th>Imports</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>2,295.6</td>
<td>59.0</td>
<td>2,236.6</td>
</tr>
<tr>
<td>1993</td>
<td>2,426.2</td>
<td>55.7</td>
<td>2,370.5</td>
</tr>
<tr>
<td>1994</td>
<td>2,973.3</td>
<td>437.4</td>
<td>2,535.9</td>
</tr>
</tbody>
</table>

Source: US International Trade Commission
Table 6
MEXICAN TOTAL EXPORTS, IMPORTS AND TRADE BALANCE WITH THE US IN INTERNAL COMBUSTION PISTON ENGINES AND PARTS (SITC 713)
(January-October data in millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Exports</th>
<th>Imports</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>742.0</td>
<td>808.0</td>
<td>-66</td>
</tr>
<tr>
<td>1993</td>
<td>799.4</td>
<td>738.2</td>
<td>61.2</td>
</tr>
<tr>
<td>1994</td>
<td>1,256.1</td>
<td>882.7</td>
<td>373.4</td>
</tr>
</tbody>
</table>

Source: Bureau of the Census, Foreign Trade Division

Mexico’s $1.8 billion deficit in auto parts with the US could prove to be temporary, since a demonstrated capability in auto assembly and major components is likely to attract suppliers as well. Chrysler of Mexico’s president commented in an Automotive News interview that "suppliers are feeling confident about coming to Mexico." (1994b, p. 41). A New York Times article confirmed this observation by concluding that "the Big Three auto companies are asking suppliers to set up factories near the auto makers’ Mexican assembly plants." (1994, C2). Moreover, new entrants to the North American auto industry are also looking for Mexican suppliers. "We want to purchase as much local content as we can in Mexico," BMW’s manager of international purchasing maintained (Chappell, 1994, p. 22).

Table 7
MEXICAN TOTAL EXPORTS, IMPORTS AND TRADE BALANCE WITH THE US IN PARTS AND ACCESSORIES OF MOTOR VEHICLES (SITC 784)
(January-October data in millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Exports</th>
<th>Imports</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>1,653.7</td>
<td>3,173.4</td>
<td>-1,519.7</td>
</tr>
<tr>
<td>1993</td>
<td>1,948.6</td>
<td>3,316.7</td>
<td>-1,368.1</td>
</tr>
<tr>
<td>1994</td>
<td>2,030.8</td>
<td>3,845.1</td>
<td>-1,814.3</td>
</tr>
</tbody>
</table>

Source: Bureau of the Census, Foreign Trade Division
In recent years, a surge in new auto investment in Mexico has taken place. Investment targeted for the Mexican domestic market, however, is likely to be put on hold because of the country’s severe financial crisis, but production for export could well increase. Existing producers in Mexico are all expanding operations. Ford announced at the end of 1994 a planned investment of $175 million in an existing plant near Mexico City which will create an export capacity of about 50,000 units a year to the US for its new world car. GM is completing a new truck plant in the state of Guanajuato and will soon be exporting the Corsa. Chrysler plans to invest $300 million in a new plant in northern Mexico, while Nissan will begin exporting 15,000 Sentras annually to the US in 1995 from its recently expanded plant in Aguascalientes. (US/Latin Trade, 1994, p. 10). New firms are also evaluating production in Mexico. BMW is planning a new plant near Mexico City, involving an initial investment of about $180 million and employing 1,500 workers, Automotive News reported on May 9, 1994. Honda is also reportedly investigating building a new assembly plant in Mexico.

a) The new export plants

- Ford Hermosillo assembly and stamping plant

In seeking to understand the success of the new generation of export plants in Mexico, we focus on two key plants, the Ford Hermosillo Stamping and Assembly plant and the Ford Chihuahua Engine plant. A central theme stands out: extensive training and a solid basic education are prerequisites for this locational strategy.

The Ford Hermosillo plant is a state-of-the-art $500 million assembly and stamping plant that began production in 1986 (Shaiken, 1990; Shaiken, 1994). The plant has been frequently visited by union-management groups from Autolatina in both Brazil and Argentina as well as from Ford affiliates throughout the world. Ford relied heavily on its Japanese partner, Mazda, for the engineering of both the production process and the car. Moreover, much of the advanced production equipment was built in Japan. The car, a proven Mazda design, was renamed the Mercury Tracer for the US market, with two-thirds of its parts (including engine and transmission) initially sourced from Japan. Three years after start-up the plant was capable of producing 135,000 Tracers a year.

Hermosillo brought together sophisticated manufacturing technology ranging from computerized transfer presses to over 100 robots with workers new to the auto industry whose average age was 23. In fact, most workers were new to manufacturing because the surrounding economy was based largely on agriculture and services. The attraction of the area to Ford was not the industrial infrastructure but rather the region’s educational system, particularly its colleges and technical schools. This allowed the company to hire a workforce in which over ninety percent of those selected had a high school education and nearly a third had attended either university or technical training.

Contrary to the expectations of many, Hermosillo achieved high quality production almost immediately and within three years was producing the second highest quality small car sold in the US market, effectively tied for first place with the Honda Civic. After a major changeover to produce a more complex vehicle, the plant has sustained high quality, tying for fifth out of 46 car assembly plants in North America in 1992, according to a J.D. Power and Associates survey (JD Power, 1993). In this survey, Hermosillo narrowly bested a Michigan plant producing the same vehicle, and surpassed five Japanese-owned assembly plants in the US often by a wide margin.
The productivity of the plant —now capable of producing 165,000 cars a year— was also high, ranking twelfth in North America, according to a 1992 study carried out by Harbour and Associates (Harbour, 1992). While comparable in terms of quality and productivity to the best plants in the US and Canada, the wage rates at Hermosillo are far different. Hourly wages were about $2.40 an hour in 1992 compared to about $18.50 an hour in Detroit while total compensation —wages and benefits— was $4.50 in Mexico compared to about $40 an hour in Detroit.

What did the spectacular success of the Hermosillo plant rest on? The company relied heavily on extensive training to develop skills and then introduced a flexible form of work organization to utilize these skills. The result was one of the most far-reaching uses of flexible production anywhere in North America, let alone Mexico. This production approach, however, did not take place in an idyllic setting of worker commitment and loyalty to the firm —in fact, the plant has been rocked by periods of considerable conflict, including three major strikes since 1986, and a turnover rate averaging twenty to forty percent annually in the plant’s initial years of operation.

Underlying this flexible work organization is an extensive and ongoing system of training. Initially, before starting work all new hires received four months of intensive classroom instruction, which was the same whether someone was ultimately going to be repairing complex, state-of-the-art robots or installing seats on the final assembly line. What did the work organization look like? All workers belong to a single classification, work is organized into teams in which team members frequently rotate jobs, each team has a facilitator to coordinate production, workers can stop the line for quality problems, and a modified form of just-in-time inventory is in place.

In the early 1990s, the company spent $300 million to expand and retool the plant for two new models that marked a significant departure from previous practice: both models were more complex and both would have to be debugged on the Hermosillo line; production of both would also complicate model-mix variations in the production process. Moreover, the new models drew their parts and components primarily from North American rather than Japanese suppliers. At the same time, the plant has also moved away from some of its more participative features while retaining considerable shop floor flexibility. Team facilitators, for example, are now selected by the supervisor rather than being elected by the team.

Personnel policies changed as well. In response to high turnover, for example, Ford amended its hiring profile to include older, less educated workers with experience in other work environments; for the same reason, the company scaled back on initial training from four months to two, with the balance becoming available only after the worker had been on the job six months. Nissan has also had similar quality and productivity results at its sprawling Aguascalientes complex with a significantly lower educational profile than Hermosillo, indicating that a solid basic education ranging from junior high school to high school may be sufficient for successfully deploying these technologies and forms of work organization.

- **The supplier base**

Major new auto assembly plants tend to set up adjacent suppliers whenever possible. At Hermosillo, for example, four primary suppliers are located in a neighboring industrial park. Beyond these immediate suppliers, Hermosillo initially sourced 30 percent of its parts from plants in Mexico, in accordance with an agreement with the Mexican government. While much has been made about the inadequacy of Mexican suppliers, in this case the company reorganized the production process and quality
assurance systems in suppliers’ plants to meet its standards. By the end of the first model run in 1990, some managers felt that the Mexican suppliers were producing higher quality parts than their US counterparts, though not yet up to the level of Japanese suppliers. General Motor’s is seeking to create an even more extensive supplier base for its new $400 million truck plant near Guanajuato. Although the company has released few specific details publicly, economic development officials in Guanajuato indicated that 20 to 30 suppliers will likely locate in the area, some moving from Mexico City while others come from the US.

One further problem is the length of the supply lines, which stretch from northern Mexico to Mexico City, the United States, and Japan. Hermosillo initially drew about 65 percent (by value) of its 2,300 component parts from Japan and much of the rest from widely scattered sites throughout Mexico and the United States. The plant adapted just-in-time inventory (JIT) to a global supplier network through what the material manager referred to as a “one-day-at-a-time” inventory system. Japanese suppliers, for example, ship parts to a consolidation center in Japan where they are packed into containers that supply the plant with a full days production. Almost two months after leaving the dock in Japan, the parts are unloaded in sequence at the plant.

- Automotive engines

Similar high quality and productivity are found in the new generation of export engine plants. Herzenberg and Shaiken compared a $250 million auto engine plant in Mexico that went on line in 1982 to a plant in the US producing the same engine, with similar technology (1987). The average age of the Mexican work force was early twenties and none had ever worked in an auto plant before. Moreover, the plant was built in an agricultural and administrative area with little comparable industry. In the key area of machine yield—a measure of the productivity of technology in a high tech plant—the Mexican plant achieved 85 percent of US performance in less than 2 years and 97 percent after eight years at the end of the model run. The product quality of the Mexican plant was even more impressive. It surpassed the American plant in four of the six years for which data is available (1986-1991) and exceeded US quality by 32 percent in the last year of production. Not surprisingly the US automaker is allocating over $500 million for the expansion and retooling of the Mexican plant.

Nissan has also achieved high quality and productivity in a manufacturing complex in Aguascalientes. The plant achieved the lowest number of defects on engines checked at the end of the line of any of the company’s plants worldwide (Shaiken, 1993, p. 26). Nissan has announced that the Mexican plant will produce all engines for the US-assembled Altima, one of the company’s most important products in the hotly competitive US market. The company projects engine exports will reach an annual rate of 120,000 by late 1993 (Maskery, 1993, p. 1). General Motors has experienced similar high quality results at its Toluca engine plant, a one hour drive from Mexico City. The company reports that it has conducted 33 zero defect audits in a row in this plant. Given these successes, it comes as little surprise that the Mexican government predicts that engine exports will double from 1991 levels to $2.4 billion annually by 1994 (Saavedra, 1993, p. 28).
IV. CONCLUSION

As import substitution regimes are replaced by more open markets, the Latin American auto industry is going through a profound transformation. Three major themes run through this research: a much heavier reliance on exports, the introduction of new forms of work organization and technology, and a reliance on a different kind of work force in new plants.

All three countries saw their exports rise dramatically from 1980 to 1993. Brazilian exports went from 13 percent of production (157,000 vehicles) to 24 percent of production (330,000 vehicles), Mexican exports soared from 4 percent of production (18,000 vehicles) to 44 percent of output (472,000 vehicles), and even Argentina went from 1 percent of production (3,600 vehicles) to 9 percent (30,000 vehicles). Beyond this surge of export production, the character of exports remains different. Eighty percent of Brazilian exports go to South America while 90 percent of Mexican exports go to the more hotly competitive North American market. Ninety eight percent of Argentinean exports go to South America, almost all to Brazil.

As exports increase and import penetration also rises, all three countries are rapidly introducing new forms of work organization and technology. In Brazil and Argentina it is the fear of growing imports that is largely fueling the organizational changes taking place; in Mexico it is the construction of new plants for export that are driving the transformation of the industry. Plants in all three countries have demonstrated the ability to achieve world class quality and productivity. Plants we studied in Brazil, in particular, indicate that new investment as well as new forms of organizing work are necessary to achieve high quality and productivity.

Finally, new plants in Mexico and Argentina rely on younger, more highly educated workers, frequently without any previous industrial experience and, in the case of Mexico, union involvement. The location of schools and large numbers of educated workers becomes a new component influencing the geographical reorganization of the industry, to the north in Mexico and the northwest in Argentina.

The findings of this study have considerable implications for a new international division of labor in which auto production is more globally integrated and newly industrializing countries play a greater role. These preliminary observations raise important research questions concerning the emerging industrial relations in these plants, the rate at which new technologies and production approaches are introduced, and the role of training, education levels, and schooling in the industrial transformation. The answers to these questions are central in understanding the broader implications for industrial change in the countries involved.
APPENDIX
TABLE 1
Total Vehicle Production
Brazil, 1980-1993

SOURCE: ANFAVEA
TABLE 2
Total Vehicle Production,
Mexico, 1980-1993

<table>
<thead>
<tr>
<th>Year</th>
<th>National Market</th>
<th>Exports</th>
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<tr>
<td>1980</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1984</td>
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<td>1986</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SOURCE: AMIA
TABLE 3
Total Vehicle Production
Argentina, 1980-1993

Source: ADEFA
TABLE 4
Exports as Percent of Total Vehicle Production
Brazil, Mexico and Argentina, 1980-1993

Sources: ANFAVEA, AMIA, ADEFA
INVESTMENT IN MEXICO AND BRAZIL AUTOMOTIVE INDUSTRY

Investments in the Brazilian automotive industry have been short of US$1 billion dollars in the last several years, and are expected to increase and stay at about the US$1 billion dollar mark for the next several years.

Investments presented in the following table for the Mexican automotive industry may be somewhat low and therefore misleading. The data provided by SECOFI—based on company reports—is admittedly not complete for General Motors or for Nissan, for example. These are two companies that have recently completed, or are currently engaged in, expansion efforts in Mexico. Investment information about BMW, Mercedes Benz and Honda, which recently announced their intent to locate production facilities in Mexico are still unavailable. Consequently, investment in Mexico’s automotive industry is likely to surpass announced levels for the next several years.

Table 5
Investment in Mexico and Brazil’s Automotive Industries
(thousands of US dollars)

<table>
<thead>
<tr>
<th></th>
<th>BRAZIL(^{(1)})</th>
<th>MEXICO(^{(2)})</th>
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</thead>
<tbody>
<tr>
<td>1989</td>
<td>670.1</td>
<td>360.0</td>
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<tr>
<td>1990</td>
<td>994.9</td>
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<td>937.9</td>
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<tr>
<td>1992</td>
<td>944.7</td>
<td>1,348.0</td>
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<tr>
<td>1993</td>
<td>1,100.0</td>
<td>1,206.0</td>
</tr>
<tr>
<td>subtotal</td>
<td>4,647.6</td>
<td>4,099.0</td>
</tr>
<tr>
<td>1994 (p)</td>
<td></td>
<td>1,446.0</td>
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<td>1995 (p)</td>
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<td>824.0</td>
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<td>1996 (p)</td>
<td></td>
<td>529.0</td>
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<tr>
<td>1997 (p)</td>
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<td>612.0</td>
</tr>
<tr>
<td>1998 (p)</td>
<td></td>
<td>380.0</td>
</tr>
</tbody>
</table>

(1) data from ANFAVEA, 1993:40 and field interviews;
(2) data from SECOFI, fax transmittal, 26 May 1994;
(p) initial projections based on announced company investments gathered by SECOFI’s Secretaría de Evaluación y Análisis de la Industria Automotriz.
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