



Japanese Maquiladoras: Production Organization and Global Commodity Chains

MARTIN KENNEY

University of California, Davis

and

RICHARD FLORIDA*

Carnegie Mellon University, Pittsburgh

Summary. — During the last decade at least 66 Japanese maquiladoras have been established in Mexico employing in excess of 20,000 workers. This paper examines the organization of production in these plants and the insertion of these production activities in the global commodity chains of these firms. Managers at 17 firms were interviewed either in person or by telephone and 10 of the plants were visited. The results indicate that the production organization and labor-management relationships resembled that of temporary employees in Japan. Most of the activities undertaken in the maquiladoras are relatively low-skill level, labor-intensive activities. In Tijuana there are now at least 31 Japanese maquiladoras most of which are in the electronics industry and these include a number of Japanese suppliers, thereby creating a proto-industrial complex.

I. INTRODUCTION

Looking south from Siempre Viva Road on Otay Mesa in San Diego it is possible to see the hillside shanty towns of Tijuana. Drive north two blocks and there are beautiful new combination office/warehouse buildings leased by Sanyo, Hitachi, and Casio. Drive into a nearby complex and there are the smaller offices of Sanoh, Tabuchi and Tocabi. These are all linked to assembly plants only a few kilometers away in Mexico where these firms employ thousands of Mexican workers to assemble products for the US market. These outposts of Japanese industry can tell us much about the nature of contemporary capitalism.

Scholarly interest in the dynamics of Japanese capitalism has grown considerably over the past decade as Japanese firms became global leaders in industries such as automobiles and electronics (Womack, Jones and Roos, 1990; Kenney and Florida, 1993). In the late 1970s Japanese firms began to internationalize and establish overseas manufacturing facilities. Japanese investment in the maquilas provides a critical case study that can make the initial steps toward a unification of two different but actually intimately interconnected sets of research agendas: the international transfer of industrial relations systems and studies of global commodity chains. This move towards unification will allow a strengthening of the explanatory power of

both of these concepts. This should also galvanize further research in an effort to more adequately theorize the contemporary internationalization of capitalism.

The contours of the Japanese model of industrial relations and production organization are now quite well established. On one extreme are the regular employees of large firms who experience long-term employment, weak distinctions between blue and white collar employees, self-managing work teams, rotation, functional integration of tasks, continuous improvement activities and close contractor-subcontractor relationships. This differs markedly from Western mass production industry (see, for example, Dore, 1987; Cole, 1989; Aoki, 1988; Kenney and Florida, 1993). On the other extreme are temporary workers, especially those in smaller companies. These workers, often female or old, have far fewer of the benefits experienced by the regular employees

*The authors thank the US Office of Technology Assessment for funding this research. The data and views presented in this article are strictly those of the authors and do not necessarily represent those of the Office of Technology Assessment. The authors would also like to thank Shoko Tanaka, Oscar Contreras and an anonymous reviewer for helpful comments and discussion. James Gordon provided research assistance. The order of names reflects our long-standing policy of rotating lead authorship. Final revision accepted: July 13, 1993.

in the large firms. The work tends to involve less skill, lower capital intensity and far less emphasis on employee participation.

Recent research has focused on the international transfer and generalizability of the Japanese production system as experienced by regular workers (Florida and Kenney, 1991; Yamashita, 1991; Koike and Inoki, 1990; University of Tokyo, 1990; White and Trevor, 1983; Oliver and Wilkinson, 1988). An emerging consensus suggests that the core elements of the Japanese production system can be successfully transferred and generalized outside Japan, and successfully take root in such diverse locations and environments as the United States, Britain, Western Europe, and Asia. Research on the transferability of the Japanese production system has thus far, however, been largely confined to firms operating in advanced industrial societies and mainly concentrated upon the automotive industry. Other industries, such as electronics, have received considerably less attention. Furthermore, with a few notable exceptions (Yamashita, 1991; Szekely, 1991), little research has examined the production operations of Japanese companies in developing countries.

Commodity chain analysis focuses on the flows of materials and goods through a complex set of industrial linkages within the spatial division of labor. Hopkins and Wallerstein (1986, p. 159) define a commodity chain as a "network of labor and production processes whose end result is a finished commodity." The commodity chain concept is a useful analytical tool because it directs attention to which "links" in the chain are internationalized and to where the specific links are relocated. As did dependency theory, commodity chain analysis focuses on the locations of the nodes of control (Gereffi, 1992). It is interesting to note the parallels between the commodity chain perspective which emphasizes the linkages in the production chain and the spatial division of labor literature which directs attention to the location and the attributes which make a location conducive to particular productive activities (Sayer and Walker, 1992). As Japanese firms internationalized their production activities they developed multinational commodity chains.

This article is organized as follows. Section 2 describes the data collection process. Section 3 outlines the extent of Japanese investment in Mexico. Section 4 uses the original data from interviews to examine the industrial relations and production organization of the Japanese maquilas. Section 5 traces the insertion of the maquilas in the commodity chains formed by Japanese firms. The final section speculates upon NAFTA's impact upon the establishment by Japanese firms of more export-oriented plants in Mexico. In addition we summarize the implications of this case study for thinking about commodity chains.

2. DATA SOURCES AND METHODOLOGY

Our research is based upon field research conducted in Mexico, the United States, and Japan. Both aggregate-level data on Japanese direct investment and maquila facilities were compiled from published and unpublished statistics from Japanese, Mexican and US government sources and the Japanese Industrial Location Center. The field research obtained detailed firm-level data on the organization of production, wages and working conditions, labor-management relations, the transfer of Japanese production organization, the decision to locate production in Mexico, linkages to Japanese and US plants, component parts procurement, supplier relations and content issues. The data were collected through the use of in-person and telephone interviews.

The total population of maquilas is rather difficult to accurately identify because there are a number of Japanese factories operating in Mexico that technically are not maquilas. Szekely (1991) counts 70 maquilas as of 1990, however, we were able to identify only 65 maquilas. There are two likely reasons for this divergence: First, our study probably undercounted the maquilas located in the interior of Mexico. Second, Szekely may have counted a firm's different factories in one city as establishments. So, for example, on one site in Tijuana there are two plants, one a subsidiary of Kyushu Matsushita and the other of Panasonic. Both of these companies are wholly owned subsidiaries of Matsushita Electric Industries Corporation. We count these as one establishment because they are on the same site and have the same top management. On the other hand, Sanyo has five plants in Tijuana on separate sites. We count these as five separate establishments, though they are all controlled by one office in San Diego and Japan. In another case, Yazaki Corporation operates four separate companies in the State of Chihuahua with a total of 18 plants. Here, we counted only four which are the four "independent" companies.

We identified the Japanese-affiliated maquilas in two ways: First, through telephone contact with municipal and county agencies and local Chambers of Commerce along the US-Mexico border. We also used the Toyo Keizai Shinposha *Handbook of Foreign Investment* (1991) which lists all Japanese investment in Mexico. The problem with this listing is that it does not identify which operations are maquilas, so we had to follow this up with letters. The sample used was the entire population of Japanese maquilas. A letter was sent to each firm detailing the purposes of the study and included: a short biography of the investigators, the names of three prominent Japanese professors of management as references and a copy of a recent article on the Japanese transplants by the investigators. The plants were then contacted with follow-up phone calls. In

two cases previous contacts with firm personnel in the Tokyo and US headquarters were used. In these cases excellent cooperation was received including extensive tours of the US "sister" plants and the Tijuana facility.

Those plants not in the Tijuana area were contacted and interviewed over the phone. Five phone interviews were conducted with non-Tijuana plants, but due to two firms' unwillingness to answer specific questions, they could not be included in the database. Important background information, however, was collected in these two interviews. In-person interviews were conducted at 12 firms. Ten firms allowed visits to their maquilas. For the other two only the US office was visited. In four cases the maquila was revisited for a second interview to ask further questions on parts sourcing and interaction with suppliers. A Mexican accounting firm that handles the accounting for a number of the Tijuana-based Japanese maquilas was also interviewed. In Japan two firms that have invested in maquilas were interviewed regarding their activities. Finally, two Japanese firms that have considered establishing maquilas, but thus far had not, were interviewed. This sample size of maquilas is considerably larger than in previous studies and broadly representative of Japanese maquila activities in Mexico.

Preliminary interviews were conducted both in person and by phone with two Japanese maquilas to develop and test the interview questions. The actual interviews took 1–1.5 hours to complete. Including the plant tour each visit lasted 2–3 hours. The site visits and interviews were undertaken in June 1991, October 1991, March 1992, and April 1992. We believe that the answers were forthright. In certain cases, the interviewee declined to provide certain very specific information. Finally, in the interest of prompting honest responses all respondents were told that their identities would remain anonymous.

Though a number of firms declined to participate, there is no reason to expect any serious bias due to having an unrepresentative sample. All of the important firms in Tijuana with the one exception were interviewed. Similarly, a number of the suppliers were interviewed. Bias might be introduced because none of the Japanese maquilas located in the interior of Mexico was studied.

3. THE MAQUILADORAS AND JAPANESE DIRECT INVESTMENT IN MEXICO

The maquiladora program was introduced by the Mexican government in 1965 in an effort to attract the increasing numbers of US businesses which were relocating labor-intensive production activities to Asia. The maquila program had three related goals:

(a) to attract foreign firms and stimulate employment, (b) to provide a source of foreign exchange, and (c) to enhance technology transfer to Mexico and build linkages to national industry. The Mexican government's strategy was to take advantage of items 806.30 and 807.00 of the Tariff Schedule of United States. These items permit goods to be "assembled abroad from US components [and] brought back into the US with duty only on the value added, mainly the (cheap) labor and overhead costs" (Sklair, 1989, p. 9). In addition, the maquilas are not subject to any rules of origin regulations, thus the materials can be largely or entirely shipped from abroad (Japan Economic Institute 1991, p. 8). Japanese maquilas comprise a relatively small, 3.6% share of over 1900 maquilas operating in Mexico—the vast majority of which are US owned and operated.

Mexico has not received much Japanese investment. According to Szekely (1991) before 1970 only 10 Japanese plants were operating in Mexico. It was not until the 1980s that Japanese industry began to expand its activities in Mexico. In 1990, there were 274 cases of Japanese direct investment in Mexico with a total dollar value of \$1.87 billion US. This was slightly more than 1% of total Japanese direct investment in North America (24,225 cases, \$136.2 billion US). Japanese investment is only a relatively small share of total foreign direct investment in Mexico, the overwhelming bulk of which comes from the United States. The total dollar value of Japanese foreign direct investment in Mexico was only 5% of all foreign direct investment in Mexico.

As Table 1 shows, Japanese direct investment in Mexican manufacturing comprised 61% (\$1.15 billion) of the \$1.87 billion total investment. The largest investment category by far was transportation equipment which accounted for nearly 43% of total investment and nearly two-thirds of all Japanese direct investment in manufacturing. The transportation equipment investment is almost entirely the \$1 billion investment by Nissan in an automobile assembly plant and an engine casting facility. The Nissan facility is not, however, a maquila. Japanese firms have also invested in excess of \$500 million in mining operations.

According to Szekely (1991) as of 1991, there were 131 Japanese manufacturing plants in Mexico and 70 Japanese maquilas. Japanese maquila investment has been concentrated primarily in the electronics and related industries such as video and audio cassette production. There are smaller numbers of establishments in automotive component parts, industrial machinery and food processing. Electronics dominates Japanese maquila activity with 39 plants or 55.7% of the total number of Japanese maquilas (Szekely, 1991; also see, Echeverri-Carroll, 1988; Sklair, 1989).

Table 1. Japanese direct investment in Mexico by sector (millions of US dollars)

Sector	Total (\$)	Share (%)
Manufacturing		
Transportation Equipment	803.6	42.9
Steel	126.6	6.8
Chemicals	59.4	3.2
Food Processing	59.1	3.2
Industrial Machinery	43.7	2.3
Electronics	39.7	2.1
Other	10.7	0.6
Total Manufacturing	1,150.5	61.4
Mining	502.1	26.8
Service	220.9	11.8
Total	1,873.6	100.0

Source: Ministry of International Trade and Industry, 1991.

Due to the purpose of the maquila program, most facilities have concentrated on the US-Mexico border. The reason for this are clear. The Mexican border is the only place in the world where an advanced developed country and its infrastructure directly adjoins a less developed country. The US-Mexican border is a conjuncture which provides unique opportunities to businesses for combining the attributes of the developed and developing world. The primary concentrations of maquilas within Mexico are in Tijuana on the California border and in Ciudad Juarez on the southwestern Texas border (Szekely, 1991; South, 1990). In Tijuana, there were a total of 447 maquilas employing 57,295 with a total investment of \$61 million. Japanese maquilas are concentrated in Tijuana where at least 31 Japanese-affiliated plants are located, employing what we estimate to be approximately 15,000 workers (for a map of Japanese-operated maquila locations in Mexico see Figure 1). There is a secondary concentration of

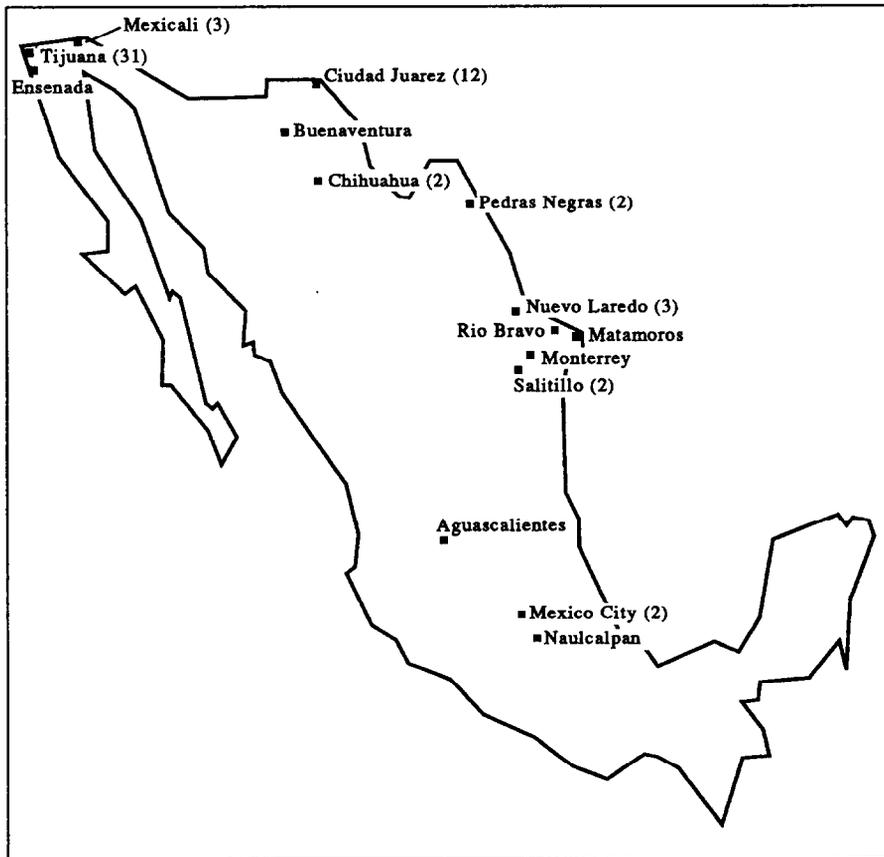


Figure 1. Japanese maquiladora facilities in Mexico.

Japanese maquilas in Ciudad Juarez (and the State of Chihuahua), where Yazaki, the largest Japanese automotive wire harness firm, has 18 plants (not all of which are on map) and 7,500 employees.

Figure 2 provides a map of Japanese maquilas which comprises the core of Japanese investment in Tijuana. For Japanese manufacturers Tijuana is an ideal location. The most important advantage is its location on the Pacific Ocean which permits parts to be quickly delivered through the port of Long Beach, California. The Mexican cities on the Texas border do not have such access to ports. Similarly, flights to Asia from the West Coast are more convenient than from Texas. In fact, there is no other location in North America with low labor costs and such convenient ports for component importation. Tijuana also provides proximity to the US market which reduces transportation costs for bulky products such as televisions, refrigerators and automobile wiring harnesses. This proximity also facilitates communication between sales and production, improving response time to market trends (Koido, 1991). Tijuana is also favored because of its proximity to the San Diego area where the Japanese managers live (see also Coronado Yu, 1992).

4. INSIDE THE MAQUILAS

(a) *Labor costs and location*

The first and foremost factor driving the Japanese maquila investment is labor costs, specifically the availability of inexpensive labor. Table 2 provides data on wages for the Japanese maquilas in our sample. Wages are paid in Mexican pesos, however, the Japanese managers calculate their labor costs in US dollars. For production workers wages averaged approximately \$50 per week or between \$1.10 and \$1.25 per hour. The mode was \$1.10, and the range was between \$0.50 and \$2.00 per hour. A worker's wages generally increase by roughly 10% after one year of employment. These wages contrast with Shaiken's (1990, p. 92) 1987 report of entry-level wages of \$0.87 per hour and indicate a relative wage inflation. Still, wages remain considerably below the US minimum wage of \$4.75 per hour. In October 1991, one company which was paying \$1.00 an hour said it expected to increase to \$1.25 an hour in December 1991. By 1996, it expected to pay in the range of \$2.50 per hour. In the interviews all the Japanese managers expressed the feeling that wages were being driven up in Tijuana.

The nonwage benefits for regular production workers were relatively small and varied by firm. They included: food coupons, small transportation subsidies, company-sponsored parties for Christmas and other holidays, subsidized cafeterias, and paid

vacations (many of these are required by Mexican law). One firm had its factory physician practice dispensary type medical care for its employees.

Wages for higher level employees (e.g. technicians) ranged from approximately \$320 per month (\$1.58 per hour) to \$1,200 per month—evidencing significant variation by company and skill level. These wages are difficult to compare because higher paid technicians are graduates of two-year technical colleges, while the lower level technicians are shopfloor operators who have received slightly more training and a promotion. The most highly paid Mexican nationals are the managers. They received \$1,500–\$3,000 per month depending on rank, the average being \$2,000–\$2,500. The wages for managers were approximately half that in the United States. The reason for this narrowing wage differential is that Mexican managers are scarce and US salaries are their reference point. At the higher managerial levels, companies provided Mexican managers with the same automobile, health insurance and other benefits demanded by US managers. An executive of one maquila reported that salary costs for nine Mexican managers equal the wage bill for 70 factory workers.

(b) *Production organization and work*

This section presents our analysis of the organization of production and work in Japanese maquila facilities. This analysis serves two related purposes. First, it examines the transfer of core elements of the Japanese production system into the Mexican environment. Second, it explores the organizational characteristics and social relations of production of Japanese maquila production, and thus provides important evidence of the role and function of maquila facilities in the global production chain of Japanese capital.

At the technical level, the production processes in the maquila plants were standardized, low-skill operations. Activities such as circuit board stuffing and electronic product assembly were produced on assembly lines. In mechanized processes such as metal stamping and plastic injection molding plants, the operators were essentially "machine minders." Wire harness production was the simplest production process, requiring operators merely to bundle different colored wires together or attach connectors to wires.

A number of maquilas highlighted a labor cost/automation tradeoff. Some companies did not seek to upgrade their equipment, because automation would cost more than human labor. One Japanese maquila reported that a move from labor-intensive insertion type printed circuit board building to surface mount technology would drastically decrease

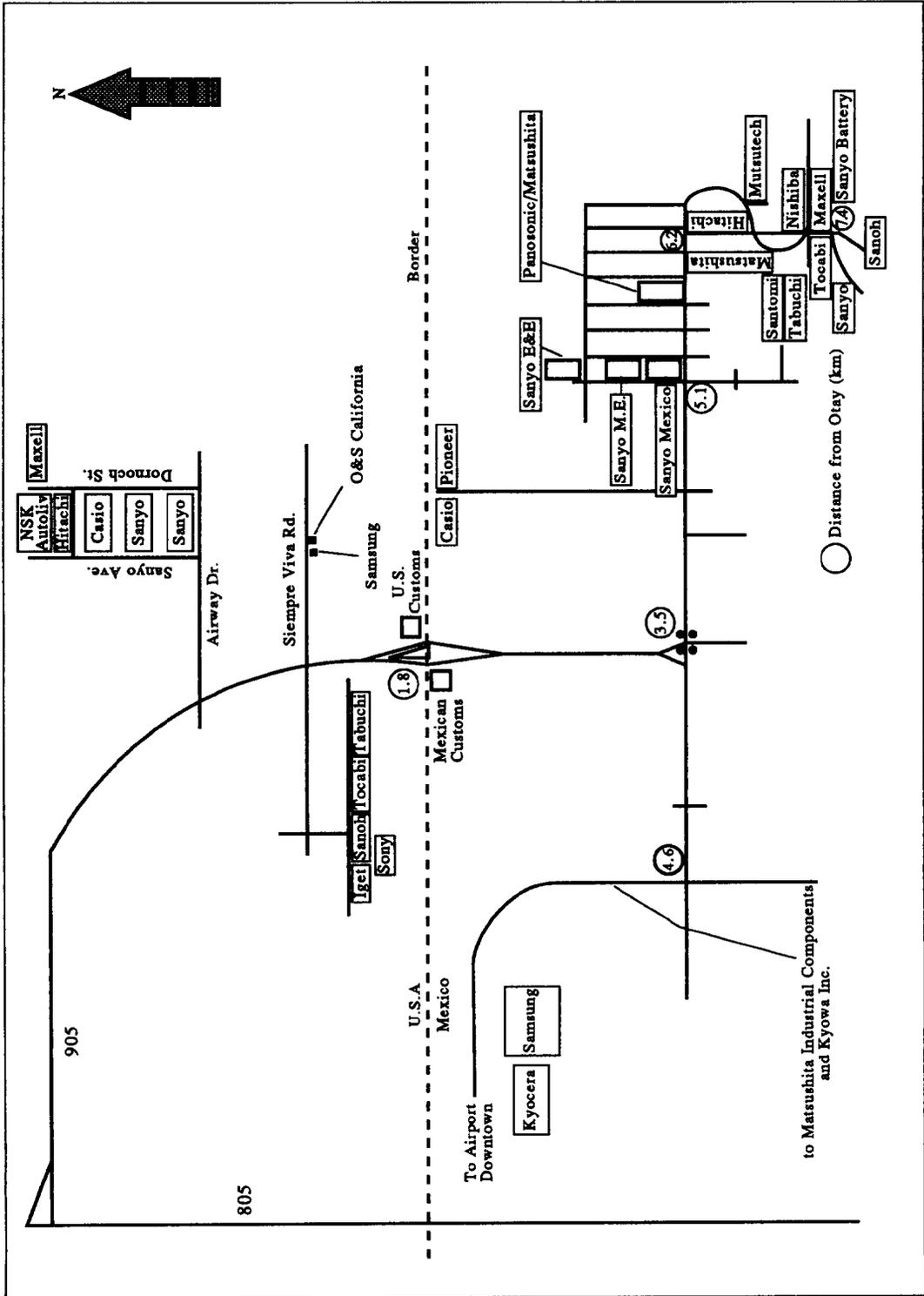


Figure 2. Japanese plants in Tijuana's Ciudad industrial complex.

Table 2. *Wages in Japanese maquiladora plant*

Company	Hourly wages (US \$)	Employment
A	0.50	55
B	0.50-2.00	100
C	1.00-1.15	170
D	1.10	800
E	1.10	110
F	1.50-2.00	100
G	1.25	400
H	1.00	1,800
I	1.10	300
J	1.15	500
K	1.10	250
O	N/A	5,000
P	0.90	136

Source: Personal interviews by Martin Kenney (1991).

the labor cost advantage of their Tijuana location. Chip insertion robots were being used in Tijuana, however, because they produced less defects than human operators. One manager reported that his company had more highly automated facilities in Japan and the United States.

In general, the labor process in Tijuana was typical of that performed by part-time and temporary workers in Japan. There was scarcely any use of teams or rotation. The executive vice president of one of the first and largest assemblers in Tijuana said his company practiced the rotation of managers from one of his company's subsidiaries to the other. But there was only limited and irregular rotation of production line workers to varying jobs on the production line. In the Japanese maquila facilities, neither team-based activities nor rotation have been adopted in any meaningful way.

One of the crucial features of the Japanese system is the involvement of regular workers in *kaizen* or continuous improvement activities. In the maquilas such activities did not typically exist and where they did they were quite rudimentary. Currently, there is little need for continuous improvement in the Mexican environment. The production processes utilized in Japanese maquilas are extremely standardized. At this stage few productive improvements are expected. Second, high rates of employee turnover make it difficult to develop the capacity to engage in continuous improvement activity. Third, maquilas have very limited production engineering staffs. Two maquila assemblers practiced a limited form of *kaizen*. According to a manager at one of the plants:

Each department's Mexican manager sometimes holds a meeting for *kaizen* improvement. They have a regular meeting once a week or once a month. Sometimes they set up a project for improvement. This is *kaizen*. So, yes, we are implementing *kaizen*.

From all accounts of normal practice in Japanese factories this could hardly be considered active *kaizen*. The president of a Japanese supplier maquila, however, added: "From a certain level [of employee] we listen. . . . Below that, we consider the turn-over zone. So, we do not even listen to them. . . . Listening to [those in] the turnover zone just confuses the operation."

In contrast with previous research by Shaiken and Browne (1991, p. 38) who found organized quality control (QC) activities in the Japanese maquila plants, we found little evidence of such activity. The Japanese executive vice president of one of the oldest assemblers in Tijuana said they started their QC circle activities in 1989. He continued saying, however, that "we are still in the application process. . . . It is difficult to start and it's difficult to maintain." Another company in the sample had some small group QC activities, but said that these were not comparable to Japan. Other maquilas indicated that QC circles are too difficult to implement in Mexico. The maquilas depended upon extensive inspection to ensure quality. Here, the important difference between "first-time" quality and quality that is "inspected in" should be highlighted. First-time quality is crucial because it refers to products that have successfully gone through the process and need no added labor inputs (i.e., repairs). In Mexican plants, quality is inspected in throughout the process by using inspectors and not by depending upon workers to produce quality products. While this is a less efficient method of ensuring quality, it is feasible in the Mexican environment due to low labor costs.

There are some indicators of successful transfer of more superficial aspects of the Japanese production-management system, such as the use of company uniforms. All plants required uniforms for shop-floor workers, and at most plants, everyone from the plant manager to operators wore uniforms. At two plants, however, new recruits did not receive a uniform until after a trial period. This served two purposes: to assist in identifying new employees and as a cost-saving measure given high-labor turnover. A third maquila had experienced problems implementing its uniform policy. The company started operations without a uniform, but two years later implemented the uniform requirement. It still had not fully taken hold. Aspects of the Japanese open office system were in evidence. All plants used a "Japanese-style" open office plan for white collar staff with the exception of private offices for the plant manager, and sometimes the highest ranking Mexican managers. In the plants with cafeterias there was a single one for all personnel from operator to plant manager. Since in Mexico only top managers can afford to drive cars there were few reserved parking spots except for the managers and visitors. One maquila in

Tijuana and the largest maquila in Chihuahua provided a bus service for their employees. This was implemented to extend the labor pool to workers from residential areas far from the plant.

The Japanese maquilas had a distinct managerial hierarchy. Generally speaking, the headquarters staff was located in the US. In all cases the president was Japanese and alternated between the Mexican plant and a company office in the San Diego or Orange County area. In most cases, the plant manager was also Japanese and reported directly to the US headquarters. Mexican nationals occupied the middle-levels of management and were responsible for personnel administration and liaison with the government authorities. The front-line supervisors were Mexican. While there was some limited evidence of promotion from the shop floor, such "promotion-from-within" was very limited compared with both Japan and Japanese transplants in the United States. In contrast to Japanese regular workers there was a clear divide between managers and factory workers in Japanese maquilas. According to a company president:

There is a line between labor and management. But, we only have two years experience here in Tijuana. In 10 or 20 years time, I do not know if we will still keep a line. In the case of a worker who has improved so much, who knows operations perfectly, and speaks perfect English and Spanish, maybe he can be promoted to manager as in Japan.

In fact, here again the relationship between managers and operators was far more like that between regular and temporary workers in Japan.

A clear-cut gender division of labor was also evident. The results substantiate Sklair's (1989) finding that the maquilas hire both men and women. The gender ratio varied significantly by plant. Japanese managers commented, however, that managing gender-based division of labor was "simpler" in Mexico than the US. In Mexico, they could assign women "women's" work and men "men's" work. For example, the employees in television cabinet manufacturing were almost exclusively men. On the other hand, in printed circuit board stuffing there were only women. In general, technicians, supervisors and managers were men. The notable exception was in printed circuit board production where team leaders and first-level supervisors were often women.

(c) *Labor force issues*

The key to understanding the activities undertaken by the Japanese maquilas is the levels and skills of the workforce. The availability and supply of labor differs markedly by skill level. The majority of maquilas in our sample reported that there was no shortage of operators. Shortages, however, were

reported for skilled technical workers and managers. Technical workers were difficult to retain given demand from non-Japanese maquilas and most importantly, the possibility of crossing to the United States and securing even a low-wage job which pays \$4.0-\$5.00 per hour. Competition for managers was severe, especially in Tijuana.

In Japan, companies erect both formal and informal barriers to labor mobility to protect investments in their workforce (see Taira, 1970). In Tijuana, the Japanese maquilas have an unwritten policy — or as one manager put it, a "gentlemen's agreement" — not to "raid" employees from other Japanese firms. This was especially true for managers and technicians. For example, a Mexican manager recounted that another Japanese maquila sent a sound truck advertising for operators past his plant for a couple of days during noon hour. His response was to telephone the offending firm to complain. After his call, this "unprofessional" practice stopped. The Japanese maquilas were perfectly willing, however, to recruit workers from other US or foreign-owned maquilas.

Shortages of managers were severe but raiding was virtually nonexistent. Each of the Japanese maquilas interviewed reported that it would not hire a manager from another Japanese maquila without first consulting that firm. A couple of companies indicated that they would consider hiring someone with experience at another Japanese firm, if that employee had left the previous employer a number of months earlier. Japanese maquilas are thus recreating some aspects of the labor market barriers found in Japan.

(d) *Training*

The Japanese production system emphasizes constant and continuous training both on and off the factory floor. Such worker training, however, was limited in the maquilas. The reasons for this included the unskilled nature of the work and the high turnover rate. In such environments there is little incentive to invest in significant training especially for those in the turnover zone. One Japanese maquila had a small room in which operators were trained after hours to solder or correctly tighten bolts; this off-the-job training usually took only two or three hours.

Japanese transplants in the United States often send managerial and technical-level personnel to Japan for training (see, for example, Kenney and Florida, 1993). At times, the maquilas sent managers and some technicians either to their US subsidiary or to Japan. In one case, 15 technicians were sent to the United States for three months for training to prepare for the introduction of new automation. One maquila had dispatched some of its Mexican managers to Japan for training. Another maquila had already sent

three top-level Mexican managers to Japan three times for training. This company also sent 35 operators (in groups of five) to Japan for six-month stays. Interestingly, the company was able to send operators to Japan because the Japanese parent company suffered from a labor shortage and the trainees were used as workers in the company's plants. The limited training provided to workers in maquila facilities is further evidence of the lack of transfer of the Japanese production system to the Mexican environment.

Whereas, among regular workers in Japan turnover and absenteeism are low. Among temporaries turnover is quite high, though absenteeism is low. In Mexico, however, turnover and absenteeism are high. The turnover rates ranged from 4 to 15% per month, the mode being 10% per month. Turnover was highest in the smaller suppliers. This was comparable to turnover rates in US-owned maquilas of 10–20% per month. These high turnover rates are, in part but not entirely, due to the fact that Tijuana and Ciudad Juarez are the most transient cities in North America. These two cities have large numbers of migrants who are attempting to cross into United States or are returning home to central Mexico. Nonetheless, for most plants turnover rates have stabilized over time at 5–10% per month. One maquila supplier in our sample said that its initial turnover rate was 30–40% per month, but later settled to 10% per month.

Turnover rates were said to vary by the particular area of Tijuana. For example, in the major concentration of maquilas depicted in Figure 2, the competition for operators is greatest and it also has the greatest turnover. An important causal agent for this turnover is a poor public transportation which effectively limits the labor market to housing close to the plant. As more plants are built in an industrial area, the labor pool is depleted. It is for this reason that the more recently established maquilas are locating plants in new industrial parks which are in close proximity to other low-income residential areas with untapped labor concentrations.

The high turnover rate does create problems. The executive vice president of one assembler said that his firm is having trouble "accumulating know-how and management skills because of the turnover." Further, Mexican managers frequently leave for jobs in the United States. Not all the Japanese maquilas, however, considered the turnover rate to be serious. The executive vice president of one maquila went so far as to suggest that an optimal situation was for 10–15% of employees to stay permanently, thereby providing a stable core for the firm. The other workers were expendable.

The importance of skill formation in the maquilas can be seen by the fact that only two of the 11 maquilas that responded tested prospective workers.

In fact, only two firms had any training or even introductions for newly hired workers. New hires were simply put to work. This more closely resembles the experiences of temporary or casual employees in Japan.

Unexcused absenteeism was also high by both Japanese and US standards. In most Japanese maquilas in our sample, absenteeism was 3–5% per day. But this varied considerably by company and even the day of the week, with Monday having high absenteeism and Friday, which is payday, having essentially no absenteeism. In addition, absenteeism increased during holiday periods as many workers left to visit their relatives in central Mexico. Japanese maquilas nonetheless had relatively strict policies regarding absence, though not as strict as in Japan or in the Japanese transplants in the United States (Kenney and Florida, 1993). The general rule was that either three or four days of unexcused absences would lead to dismissal. Unlike Japanese transplant firms in the United States that offer small bonuses for perfect attendance, only one maquila plant awarded small bonuses for attendance.

In short, this study suggests that Japanese firms are managing their operations in ways that resemble their usage of temporary and part-time workers in Japan. The only exception may be among technicians and managers who receive training. These findings do not conform with Shaiken and Brown's (1991) claim that true "continuous quality" production can take place in the Mexican environment. The maquilas studied are undertaking highly standardized activities where quality can be effectively "inspected in." This differs markedly, however, from first-time quality, which is the mark of true continuous quality production of the sort achieved by Japanese plants in Japan and by the automotive transplants in the United States. It is unlikely that extensive skill formation and employee commitment to quality can be achieved in environments with turnover of 60–150% per year, educational skills at the sixth grade level and only the most rudimentary training. Indeed, there is reason to conclude that a true working class, in E. P. Thompson's (1966) terms, has not yet formed in the border areas of Mexico — though perhaps it is in the process of formation.

The previous discussion has clarified the particular productive activities undertaken by the Japanese maquilas and argued that the work does not require high levels of skill formation. We have shown that the work process requires unskilled laborers and the industrial relations bear a greater resemblance to those of part-time and temporary workers in Japan. In the next section we will contextualize these production activities in the global production activities of these Japanese firms.

5. JAPANESE MAQUILAS IN GLOBAL COM-MODITY CHAINS

Mexican production locations have a particular function in the global commodity chain and accompanying spatial division of labor. Japanese maquila plants generally specialize in assembly operations, which are the most labor-intensive aspects of the production process. Furthermore, the labor-intensive activities located in Mexico are usually in specific product areas which are undergoing severe price competition in the US market, such as small televisions, small refrigerators, electronic typewriters, automotive or electrical wire harnesses, audio cassette tapes, disposable cigarette lighters and certain semiconductor packages. In these product areas, profit margins are low and small labor cost savings can mean the difference between profit and loss.

To understand where the maquilas fit in the commodity chains of Japanese firms it is best to examine a particular product. So, for example, the production of a television has a number of relatively discrete subactivities that require quite different mixes of skill, technology, labor and capital. Television tube production is a capital-intensive and automated production process which requires excellent process-engineering skills and skilled technicians. The factory is capital intensive, highly automated and requires a large initial investment. A firm wishing to site a tube facility will require access to skilled labor, a developed and dependable infrastructure and low levels of political risk. Further, labor costs are not a crucial issue. Televisions also require integrated circuits which are produced in a semiconductor fabrication facility. These fabrication facilities are very capital intensive and produce semiconductors not only for televisions, but many other products. Therefore, there is little reason for them to be located in close proximity to the assembly facility. Other activities such as chassis assembly, printed circuit board stuffing and/or final assembly and test cannot be inexpensively automated. The actual production activities do not require high skill levels and thus can be located in lower wage locations. Traditionally, the maquilas have performed labor-intensive assembly operations, while US or Japanese factories focus on higher value-added products or aspects of the production chain. The executive vice president of a major consumer electronics firm described the tradeoff in this way, "Once a factory is automated, . . . [it] does not come to Mexico. But, if a company still [is] labor intensive [it] will go to Mexico."

In generalized terms then, the firm must calculate the relative advantages which include labor cost, location specific advantages, costs of transportation and risk in deciding which location for each subactivity. This calculation, however, cannot merely be static. The firm must also consider what the evolu-

tionary trajectory of a specific location will be as changing circumstances such as improved transportation links and agglomeration economies due to the relocation of suppliers improve the economics of operating in a location. Conversely, increased labor costs, worsening pollution or political change can increase the costs of operation in specific locations and therefore must also be part of the calculation. Parenthetically, Japanese assemblers with their emphasis on encouraging their suppliers to relocate with them are far more active than corporations from other countries in actively changing the infrastructural characteristics of their production sites (Kenney and Florida, 1993).

The maquilas have become an integral part of the North American strategy (i.e., the regional configuration of production and distribution) of Japanese firms. Over the past two decades in response to considerable political pressure, Japanese corporations are producing a significant proportion of the televisions, consumer electronics and automobiles they sell in the United States in North America. The Japanese maquilas sell the majority of their output into the US market. Only a very small share of production is sold in Mexico or Latin America. Just three companies in the sample reported exporting their production outside North America.

The role of Japanese maquilas as export platforms is evident in their particular insertion in the Japanese firms' global commodity chain. The maquilas almost always report operationally to a US plant or office, though, in some cases, they report directly to Japan.

Overall, the movement of Japanese consumer electronics production to Mexico has been motivated by the competitive dynamics of this sector. The consumer electronics sector is highly competitive, and labor costs still form an important though declining portion of the final cost. So, for example, Korea used low labor costs to gain a competitive advantage. The Japanese response was to shift small screen television production from Japanese assembly facilities in the United States to Mexico. Sanyo, for example, shifted all its small television assembly from Arkansas to Tijuana. A similar situation exists with small refrigerators (under 15 cubic feet) where competition is so fierce that US manufacturers have either abandoned the segment or begun operations in Mexico. Whereas, US firms often abandoned market segments under price pressure from low-wage competitors, Japanese firms responded in kind by establishing production facilities in low-wage countries.

The maquilas can be divided into four groups based on their particular insertion into commodity chains. These are depicted in column two of Table 3. The first group (signified by capital letters in Table 3) operate in the traditional sister plant relationship

Table 3. Destinations and supplier relations among Japanese maquiladoras
Destination of product (in percentage)

Company	Assembler or supplier	US consumer	US plant	Maquila	J.	Row
A	S	0	65	35	0	0
B	S	0	100	0	0	0
C	S	0	25	75	0	0
D	A	X*	0	0	X*	X*
E	S	0	30	70	0	0
F	S	0	25	75	0	0
G†	A	50	50	0	0	0
H	S/A	34	66	0	0	0
I	S	0	35	65	0	0
J	S/A	65‡	0	35	X*	X*
K	A	80	0	0	0	20
O	S	0	100	0	0	0
P	A	100	0	0	0	0
Q	S/A	X*	X*	0	0	0

Source: Personal interviews, 1991.

*Firm was unwilling to provide exact percentages.

†Initially supplied US factory which has since been closed.

‡The 65% is largely US, but it also supplies Japan and the rest of the world.

between a plant in Mexico and one in the United States. The second group are those in which the maquila both supplies a sister plant and ships directly to the consumer market. The third group are plants that ship directly to final consumers. The fourth group includes the *maquilas* which are subcontractors for manufacturing facilities in either the United States or Mexico. Each of these insertions in the commodity chains is different and thus can be considered separately as they provide insight into the complicated logic of commodity chains.

The first group is, of course, the one that is most discussed in the literature and enshrined in the "twin" or "sister" plant concept so highly touted by promoters of the maquila program. In fact, some of the larger firms operate twin plants. A prototypical example is the NEC subsidiary, *Tecnologia NEC de Mexico*, which processes and assembles communication equipment in its Cuernavaca and Guadalajara plants. The materials are imported from Los Angeles by airplane and then re-exported to Dallas where NEC has its main telecommunications equipment factory for North America. In 1990 NEC imported 100% of the inputs used in Mexico (JETRO, 1991). Another of the firms interviewed had a small maquila that did some labor-intensive chip package production in one of its products undergoing severe price competition, while most of its chip package production continued in its US plant.

In the second group are firms that do assembly for sister plants in the United States and also supply finished products to the market directly. This group consists of most of the large consumer electronic

assemblers. Generally, the low value-added products are the ones that are entirely assembled and packaged in Mexico for direct delivery to the market. For the higher value products such as big screen televisions the maquila assembles the cabinets and often stuffs the printed circuit board. Final assembly continues to be done at a plant in the United States. But, if this is seen in historical perspective another pattern emerges. The maquilas have been absorbing an increasing proportion of the commodity chain from their US sister plants.

In the third group are maquilas that supply the market directly from Mexico. In many cases, these maquilas have absorbed all of the activities once undertaken by their sister plants. For example, Table 4 (provided by an interviewee) indicates the division of labor between the company's US and Mexican plant in 1991. The division of labor is seemingly a clear case of symbiosis. At the end of 1992, however, the US plant was closed, 400 employees laid-off, and the remaining activities were moved to Tijuana. Recently, Taiyo Yuden, a maker of capacitors, announced that it was discontinuing production activities in San Diego County and moving production to its Tijuana maquila (Personal interview, Taiyo Yuden Corporation, 1992).

The quintessential example of a firm whose US operations have been steadily shrinking while its operations in Tijuana have expanded is Sanyo Corporation. As can be seen in Figure 2 Sanyo now has five separate production facilities in Tijuana. Currently, Sanyo assembles televisions, small refrigerators, vacuums, juicers, electric fans and batteries

Table 4. *Activities undertaken by Japanese-owned US and Mexican sister plants*

		Mexico		US	
Large TV	wooden cabinet processing/ production	(1)	CRT	(1)	adjustment
		(2)	chassis	(2)	examination
		(3)	check w/electricity	(3)	packing
		(4)	examination	(4)	shipping
		(5)	packing		
Smaller TV	wooden cabinet processing/ production	(1)	assembly		
		(2)	adjustment		
		(3)	examination		
		(4)	packing		
		(5)	shipping		

Source: Anonymous Japanese consumer electronics producer.

in Tijuana. In fact, Tijuana has become the central North American production site for Sanyo Corporation. This is, in large measure, because Sanyo competes against low-wage Korean producers in the low price and original equipment manufacturing (OEM) categories, both of which are very price sensitive. Low wages are important.

In effect, the sister plants may be symbiotic. However, if any product becomes price competitive there is always the possibility that the link in the commodity chain will be moved to Mexico. This points out an important lacunae in much of the literature on commodity chains which considers these divisions of labor as static (for elaborations of this critique see Sayer and Walker, 1992; Dicken, 1992). The reality, however, is constantly evolving spatial divisions of labor.

The final and most numerous group is firms that are suppliers. This group can be divided again into two groups. The first were those who located in Mexico, but aimed at supplying customers in the United States. The classic case is Yazaki Corporation which produces automotive wire harnesses in Mexico for the US plants of Ford, Nissan, Honda and Mazda. Yazaki has a long history of Third World production. Its first off-shore plant was opened in Thailand in 1962 to supply wire harnesses for automakers in Japan. In the 1970s it established subsidiaries in Taiwan and the Philippines (Yazaki Corporation, 1991). Thus, Yazaki was well prepared for operating in Mexico. Yazaki factories receive most of their materials from the United States (JETRO, 1991). The maquilas operated by the auto parts suppliers are almost entirely geared to directly supplying automobile assemblers with labor-intensive parts.

The most interesting group of firms is the suppliers that have located in Tijuana to serve the electronics maquilas. Currently there are 11 suppliers that supply seven electronics assemblers. Whereas, the

Japanese maquilas in other industries and Mexican cities are largely free-standing, in Tijuana there is an intermaquila trade developing. This is most interesting, because much attention has been given to relationships that Japanese firms have between assemblers and suppliers in Japan and the transference of these relationships abroad (Mair, Florida and Kenney, 1988; Kenney and Florida, 1993). In Tijuana a number of Japanese component suppliers have established plants to serve their Japanese customers.

The movement of suppliers to Mexico was propelled by the 1985 Plaza Accord and dramatic upward revaluation of the Japanese yen, which combined with increasing price competition in the consumer electronics sector and meant that Japanese assemblers could no longer source parts on a cost-effective basis from their vendors in Japan. Prior to 1988, however, it was illegal for maquilas to supply one another because the original law establishing the maquilas required the immediate reexport of production. In 1988 the law was amended to allow intermaquila trade. This made Mexico even more attractive to Japanese suppliers. This movement was furthered by mounting political pressure upon Japan to decrease its trade imbalance with the United States. For Japanese maquila suppliers, proximity to existing assembly plant locations both in the United States and in Mexico was a key factor driving their choice of a particular location in Mexico.

In a significant number of cases, relocation was tied to a request from a Japanese customer. This has created a small manufacturing infrastructure of subcontractors that the assemblers can draw on. Curiously, the Mexican environment poses less of a problem for Japanese suppliers than for larger Japanese assemblers. This is because in Japan, suppliers operate as subcontractors and tend to undertake the labor-intensive aspects of production using a less stable workforce consisting of a high percentage

of temporary and part-time employees. They are therefore already accustomed to a less skilled work force and relatively high labor turnover.

The growing manufacturing infrastructure of Japanese suppliers has played a role in attracting still other Japanese assembly plants such as Casio and Canon. The president of one Japanese supplier maquila indicated that relocation to Mexico provided an opportunity to supply other firms such as Casio, Sony, Matsushita, Pioneer, Sanyo and Hitachi. This allowed his company to expand beyond the orbit of a single dominant customer. Another Japanese maquila supplier came to supply the electronics maquilas, and later found a new market supplying Nissan's Mexican facilities. Additionally, one of the Japanese supplier maquilas has begun to supply plastic injection molded parts to a US company. The president of one assembler said that transplant suppliers in Mexico (e.g., Tijuana) were in an excellent position because they faced little competition. To be adopted as suppliers they simply needed to slightly undercut the price of Japanese-sourced components.

The relocation of Japanese suppliers has created an interesting situation. The Mexican content of the output of the assemblers can be significantly raised by having more Japanese suppliers locate in Mexico. This would not, however, significantly benefit Mexican capitalists directly or lead to the much publicized goal of technology transfer — all the technology would remain within Japanese firms. But, since Mexican industry is not active in consumer electronics and the production is largely exported there is no opposition to the building of such an infrastructure. As Japanese suppliers continue to relocate to Tijuana the infrastructure is reinforced creating a more powerful attractive effect on other Japanese electronics firms.

The relatively large number of suppliers in close proximity to assemblers apparently would provide an excellent opportunity to implement just-in-time (JIT) delivery. Conversely, the development of an operating JIT system would be an important indication of the development of an infrastructure capable of supporting advanced industrial production. Even though the suppliers' factories are often less than two kilometers from their assembler, however, there is currently no JIT system in operation. Inventory was significantly higher than in Japan which is understandable as many inputs are imported from Asia or the United States. One Japanese maquila manager said that inventory is "five times greater" than in Japan. Another Japanese maquila reported inventory of approximately one month, compared to just a couple of days in Japan.

Implementing JIT in Mexico has been difficult. One Japanese supplier was asked to relocate to Tijuana so that it could deliver on a JIT basis to its main customer's Mexican plant. Even after reloca-

tion, however, the end-user and supplier were unable to develop a JIT supply relationship and deliveries continued to be made on a daily basis. Proximity alone has thus far not led to effective implementation of JIT. The general manager of the supplier pointed out that:

The just-in-time program [we operate] does not work like in Japan. [We deliver] not by hour but by day . . . [This is because the company we assemble for] assigns more responsibility and activity to local people and we are trying to do the same. We [the Japanese] are trying to not show up in front. So the [local people] have responsibilities. In some sense, [our assembler] is not taking advantage of our existence here. There is not so big a difference from when they were buying from [our facility in the US]. So, I do not think [the assembler is] applying a strict just-in-time system.

The Japanese manager said it was difficult to train Mexican workers of the necessity of supplying on-time. This was attributed to a tendency among Mexican employees to treat deadlines and targets as goals rather than commitments. The future development of this infrastructure is contingent upon the global commodity chains within which the maquilas are only a segment. Being a segment also means that Mexico's possibilities are limited by its appeal to multinational actors over which it has little control and with which its only important leverage is cheap labor. Concomitant with this is the fact that if labor costs increase too drastically, Japanese firms can choose to relocate back to the United States.

6. COMMODITY CHAINS AND THE GLOBAL DIVISION OF LABOR

The maquilas have a specific insertion in the global commodity chains of Japanese firms. This section examines the national origins of the inputs assembled in the maquilas and the opportunities for indigenous Mexican capital to become involved in the production process. The aggregate results of the survey are presented in Table 5 which lists the local content levels (excluding labor).

The maquilas are only one link in a commodity chain that runs from raw materials to a finished good. The firm, on the other hand, usually has a longer section of the entire commodity chain internalized than does a single plant. So, for example, Matsushita assembles televisions in Tijuana, but it produces television tubes in Singapore, Japan, and the United States. Similarly, it produces many other components internally and supplies them to its Tijuana operation. More recently, a sister company, Matsushita Industrial Components, opened a plant in Tijuana to supply components not only to Matsushita, but also to other firms in the Tijuana area.

Japan and Southeast Asia were the major sources for crucial electronics components. In some measure, this is due to the earlier off-shoring of the North American consumer electronics supply infrastructure. This meant that many components necessary to consumer electronic production were unavailable in North America and had to be imported. In fact, East Asia has developed the strongest infrastructure in the world for consumer electronics production (Dicken, 1992). In addition, Japan became the major source for consumer electronics production equipment.

In the maquilas studied the vast majority of the production equipment was imported from Japan. For example, all plastic injection molding machines (which cost up to US\$1 million) were produced in Japan by companies such as Toyo, Toshiba and Sumitomo. At one plant these machines were combined with Japanese pick-and-place robots which removed the plastic part from the mold and delivered it to the operator. In metal stamping operations Komatsu presses were used. Invariably, at printed circuit board facilities Panasonic (a Matsushita name brand) pick-and-place robots and Panasert insertion equipment were utilized. This was true even at maquilas operated by Matsushita's direct competitors. There were two companies that were involved in sewing operations. One company used industrial sewing machines from the United States and/or imported from Taiwan and the other used mostly US and German machines. Finally, some of the wood-working machinery used for assembling television cabinets was US made. The machines were serviced by service centers established by Japanese equipment vendors in Los Angeles or San Diego.

The relative composition of the sources of inputs usually depended on the type of input required and thus varied by the activity the maquila undertook. In general, the highest value inputs such as specialized application-specific integrated circuits and compo-

nents were from Japan. As Table 5 shows for a number of firms, subsidiaries in Southeast Asia were an important source of parts.

The components sourced from United States were quite varied and included: (a) basic commodities such as paper, wood, copper wire, boxes, lubricants, plastic resins, and paints; (b) plastic injection molded and stamped metal parts; (c) television picture tubes; (d) solid state components for printed circuit boards; (e) a limited number of capital goods; and (f) building and construction materials. These parts, however, were not necessarily sourced from US firms. Often the US-sourced parts came either from the firms' subsidiary or from a Japanese supplier. US firms often provided the basic commodities. Interestingly, even for basic inputs Japanese managers complained about quality problems. For example, one Japanese quality control manager showed the poor print quality on boxes made by a major US container manufacturer. Similarly, one wire harness producer demonstrated how US-made wire was of poor quality. Another wire harness manufacturer solved this problem by establishing its own wire manufacturing facility in the United States. At another metal stamping operation the manager said that US galvanized steel is of such low quality that he continued to source steel from Japan through a Japanese trading company (for a discussion of the Japanese steel transplants see, Florida and Kenney, 1991).

The Mexican contribution to the inputs to the maquilas is strikingly low (see also Rodriguez Villalobos, 1990). Company P, which reported the highest Mexican content (35%) is located in Ciudad Juarez and mainly sources raw materials such as leather, thread and fabric from Mexican vendors. Company J reported 30% Mexican content, but it was entirely from Japanese subcontractors operating in Tijuana. The other firms did not even report the

Table 5. *Origin of inputs to Japanese maquiladora plants (Percentage of content by country of origin)*

Company	US	Japan	Mexico	Other Asia
A	100	0	0	0
B	45-55	45-55	0	0
C	50	50	0	0
D	20	50	0	30
E	95	0	5	0
F	40-50	50	>5	0
G	45	35	2-5	15
H	15	15	2	68
I	40	60	0	0
J	37	33	30	0
K	50	45	0	5
L	50	0	0	50
P	64	0	35	1

Source: Personal interviews by Martin Kenney (1991).

parts they sourced from Japanese contractors located in Tijuana as Mexican content.

There are a number of other reasons for the low level of Mexican content. First, Japanese electronics companies are large vertically integrated firms that produce television tubes, integrated circuits and a myriad other electronic products internally. Thus, the maquilas source many of their components from related plants in the United States, Japan and/or other Asian countries. They also have long-term sub-contractors with which they have close relationships. Second, the maquilas are distant from Mexico's major industrial bases around Mexico City and Monterrey. Parts sourcing is logistically difficult given such long distances and Mexico's underdeveloped transportation system. Third, Mexican factories lack the technological capability to supply many of the required components and suffer from significant quality problems. According to Japanese managers, Mexican firms cannot provide high quality at a reasonable price. The Japanese firms were unable to source even the simplest products, such as cardboard boxes from local suppliers. This is exacerbated by the Mexican transportation system, which is oriented on a North-South axis. This does not facilitate interaction between nodes in the industrial system. Fourth, adherence to the strict delivery schedules favored by Japanese managers is not common practice in Mexico. Fifth, a number of Japanese maquilas reported that Mexican producers do not aggressively target Japanese maquilas. Sixth, there is far less pressure in Mexico to increase local content than in the United States, the European Community or ASEAN.

NAFTA which was designed as a protectionist agreement, will likely have little impact on the Japanese electronics firms, even though the agreement has a requirement that televisions contain a 60% North American content. The reason for this is that the large Japanese consumer electronics firms have already prepared to raise their local content. To understand this it is necessary to break down the value added in television sets. Approximately 30% of the entire value of a television is the picture tube, another 30% is the chassis and body, 15% is in the integrated circuitry, 5% is the deflection yoke and the other 20% is the stuffed printed circuit board and miscellaneous parts. Given this admittedly rough breakdown, the situation of the major Japanese firms is clear. The chassis and body materials are sourced in the United States and assembled in Mexico thus achieving 30%. All of the maquilas with the exception of Sanyo already have a tube facility in the United States thus securing another 30%. The deflection yokes are being made or will soon be made in Tijuana and finally all of the major producers now have a semiconductor fabrication facility in the United States. Thus, they can reach the 60% mark easily.

7. NAFTA AND JAPANESE MAQUILAS

There has been much speculation regarding the impact of NAFTA on Japanese siting decisions in North America. The following discussion is predicated upon NAFTA actually being ratified which is not a foregone conclusion. Szekely (1992) argues that NAFTA will convince Japanese firms to locate more of their production facilities in the United States. Koido (1991), more generally, agrees with Szekely saying automation will encourage Japanese manufacturers to relocate to developed countries. On the other hand, Prestowitz *et al.* (1991) argue that NAFTA will either continue or even accelerate the movement of Japanese assembly facilities to Mexico (see also Prestowitz, 1992). A recent *Nihon Keizai Shimbun* survey of 269 US subsidiaries of Japanese firms found that 62.1% of the respondents thought that the passage of NAFTA would make Mexico a more attractive place to invest (*Nikkei Weekly*, 1992). For predicting the impacts of NAFTA the commodity chain perspective we have developed in the preceding sections is useful.

As we have shown, Mexico attracts plants which have production processes that require cheap labor and are in markets suffering from intense competition. It is highly unlikely that the more capital-intensive production processes that rely on high levels of skill formation among workers will be relocated to Mexico. The lack of infrastructure and skilled engineering personnel, high labor turnover and perceptions of higher risk will mitigate against large capital investments by Japanese firms in Mexico for the purpose of export to the United States. This is especially true in production processes which require clean room-style production. Mexico does not have the infrastructure to undertake such activities. For example, one of the firms in our study produced floppy disks on the US side of the border and only packaged them on the Mexican side. Mexico was not even considered for the clean-room assembly operation.

As mentioned earlier, Nissan is the single exception to the pattern of Japanese firms not making large-scale investment in manufacturing in Mexico. The recent massive investments and the development of an infrastructure in the US Midwest capable of prompt delivery of high quality parts make it all the more unlikely that Japanese auto assemblers will follow US auto assemblers to Mexico (Kenney and Florida, 1993). The Japanese strategy contrasts radically with the US auto assemblers who have clearly embarked upon a cheap labor strategy based on auto assembly in Mexico.

An impact of NAFTA that is usually not considered is the effects upon the Korean and weaker Japanese television producers that do not have television tube and semiconductor production facilities in North America. To comply with NAFTA as now

written these companies will either have to make major investments in new production facilities to increase their local content, source important components from their competitors or import parts which will require payment of duties. The ultimate result might be an easing of the pricing pressure on the low end of the market. This would benefit the larger Japanese consumer electronics producers.

The other issue is whether NAFTA will shift Japanese investment in consumer electronics from Asia to Mexico. For example, Zenith has decided to close its facilities in Taiwan and in the United States and relocate all of its television production to Mexico. Zenith, however, will keep its office in Taiwan for the purpose of continuing to source parts from Asia (Miller, 1991, p A6). For the Japanese manufacturers there is less pressure to relocate from Asia because the rapid growth of the Asian economies has led to expanding markets. As a result, Mexico could become an assembly base for the Americas, while Southeast Asia continues to supply Asia and Africa. Thus, NAFTA may cause some investment diversion from Southeast Asia to Mexico, but it may not be as important as the relocation of assembly jobs from the United States to Mexico.

8. SUMMARY AND DISCUSSION

The Japanese maquilas are responses to a set of political and economic forces that are forcing Japanese multinationals to internationalize their production chains. This paper has analyzed the internal and external relations of these production facilities. By relating these two facets of capitalist production a more comprehensive understanding of Japanese strategies and the future evolution of Japanese investment in Mexico has been provided.

The industrial relations system in use in Mexico, by and large, resembles that used to manage temporary and part-time workers in Japan. This is hardly surprising as the work is similar to that of part-timers in Japan. This can explain the different results of researchers who found that in the US automotive transplants the labor relations experienced by regular workers in Japan were being transferred. This also explains the aspect of Shaiken and Browne's (1991) results regarding the Japanese auto facility in Mexico. These results, however, call into question Shaiken and Browne's results which indicate the transfer of the industrial relations Japanese regular workers experience to the electronics maquilas.

The maquila facilities occupy a unique niche in the global commodity chain and related technical division of labor of Japanese corporations, performing standardized, labor-intensive activities. The maquilas actually produce few of the components of

the final product. They essentially "put together" advanced, high-quality components which are manufactured in Japanese, Southeast Asian, and/or US factories. Such activities remain extremely sensitive to labor costs, can be effectively performed with unskilled labor, and are sufficiently standard so as to not require continuous improvement activity. Since labor costs are low, quality can be "inspected in."

For Mexico these results lead to a number of policy recommendations. First, should Mexico seek to expand its part of the production chain it will be necessary to make significant investments in the nation's infrastructure. Upgrading the educational system will be crucial for securing investment that will create higher quality jobs. Second, Mexican capital must become more aggressive in seeking out opportunities to supply Japanese assemblers. The qualification process to supply Japanese firms is a type of technology transfer. For example, the experience of US suppliers to Japanese auto transplants has created a more capable group of US auto parts suppliers. Mexican capital might benefit from a government technical extension program and loans to upgrade their capability. Third, Mexico could upgrade its port at Ensenada to handle freight from Asia. This would permit Mexico to capture more of the commodity chain from the Port of Long Beach.

Generally speaking, in terms of the regional configuration of production and distribution for North America, the low-skill, labor-intensive aspects of the production process (especially in price competitive product areas) will continue to be located in Mexico, while the capital intensive parts of the production process will continue to locate in the United States. Japanese firms are mobilizing the social and economic disparities of the existing spatial division of labor in North America to meet their functional requirements for different production environments and different types of labor.

The relative advantage of Tijuana, however, may change as the television tube factories being built by Japanese firms in the Midwest become operational and displace tubes and components imported from Asia. This could make Mexican cities on the Texas border more competitive in attracting Japanese consumer electronics maquilas.

The Japanese maquilas are developing an assembly-oriented production-agglomeration of consumer electronic products in Tijuana which includes plastic injection molding, metal stamping, printed circuit board stuffing, simple component production, and assembly of more complicated parts. Even though an assembly complex is developing, these maquilas remain links in the global commodity chain in which production based upon high capital intensity and high-skill levels among production workers shows no sign of relocating to Mexico. This differs to some degree from the situation in ASEAN, where

Singapore has become a site for investment in relatively capital-intensive production processes such as television tube and microwave magnetron production (Gereffi, 1992; Yamashita, 1991). Further, ASEAN and Taiwan have become increasingly important sources of electronics components.

Mexico's insertion into the international division of labor thus remains quite different from that of Southeast Asia. This is due to the undeveloped state of Mexico's broader manufacturing infrastructure. Advanced industrial production requires a stable workforce, high-quality suppliers, and efficient transportation system. This is especially true as pro-

duction processes become increasingly automated, more tightly integrated organizationally and spatially, and operate according to just-in-time principles. Mexico currently lacks the developed working class, labor skills, and the physical and manufacturing infrastructures needed to meet the requirements of such advanced industrial production. For Mexico the crucial policy issue may well be developing the infrastructural capacity to make the transition from an assembly export-platform to that of a component supplier with local capitalists actively pursuing economic niches as suppliers and even beginning their own assembly activities.

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