



San Diego/Tijuana Manufacturing in the Information Age

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Executive Summary

The economic success of San Diego and Tijuana in the late 1990s has been largely the result of the economic restructuring processes commonly referred to as globalization. In San Diego, old-line defense-related industries such as aerospace and aircraft have diminished greatly in importance. Knowledge-based high-technology industries such as biotechnology and wireless telecommunications now dominate the San Diego economy. While manufacturing is an important part of the global structure of these industries, most of the manufacturing associated with these industries is located outside of the region.

Manufacturing employment in San Diego has declined from a peak in the mid-1980s and has yet to fully recover. Current forecasts predict that manufacturing jobs in San Diego County will not grow significantly in the next 20 years, and will actually decline relative to other employment categories. San Diego is essentially a high-cost region for manufacturing. It is unlikely that new high-value-added large-scale industries will locate here in the foreseeable future. Rather, the most important area for manufacturing growth and development is in small and mid-sized companies.

Tijuana has experienced a manufacturing boom situated at the other end of the Information Age globalization process. Investment in consumer electronics manufacturing, predominantly by Asian multinational television manufacturers and their associated suppliers, has changed the face of Tijuana over the last decade. These television companies have moved Tijuana's manufacturing economy beyond the old twin-plant maquiladora model by creating integrated complexes of assemblers and parts/component suppliers. Tijuana's manufacturing economy is likely to continue to grow for the foreseeable future, although the city's failure to develop an indigenous manufacturing base that is integrated with the global economy and its dependence on potentially capricious foreign investment are worrisome.

Major Findings and Conclusions:

While the recent economic growth in both San Diego and Tijuana is in large part predicated on the same globalization processes, the outcome for each city is different. In terms of the most important core industry, electronics, San Diego is increasingly a center for "knowledge economy" activities such as product research and development and standards management. Meanwhile, Tijuana is increasingly involved in the manufacture of the tangible goods associated with knowledge economy functions.

Traditional manufacturing, while important, will not be the engine that drives San Diego's economic growth. While there is the possibility that some expansion in biotechnology- or electronics-related manufacturing could occur, it is unlikely to be very large. Large-scale, high-value-added manufacturing of the type represented by aircraft and aerospace has essentially left the region and, given the current configuration of those industries, is not likely to return. San Diego is rapidly becoming an Information Age city in which manufacturing plays an important, but diminished, role.

While Tijuana's manufacturing base is growing in complexity, the city still lacks an indigenous globally articulated manufacturing base (such as electronic industry supply companies). While there are some local suppliers involved in Tijuana's electronics manufacturing complexes, their number is few and the immediate prospects for growth in this area are dim. Many electronics plant managers

have expressed their desire to find local sources for inputs, but there are several barriers to the creation of local supplier networks. The big question for Tijuana and Baja California is whether the move to a more advanced level of production can be leveraged beyond the multinational producers around which it is centered.

Tijuana *and* San Diego both lack a broad base in critical areas such as advanced contract manufacturing and supply chain logistics management, both of which characterize electronics manufacturing regions. The current world standard for electronics contract manufacture consists of companies that provide “one-stop” services for everything from design and manufacture to supply chain and distribution-channel management. The region also lacks sufficient infrastructure for cargo transport (particularly air cargo) to support these kinds of functions.

The proximity of San Diego and Tijuana does not necessarily provide electronics or other high-technology industries (particularly large multinational companies) with a compelling reason to establish manufacturing facilities in San Diego and with associated facilities in Tijuana. San Diego’s advantages for Information Age industries include its highly educated and skilled workforce, its top-level educational institutions and lifestyle considerations related to its climate and geography, but not its proximity to Mexico. There are essentially few, if any, compelling reasons for large-scale manufacturers, particularly in the important electronics subsector, to locate in either city in order to gain access to the manufacturing resources of the other city.

Despite a great deal of progress during the past decade in strengthening ties between San Diego and Tijuana, the two cities are still too far apart. Many local businesspeople are not sufficiently aware of the region’s manufacturing potential. The lack of a truly integrated regional consciousness can have negative consequences on the development of manufacturing linkages across the border and future regional competitiveness.

Policy Initiatives

Policy efforts to strengthen manufacturing in San Diego/Tijuana need to be organized around a realistic sense of what is possible in our region. For San Diego, policy approaches should concentrate on small and mid-level manufacturing. On the Mexican side of the border, Tijuana needs to find ways to encourage the development of small manufacturing facilities, particularly in the area of supplying the large electronics companies. Both cities should examine the potential of those knowledge-based companies usually thought of as service companies. Cross-border contracting relationships in this area could save costs for San Diego companies while providing an opportunity for entrepreneurs to create small businesses with minimal startup costs. Measures that strengthen the ties and linkages between Tijuana and San Diego, and that normally are not thought of in terms of manufacturing, are also critical. Initiatives that make the border less of a barrier are imperative.

Some specific policy suggestions are listed below:

Mexico-Side Initiatives

- Target the potential technology-related growth areas that complement the television-led electronics sector for promotion and development. Such industries might include personal computer and PC component production, software development or Web development.

- Implement a strategy to develop electronics contract manufacturing at all technology levels and at all levels of production scale. A key component of this strategy should be the improvement of air cargo capabilities.
- Seek more government funding for education in general and for business and technical education in particular.

San Diego-Side Initiatives

- Work with (and donate money to) Tijuana and Baja California educational institutions to promote entrepreneurial and technical education.
- Target small manufacturing industries such as musical instruments, sports equipment, custom manufacture or small-lot electronics goods for promotion and growth.

Tijuana/San Diego Joint Initiatives

- Promote the potential joint advantages of the region to both global and local manufacturers.
- Augment San Diego's and Tijuana's cargo transport capabilities, particularly air cargo at the Rodriguez and Brown Field (Otay) airports. Develop a joint strategy for both airports.
- Seek the creation of a small-scale manufacturing base capable of meeting the needs of small-scale development and manufacturing companies in the San Diego region. Work with San Diego to promote the potential regional advantage for twin-plant-type linkages in the small electronics and non-electronics manufacturing subsectors. Such promotional efforts should be aimed at businesspeople both within and outside the region. Investigate the potential for the creation of subcontracting linkages in computer programming, software development, data services and Web development.
- Lobby both governments for small business development funding in Baja California. Areas to target might include: 1) indigenous suppliers to TV and other electronics and appliance manufacturers, 2) "services" such as data processing and software development of all kinds including Web development, and 3) twin-plant-type arrangements with regional small or medium-size manufacturers, including small-scale subcontracting.

Introduction

The decade of the 1990s has witnessed large-scale change in the manufacturing base of the San Diego/Tijuana region. On the San Diego side, defense cutbacks led to a decline in manufacturing related to military procurement, aircraft and aerospace, while the rise of the high- technology-based “New Economy” fueled the growth of both electronics manufacturing and related research and development activities. San Diego’s economy has clearly recovered from the wrenching changes of the early 1990s, transforming itself into an important technology center well situated for global engagement. In Tijuana and Mexicali, similar global industrial forces, prodded by the passage of the North American Free Trade Agreement (NAFTA) in 1993, have led to the establishment of large-scale facilities for the manufacture of a wide range of consumer electronics and appliances. In both cities employment is booming, and the respective crises of the recent past seem like distant memories.

The linkages between Tijuana and San Diego have become more apparent over the last decade. Family and social relationships, employment, commerce and culture are just some of the ties between the two cities. The current boom and its resultant urban impacts present a range of issues that have an increasingly binational character, requiring increasingly binational approaches. Issues such as air and water pollution, petty crime and organized crime, and the negative economic impacts of long border waits have binational effects and require binational solutions. Economic growth is fundamental to these issues, both as a cause and as a solution: The long-term economic health of each side is in the interest of the other side.

Yet while both San Diego and Tijuana have enjoyed the fruits of the late 1990s boom, it is clear that for each side, the boom is different. While at the most abstract level of analysis both cities are subject to the same globalizing, Information Age logic, the outcomes of these changes have been different for each city. Currently, knowledge and information have become an increasingly important part of the value composition of the commodities produced and traded in the global economy. This is particularly the case for the technology industries that are driving wealth creation. The main share of the value composition of electronic goods, for example, is predicated not on their material qualities (i.e., the actual stuff of circuit boards and silicon chips), but rather on the knowledge and information embodied within them.

High-level success in the technology field is based not so much on manufacturing ability (although manufacturing ability can be important, as in the case of Intel,) as on the ability to develop and market systems and system standards. The oft-cited dichotomy between headquarters functions and manufacturing functions is probably better understood in terms of a dichotomy between knowledge-based functions and material-based functions. The current growth driver for San Diego is knowledge-based, while for Tijuana it is material-based.

On the San Diego side, knowledge-based manufacturing is perhaps best exemplified by Qualcomm. A key factor in the 1990s development of San Diego’s new economy, Qualcomm provides a quintessential example of an Information Age company. Given the recent divestiture of virtually all of its manufacturing, and the fact that it uses independent semiconductor fabricators to manufacture its chip designs, Qualcomm has made a full transition to a company that is almost exclusively concerned with knowledge production. The main reason for this is that consumer electronics assembly manufacturing tends to have low margins and is highly competitive. This is the chief reason why so much high-volume consumer electronics manufacturing is located in low-labor-cost locations.

On the Tijuana (and Mexicali) side, the material aspect of this dichotomy is best exemplified by the television assembly industry. This industry is dominated by major Asian consumer electronics companies (Japanese and Korean), as well as some of their suppliers, which have also located operations in Baja California. They assemble television sets from parts and components sources from Asia and the United States (primarily semiconductor chips and other small, high value parts), and low-value parts supplied by their local suppliers and other U.S. and Mexican companies (Lindquist 1998b). The notable exception to this rule is the case of picture tubes, which are sourced from the United States (Sony produces them in San Diego) and increasingly from one of four plants in Baja California (Lindquist 1999).

These global electronics companies have located in Baja California for reasons having to do with proximity to markets, lower shipping costs because of the large size of the product, access to the NAFTA marketplace, and the low-value-added, highly competitive nature of television assembly, which requires low-cost labor inputs. High-value and knowledge-intensive parts such as semiconductor chips are developed elsewhere, shipped to Baja California and incorporated into the assembly process. Thus, the Baja California television industry, while part of the same technology-based globalization process as the knowledge-based industries of San Diego, exists at the other end of the technology value chain.

This paper presents a discussion of the current and future state of manufacturing in the San Diego/Tijuana region. It is important to point out that while much of the discussion of the Mexican side is focused on Tijuana proper, much of what is presented here is also applicable, at least partially, to the other Baja California municipalities (Tecate, Mexicali, Rosarito and Ensenada), all of which have thriving manufacturing sectors of their own. We must remember that the possibility of manufacturing linkages extends to these cities as well. The first two sections of the paper discuss the current state of manufacturing in San Diego and Tijuana, respectively. The third section discusses the overall logic of the region's role in globalization, particularly in the areas of knowledge-based industries and electronics manufacture — the two key areas driving economic growth in the region. Included is a discussion of the manufacturing linkages, or lack thereof, between the two cities. The final section discusses what can be done to enhance the manufacturing environment on both sides of the border.

Twin Cities, Twin Booms

San Diego: Manufacturing in the Information Age

The early to mid-1990s was a devastating period for manufacturing in San Diego County. Defense cutbacks and military downsizing both led to sharp decreases in both manufacturing and engineering employment, particularly in the aerospace and aircraft sectors. According to State of California figures, overall manufacturing employment in San Diego peaked about 1990 (Figure 1), and while it has recovered sharply since 1995, it has yet to reach the level it had attained five years previously. While high-technology manufacturing employment suffered generally, a major part of the decline is attributable to subsectors, such as aerospace and aircraft, that are either directly or indirectly dependent on defense-related expenditures (Figure 2). The largest decrease in the 1990s is in the transportation/aerospace subsector, while the most significant increase occurs in the electronics and computer-related subsector. From 1993 to 1997 employment in the transportation/aerospace subsector declined 39 percent (Figure 1). Employment in the electronics subsector showed declines or stagnation from 1985 to 1995. Instrument manufacturing (medical, measurement, etc.) employment also declined

or stagnated throughout most of the 1990s. The one area that has shown comparative employment strength throughout the decade is the miscellaneous manufacturing category, which includes a variety of small manufacturers of such products as musical instruments and sports equipment.

By 1996-1997, San Diego's economy was clearly on the mend. The key sectors for the revival were those tied to the U.S.-led global information technology boom (GSDCC 1999). In San Diego, as in many other parts of the United States, they are electronics and electronics-related manufacturing and service industries. Manufacturing employment in electronics increased 29.8 percent from 1995 to 1998 (Figure 2). Growth in electronics manufacturing employment has leveled off during the past two years and has yet to reach its 1980s level. Whether this is due to the normal limits of the economic cycle or a more localized factor (such as housing-related labor shortages) is difficult to ascertain, especially this early into the data cycle. There have, however, been recent reports of electronics companies shifting their San Diego manufacturing to Mexico for cost reasons (Calbreath 1999a).

If we consider technology-related manufacturing in the broader context of San Diego's transformation from a region highly dependent on Cold War-era military spending to one that has become more deeply integrated with the global information economy, then a slowing of the growth of technology manufacturing employment makes sense. While electronics manufacturing is important, the real story of San Diego's transformation into an Information Age city can be found in the expansion of the service sector. As an industrial classification, services run the gamut from restaurants and hotels to law firms and hospitals. In recent years, most retail and wholesale trade-related services have been disaggregated into separate categories. This still leaves a certain level of ambiguity, in that many activities classified as services can also be viewed as either directly or indirectly producing goods.

According to the U.S. Census Bureau's industrial classification system, such activities as computer programming, packaged software, motion pictures and engineering are services. In San Diego, these types of activities accounted for 35 percent of service employment in 1996 (U.S. Census, County Business Patterns, 1996). These activities are important in an era in which knowledge and information have become an integral part of the value composition of tangible products, as well as important products in their own right (Curry 1997). While they cannot be considered manufacturing in the traditional sense, they are clearly value-producing activities with integral connections to global manufacturing processes. They should not be viewed merely as managerial or headquarters functions (although in some cases, like Gateway Computer, they tend to lean more in that direction).

Employment in services has increased in every year but one since 1983 (Figure 3). San Diego's service employment growth slowed in the first half of the 1990s, as would be expected in a recessionary economic climate. However, by 1996, service employment resumed the steady increase that characterized the 1980s. The significance of this kind of activity to San Diego's economy, as well as San Diego's transition into the Information Age, is perhaps best demonstrated in the story of its leading industrial success, Qualcomm Inc. Qualcomm's growth is driven by its development and licensing of the code division multiple access (CDMA) system for wireless mobile communications. Most of the telephone and infrastructure equipment manufacturing related to Qualcomm's CDMA standard is performed either by its own subcontractors or by its licensees and/or their subcontractors.

In 1999 Qualcomm sold its own handset manufacturing capability to Kyocera and its wireless infrastructure manufacturing operations to Ericsson, and the company relies on companies such as Taiwan Semiconductor, IBM, and Texas Instruments to fabricate its chip designs (Arensman 2000). The wealth creation exemplified by Qualcomm's success is predicated not on the actual manufacture of tangible products such as wireless phones, but rather on the development and control of the

standards and designs that provide functionality. This kind of dichotomy (the split between knowledge-based development and tangible manufacturing) is driving most leading-edge technology industries, such as personal computers and networking equipment. In the knowledge economy it is as easy to conceive of a company like Microsoft as a manufacturer of software products as it is to classify it as a company providing computer software services — especially when it is possible to find its products on store shelves next to more tangible electronic goods.

Small and middle-sized companies and start-ups have driven most of San Diego's recent growth in the technology sector. Until recently, Qualcomm itself was a small company. As it has in many places around the United States, the rise of the Internet and e-commerce has impacted San Diego. Like many U.S. cities, San Diego can boast of its own roster of "dot-com" start-ups — companies that specialize in the production and distribution of knowledge, information, and services over the Internet. Examples include MP3.com and such lesser-known Internet-related startups as CollegeClub.com, Enonymous.com, ProLog Logistics, and ePangea.

It is in the context of the new knowledge economy that projections about San Diego's manufacturing future must be approached. According to the San Diego Association of Governments (SANDAG 1999), while growth in manufacturing employment will increase in the near future, any future increases will not keep pace with employment in services and other civilian employment (Figure 4). SANDAG projects only a 10.4 percent increase in manufacturing employment by 2020 (declining after a peak in 2005). When compared with a projected increase in other employment of more than 50 percent, as well as a general population increase of 44 percent, it is clear that traditional manufacturing, while important, will not be the engine that drives San Diego's future economic growth. Manufacturing employment will decline as a proportion of total employment. No doubt other traditional economic activities, such as tourism and the Navy, will continue to be important. But large-scale, high-value-added manufacturing of the type represented by aircraft and aerospace has essentially left the region and, given the current configuration of those industries, is unlikely to return.¹ Certain longstanding large-scale manufacturing activities, represented by companies such as Rohr and NASSCO, will continue to have a place in the San Diego manufacturing mix because of their specialized market niches and, in NASSCO's case, its geographical location. San Diego's technology manufacturing economy will cycle through waves of future technological change, shedding jobs in some places and adding jobs in others.

Small specialized manufacturers, older companies like WD-40 and Buck Knives, and newer companies like Callaway Golf and Taylor Guitars, along with numerous companies targeting specialized technology niches, are likely to play an increasingly important role in San Diego County's manufacturing mix. These companies show a wide range of specialization (Table 1) and many of them are highly efficient users of high-technology production methods. These kinds of companies find San Diego County a good location for attracting and keeping the skilled personnel they need. Additionally, they might find Baja California an attractive place for certain manufacturing activities.

Another factor that mitigates against the return or expansion of large-scale high-value-added manufacturing is the pressure brought about by San Diego County's rapid urban growth. The 1994 average manufacturing salary in the San Diego region was \$35,068. While lower than the state average of \$36,219, it was higher than the national average of \$33,036 (San Diego Sourcebook 2000).

¹ While it is certainly possible that some future industry — dirigibles or electric cars or hydrogen-based propulsion systems, for example — might decide that San Diego is a good location, it is hard to plan for this. As of this writing the centrality of information and electronics is clear.

According to 1996 data, California had the sixth highest average annual manufacturing salary in the nation. Contrast this with three southern states that are home to numerous large-scale (including electronics) manufacturing operations: Alabama (31st), Arkansas (46th) and Mississippi (47th) (Bizsites.com 1998). The current Consumer Price Index for western U.S. urban areas is about 4.2 percent higher than the Midwest or the South (BLS 2000). The current median housing price in San Diego County is about \$230,000, well above the national average. San Diego is one of the least affordable housing markets in the nation (Green 2000).

While housing costs are likely to stabilize somewhat in the future as supply catches up with demand, it is highly unlikely that the median price will retreat to anywhere near the national average. Moreover, while there is still considerable physical space for growth, particularly in the southern and eastern parts of the county, areas that are amenable to large-scale manufacturing activities are becoming scarce — and many large aircraft-production facilities, which might have been converted to other manufacturing uses, have already disappeared. All this puts considerable pressure on San Diego's ability to attract new manufacturing industries, particularly large-scale, labor-intensive ones.

In summary, the past drivers of San Diego's economy have been aerospace, tourism and military expenditures. New areas of growth are in the high-technology, research and development, and services areas. These are activities centered on knowledge production. The manufacturing associated with these activities is globally situated. While the possibility exists that some expansion in biotechnology or electronics-related manufacturing could occur, it is unlikely to be very large. San Diego is rapidly becoming an Information Age city in which manufacturing plays an important, but diminished, role.

Tijuana: An Export-Led Manufacturing Boom

The global forces transforming San Diego are also transforming Tijuana and Baja California, but in an entirely different way. While manufacturing in San Diego is diminishing in importance, at least in relative terms, in Tijuana it is the key sector of the local economy. As with San Diego, the 1990s have been boom times for Tijuana. Tijuana's boom has been led by foreign investment, predominantly Asian, in the more labor-intensive processes that underpin the knowledge-based activities. Thanks solely to Tijuana and Mexicali, Baja California has become the major producer of television sets in the Western Hemisphere. Baja California also produces other consumer electronics, including videocassette recorders, computer parts, components and accessories, home appliances and many other electrical and electronic parts and components. This boom in electronics production has been overlaid on an existing and expanding manufacturing base that produces a wide range of goods including wood and furniture products, various fabricated metal products, and clothing and textile products.

Baja California's manufacturing Gross Domestic Product (GDP) has accumulated significant growth in the latter half of the 1990s. Baja California's manufacturing GDP mounted significant gains from 1996 to 1998 (Figure 5). Manufacturing GDP stood at about 8.9 billion pesos as of 1998 (or about US\$936 million at current exchange rates). Overall, manufacturing has increased as a share of regional GDP and accounted for about 21 percent of Baja California's GDP in 1998 (Figure 6). Manufacturing employment in Tijuana and Baja California, driven by the maquiladora sector, underwent steady increases throughout the 1990s as well; it has more than doubled in both Baja California as a whole and in Tijuana specifically (Figures 6 and 7). The mid-decade "peso crisis" that started at the end of 1994 appeared to have no immediate effects on the general rate of growth,

although it could be argued that it was at least partially responsible — along with the effects of NAFTA, which went into effect earlier that year — for the growth-rate increase from 1995 to 1997.

The most important area of growth in manufacturing, both in Tijuana and along the entire Mexican border, has been in the electronics subsector. Electrical and electronics-related production shows the largest proportion and fastest growth of export-oriented manufacturing employment in the entire border zone (Figure 9). With the exception of automotive-related production, which is concentrated on the eastern end of the Mexico/U.S. border, these figures reflect the situation in Tijuana. While the proportion and growth of garments and furniture-related employment is not at the level of electronics, employment in these subsectors also nearly doubled over the 1990s.

By whatever measure, it is clear that Tijuana is in the midst of a dramatic expansion in manufacturing. In the past few years, a major part of this has been driven by Asian investment, particularly in television and computer monitor production but also in other electrical and electronics-related production. This Asian-led investment boom has been driven in large part by two factors: the passage of NAFTA in 1993 and the fact that Mexico represents a low-wage production platform next door to the huge and lucrative U.S. market. NAFTA provides an incentive for Asian producers to locate production in Mexico by eliminating tariffs on goods shipped within North America while maintaining tariffs on goods shipped from Asia and other regions outside the North American trade zone. This, coupled with the historic transfer of television and other consumer electronics production from the United States to Asia (and in some instances to Mexico), created a situation in the 1990s in which most remaining U.S. production was transferred to Mexico and Asian production “returned” to North America via Mexico.

The other driving force behind the expansion of electronics production has been low wage costs. Mexico’s manufacturing wage levels are highly competitive internationally (Figure 10). While certain countries’ wages might be lower (China’s, for example), Mexico’s proximity to key markets makes up for this — particularly for larger products with higher shipping costs. The 1994 peso crisis strengthened Mexico’s wage advantage; 1995 maquiladora wages dropped 35 percent from the previous year and they have yet to return to pre-crisis levels (Figure 11).

The current wave of electronics-led manufacturing expansion represents a significant break from the past model of maquiladora industrialization. In that approach, created through changes in U.S. and Mexican law in the 1960s, U.S. plants would ship parts and components duty-free to a counterpart facility in Mexico, where they would be assembled and returned duty-free to the United States (the “twin plant” model, Figure 12). Maquiladoras were essentially adjunct manufacturing facilities set up primarily to take advantage of a legal structure that eliminated tariffs and to access the abundant, low-cost labor available in Mexico. Most, if not all, ancillary functions associated with production, such as sourcing, were handled by the U.S. company. The technological skill involved in the particular product was located in the United States. In a sense, the maquiladora system was a way to import cheap labor into the United States without having to confront the problems posed by U.S. immigration or labor law (Sklair 1993).

Current electronics production, particularly by Asian television producers, has departed from this model in a significant way. These producers have essentially developed entire production complexes in which parts and components are sourced from a variety of overseas or U.S. sources or are produced locally by suppliers who have followed the major television companies to Mexico from Asia. Rather than being adjuncts to a production process whose center is located elsewhere, the TV manufacturers and other similar companies in Baja California increasingly constitute their own centers

of production. This is particularly the case when the Baja California-based manufacture of key components such as picture tubes is taken into account. While Japanese companies are dominant in this sector, Korean producers such as Samsung and LG are creating these kinds of complexes as well.

This Asian-led industrial transformation has been occurring so rapidly that it is hard to keep track of exactly what is happening. Table 2 shows the results of recent research conducted by the author on Asian maquiladoras in Tijuana (current actual numbers are probably higher). As mentioned above, Japanese companies dominate Tijuana's Asian maquiladora boom, although interestingly capital from other Asian nations, including Korea but most notably Taiwan and China, is moving into the region. According to a recent report by the Baja California Economic Development Secretariat, Japanese companies, which dominate the electronics sector, employ approximately 50,000 people in the region (Arce 2000). Many of the products produced by these companies are not final goods, but are parts and components destined to be shipped to other manufacturers both in Mexico and the United States (Table 3).

The big question for Tijuana and Baja California is whether this apparent move to a more advanced level of production can be leveraged beyond the multinational producers around which it is centered. Recent research by the author indicates that while there are some local suppliers involved in these complexes (mostly in areas such as food service, janitorial services or security services), the number is few and the immediate prospects for growth are dim. Many electronics plant managers have expressed their desire to find local sources for inputs, but there are several barriers to creating these networks of local suppliers. — including the lack of available capital, the lack of a manufacturing-centered entrepreneurial culture, an entrenched business culture that is hostile to small startups, and a lack of potential entrepreneurs with the knowledge and experience to strike out on their own. Many of these socioeconomic factors are changing, and efforts are being made to find ways to free up investment capital for entrepreneurs (Calbreath 1999b). As the years pass, the number of potential entrepreneurs will increase as more young Mexican managerial and technical personnel gain experience. If Mexico can continue its recent pattern of economic and political stability through the coming decade, then perhaps the factors could become conducive to the development of a native base of supplier companies.

As for the future of Tijuana's manufacturing industry, as of this writing, the boom still appears healthy. While Tijuana has its own urbanization-related pressures to contend with, particularly in regard to infrastructure construction and maintenance, maquiladora construction continues to expand to the south and to the east. A quick review of recent news reports turns up numerous announcements of new investments or expansion of production facilities. For example, Kyocera, a Japanese electronics company with facilities in both San Diego and Tijuana, recently announced expansion plans at its Tijuana operations and is considering Tijuana for a new cellphone plant (Maquila Portal 2000). Fears of a collapse of Asian investment resulting from the 1998 Asian economic crisis proved generally unfounded. If anything, the economic problems experienced by many Asian electronics companies and the need to restructure under-performing operations may have spurred continued investment in Mexico. The increasing need for fast turnarounds in electronics production also plays to Mexico's strength of being located so close to key U.S. markets and production facilities (especially in the PC industry). While firm predictions are hard to make in the Tijuana boomtown context, it is likely that manufacturing in the city will continue to grow in the coming decade (Gerber 1999).

San Diego and Tijuana: A Manufacturing Region?

A key premise of this paper is that the most important factor driving economic growth in both San Diego and Tijuana — whether in manufacturing industries directly or in those industries indirectly associated with manufacturing — has been the development and restructuring of the globalized electronics and information technology industries. Each of the two cities has followed a different path connected to this logic: one as a managerial, research and development, high-technology manufacturing center, the other as a low-labor-cost manufacturing center. The importance of these two development logics to the future of each city cannot be underestimated. For San Diego, like many U.S. cities, the goal is to create the kind of fast-growing technology-based industrial mix that characterizes the Silicon Valley region of California. For Tijuana and Baja California, the goal is to use electronics as a key driver for economic growth in the same way it has driven growth in newly industrializing Asian countries such as Taiwan, Singapore and Malaysia.

Another important premise underlying this paper is that both cities have a mutual interest in each other's economic success. For Tijuana, an economically prosperous San Diego provides a market for many of its services and goods-producing and retail businesses. San Diego also offers employment for some of Tijuana's residents and both a real and a potential expansion of supply chain linkages in its manufacturing industries. For San Diego, Tijuana's economic success is important too for retail trade and services, as well as for the potential negative regional socioeconomic and environmental problems caused by economic failure. San Diego and Tijuana are linked not only by economic ties, but also by social, cultural, and political ties.

San Diego's present and future economic position in the global information economy, given the reasonable continuation of current trends, is relatively well assured. The recovery from the military spending cutbacks of the early 1990s has resulted in a more diversified economic base, leaving San Diego far less dependent on any one or two industries than in the past. San Diego's economy contains a strong mix of both indigenously developed business enterprise and outside investment-based industry.

The situation for Tijuana is slightly less well assured. Prior growth in the maquiladora sector has been predicated on a dependent structural relationship in which manufacturing employment is subject to the exigencies of production systems rooted in distant locations. This is also generally the case in the booming electronics sector, which has largely been the creation of Asian multinational investment. Tijuana's manufacturing base is clearly vulnerable to market shifts over which it has little or no control. Moreover, Tijuana's economy is far more dependent on its manufacturing sector than is San Diego's. A manufacturing-led economic downturn would have devastating consequences for Tijuana. While Tijuana's manufacturing boom has a certain momentum that should carry it into the future (especially in the transition from the "twin-plant" model to production complexes), the lack of indigenous manufacturing clearly articulated with global economic trends is worrisome.

The divergent paths of San Diego and Tijuana, albeit within the same globalizing logic, raises a series of important questions. The first of these regards the future diminution of San Diego's manufacturing base in relative terms. Future manufacturing employment in San Diego is expected to hold more or less steady for the next 20 years (Figure 4). However, given the growth in other sectors, this represents a decline in manufacturing employment as a proportion of all employment. Does a smaller manufacturing base bode well for San Diego's future? Could it be that despite the rise of the postindustrial era — however that is ultimately defined — local and regional manufacturing capacity is still important, as some have argued (Zysman and Cohen 1987)? Or does it really matter, given the increased importance of information in both the global economy and the local economy? And if a

strong and expanding manufacturing base is deemed important, then what can or should San Diego do about it?

The second set of questions concerns the development of Tijuana's manufacturing base. Primary among these are questions about the multinational component of Tijuana's manufacturing boom. Is Tijuana, in fact, too dependent on foreign manufacturing investment, which could, if conditions change, leave the city with nothing but a vast landscape of empty factories? Or does the development of integrated production complexes represent an early stage in an industrial upgrading process that will gradually lead to a climate of increased capabilities and more diversity?

The third set of questions has to do with the issue of manufacturing linkages between Tijuana and San Diego. What is the current state of manufacturing-based linkages between the two cities? Is it desirable and possible to expand manufacturing linkages between San Diego and Tijuana? If so, what types of linkages should they be? What industrial sectors are most amenable to the creation of inter-city manufacturing linkages? The remainder of this section will deal with these issues.

Before moving on to some of the specifics mentioned above, it is worth considering once more the logic that is propelling development and manufacturing in the global electronics industries. As alluded to before, two basic models of production dominate Mexico's export-oriented manufacturing sector (Figure 13). The first and oldest model (traditional twin plants) is one in which parts and other materials are shipped across the border for assembly and completed products are shipped back to the United States. This model continues to be quite common and is concentrated among companies that tend to be smaller and engaged in the production of low-technology, low value-added, labor-intensive products. Examples include furniture, non-electronic toys, hardware and plumbing fixtures, sports equipment and clothing.

The second model (panel 2, Figure 13) characterizes the logic of global electronics manufacture, to a varying degree, in both Tijuana and San Diego. Vertical disintegration and production outsourcing, long a tendency in the electronics industry, has only intensified in the last decade. Whether production is outsourced or not, manufacturing location decisions are, in general, largely contingent on the exigencies of the production and the distribution process of the product being produced. These exigencies include a complex set of time-related (speed-to-market, product cycles, inventory size, etc.) and space-related (distance to markets, product transportability, local economic climate) variables, on which is overlaid a series of political, legal and social variables. The basic nature of most electronics products is that they are small and easily transportable, and that the knowledge work that goes into system development and design is, in spatial terms, easily split off from manufacturing.

San Diego: A Postindustrial City?

There is, then, no across-the-board compelling logic that forces electronics companies to locate production near to their corporate headquarters or development facility, or for the suppliers of many parts and small components to cluster around their customer(s). There are exceptions, as in the case of televisions, which are larger than many consumer electronics products and utilize larger components for which localized production makes sense. But even in the case of Baja California's television industry, many foreign-sourced parts come from Asia and almost none come from San Diego (with the notable exception of Sony, which produces tubes at its facility in Rancho Bernardo).

A local example of this situation is Gateway Computer. Interestingly, the PC industry is characterized by a reversal of the model in which low-value-added parts of the production process are outsourced to low-labor-cost regions. For the U.S. market, most PC assembly, which adds very little to the overall value of a PC, is performed in the United States (Curry and Kenney 1999). There are a growing number of maquiladoras that supply parts and components to the PC industry, several of which located in Tijuana. Gateway's main production facility is located in South Dakota (with another in Virginia) largely because that is where the company's founder is from. Locations based on founder origins or some other serendipitous factor are common in the PC industry: Microsoft, Dell and Compaq are good examples. Gateway recently moved its headquarters to San Diego largely because of the CEO's preference and the difficulty of attracting skilled managerial personnel to South Dakota, not because of any compelling manufacturing or supply chain logic—although closeness to the Latin American market was cited as a reason (Lindquist 1998a). Nor is it likely, due to the internal logic of the PC production system and Gateway's place in it, that Gateway will locate any future production expansion in San Diego or Tijuana.

The upshot of all this is that the proximity of San Diego and Tijuana does not necessarily provide electronics or other high-technology industries (particularly large multinational companies) with a compelling reason to establish manufacturing facilities in San Diego and associated facilities in Tijuana. While some local electronics-related companies do receive inputs from Tijuana, or vice versa, it is not due to any intrinsic regional advantage, nor is there a clear pattern of this. Gateway could have easily chosen to locate its headquarters in a city far from Mexico and could still have obtained production inputs from Mexico if necessary. San Diego's advantages for Information-Age industries include its highly educated and skilled workforce, its top-level educational institutions and lifestyle considerations related to its climate and geography — but not its proximity to Mexico.

San Diego County is home to an increasing number of small, specialized manufacturers of such products as musical instruments, tools and other metal products, and sports equipment (golf clubs, for example). For these kinds of companies, the proximity of a low-labor-cost region like Tijuana can be an advantage. For this class of manufacturing, outsourcing production to a distant location can be costly and troublesome. A small San Diego manufacturer who wishes to expand production in Tijuana need not deal with high transportation costs and can easily engage in direct supervision of the manufacturing process. It is in the interest of both sides to seek to nurture this subsector. Other San Diego-side companies could specialize in the Tijuana-side manufacture and importation of furniture, art objects, decorative housing fixtures and similar products that, over time, could evolve in the direction of a distinctive Tijuana/San Diego style. There already is a growing base of importers, manufacturers and retailers of such serious art objects in Tijuana (as opposed to the cheap curios marketed to casual tourists). Careful consideration should be given to ways to push this kind of industry to a higher level.

Tijuana: Moving Up?

As for Tijuana's large-scale electronics-related manufacturing base, the future is here and it is up to Mexico to take advantage of it. There exists a possibility that the exigencies of electronics production could radically change, or that some other factor, such as security problems or a political crisis, could leave Tijuana without a manufacturing base of its own. However, this is very unlikely due to the increasingly integrated nature of the maquiladora sector (Gerber 1999). Aside from the sheer size of the investments, another reason for this is the diversity of manufacturing associated with the large electronics producers. A recent report indicated that there are currently 20 new Japanese investment projects under way in Baja California (Arce 2000), and a wide range of products is being

produced by the Asian multinationals and their suppliers (Table 3). As a result, Mexican plant operatives, managers and technicians are gaining valuable skill and experience in many different aspects of industrial production and in many different product types, many for the first time in their family history. As the level of investment in these skills increases over time, and high levels of quality and productivity are achieved and maintained, there is less incentive to simply abandon Tijuana for greener pastures.

One area in which Tijuana's electronics base is lacking is in the area of contract manufacture. The current world standard for electronics contract manufacture consists of companies that provide "one-stop" services for everything from design and manufacture to supply-chain and distribution-channel management. Anecdotal evidence from a number of sources on both sides of the border suggests that Tijuana is lacking in this area. This hampers San Diego companies that might be interested in purchasing comprehensive manufacturing services in Tijuana. Currently there is only one major contract manufacturer with a facility in Tijuana, Jabil Circuit, and at this moment its production is dedicated to only one customer. Contrast this with Guadalajara, which has several major contract manufacturers, including Jabil, SCI Systems and Solectron (Friedland and McWilliams 2000). While there are other smaller-scale contract manufacturers in Tijuana, most of them are still rooted in the twin-plant model and have limited supply chain capabilities at best.

Whether government initiatives can be used to correct this situation is debatable. According to Lowe and Kenney (1999), Mexico's first phase of consumer electronics industry development in the 1960s failed for reasons that had little to do with government policy. The relatively advanced state of Guadalajara's electronics and computer industries, compared with Tijuana's, is in large part due to the longstanding presence of companies such as IBM, which has been in Mexico since 1957, and Hewlett-Packard, which started manufacturing in Guadalajara in 1982 (Bruner 1997). By comparison, Tijuana's Asian electronics investment boom has been almost an overnight phenomenon. The most important things Mexico's federal government can do in this respect are at the macroeconomic level — maintaining financial stability and investing in education and infrastructure. The existence of a stable climate for both foreign and domestic investment and a well-educated workforce will go a long way in helping Tijuana follow in Guadalajara's footsteps.

Another problem holding back the growth of advanced electronics contract manufacture in the region is the lack of adequate cargo transportation infrastructure. Speed is increasingly important in inter-company - electronics manufacture; in addition to labor costs, easy access to air transport hubs is a major factor in industries such as personal computers and other electronics contract manufacture (Curry and Kenney 1999). According to Erie (1999), the region lags far behind Los Angeles and the San Francisco Bay area in existing air and sea transport infrastructure and in transport infrastructure investment. Without adequate air transport capabilities, there is little incentive (and a great deal of risk) associated with major contractors, such as SCI Systems and Solectron, locating facilities in San Diego or Tijuana. The area could run the risk of being a niche player in the production of products like televisions, in which air transport is less of a factor.²

San Diego-Tijuana Manufacturing Linkages

² Interestingly, at least for some products, the border zone seems to hold no distance-based advantage over Guadalajara. According to a recent article in *The Wall Street Journal* (Friedland and McWilliams 2000), contract manufacturers like Solectron, Jabil, and SCI Systems who do OEM production for companies like Cisco, Compaq, and Ericsson have located in Guadalajara because of the prohibitive costs of air freight from Asia.

There are essentially few compelling reasons for large-scale manufacturers, particularly in the important electronics subsector, to locate in either San Diego or Tijuana in order to gain access to the manufacturing resources of the other city. The organizational logic of technology industries as it pertains to location is not primarily driven by the need for physical proximity between the different participants in the value chain. Location near key transportation hubs, low manufacturing costs and an available labor pool with the requisite skill and education levels are far more important in an industry with products that are usually small and easily transportable. In the PC industry, for example, proximity to markets and distribution channels has proven to be far more important than proximity to the component suppliers that ship many components to assemblers by air (Curry and Kenney 1999). Although an increasing number of PC components manufacturers are locating in Mexico to be near the major U.S. assemblers, “near” in this case usually means at least several hundred miles away.

Over the years, economic boosters on both sides of the border have promoted development of the maquiladora industry on the premise that plants in Tijuana would likely have counterparts located close by in the San Diego area. A similar argument was also made during the campaign for the passage of NAFTA. Moreover, as each year passes the social and political ties between the two cities become stronger and more complex (Curry 1997). Yet by most accounts there are still few supply-chain linkages between San Diego and Tijuana.

Companies such as Kyocera and Sony, which have major facilities in both San Diego and Tijuana, stand out as exceptions. According to The San Diego Union-Tribune (Calbreath 1998), in 1997 Tijuana’s maquiladoras spent about \$10.8 billion on inputs, with about 60 percent of that going to Asia. Another study cited in the article found that Asian maquiladoras sourced only 5 percent of their inputs from San Diego companies. Recent discussions with non-electronics maquiladora managers indicate that much of the trade (in subsectors such as furniture) flows between Tijuana and the Los Angeles area. Those San Diego area companies that do have supply linkages to Tijuana (the Western Maquiladora Trade Association [WMTA] estimated there are about 150) are concentrated in small niches and services such as printing and cleaning equipment. According to the WMTA, they accounted for only about \$416 million in trade in 1997. Interestingly, a recent article in The Wall Street Journal (Millman 2000) reports a surge in regional service companies (laundry and coupon processing, for example) that have located facilities along the border in Tijuana and Mexicali.

The reasons for the paucity of supply-chain linkages between Tijuana and San Diego are varied. Part of the problem is that the organizational logic of the electronics industry does not necessitate linkages between the two cities (discussed at length above). Another problem is the lack of air cargo transport capability, which attenuates the kind of regional electronics industry growth that could foster more integration between San Diego and Tijuana. Still another problem is caused by the barrier effects of the border itself, thwarting the possibilities for linkages between small businesses, which have fewer resources to deal with border hassles.

Perhaps the most vexing problem is a lack of awareness of the border zone’s potential on the part of many regional businesspeople, particularly on the San Diego side. The kind of regional consciousness about the economic potential of the border that is common in places like Texas is not strong in the San Diego area, particularly in the northern reaches of the city and county. Many San Diego managers and executives have migrated from elsewhere and are not always well informed about the economic structure of the binational region. This is illustrated by the recent efforts of the San Diego Padres to extend their marketing reach into Mexico, which seem a long overdue effort for a business whose primary market is the region. According to Carol Zabin, who wrote a UCLA study of

the plastic injection mold business in Los Angeles (which is rapidly losing markets to Tijuana companies): "Backward linkages are being created. The boom in Tijuana, which is tremendous, is bypassing Southern California. Potential suppliers in Los Angeles and San Diego aren't paying attention. They have their heads in the sand. They're not keyed into a market which they could be positioned for" (quoted in Calbreath 1998).

Policy Recommendations

Whether or not either side may want to admit it, San Diego and Tijuana have a mutual regional interest. The economic health of each side is critical to the other, whether considered in terms of society, culture, or environment. Mexican economic crises have had devastating effects on many local businesses in San Diego, particularly in the southern part of the county. As Ohmae (1995) argues, in a borderless economy, places like San Diego/Tijuana are natural economic regions. This is a situation that has gained increased recognition on the part of policy makers and community leaders. Yet the reality is that the two cities are still far apart in many ways.

Any policy approaches for developing and strengthening the region's binational manufacturing base must start with strengthening ties and interaction between San Diego and Tijuana generally. Initiatives that are viewed as having cultural, social and retail functions, for example, are also important for manufacturing. Chief among these is the reduction of the barrier effects of the borderline. The border effectively wastes thousands of hours of economically valuable time every day and generates additional transportation and communications costs. Central government concerns (on both sides) over the integrity of the border must be balanced against the region's need for a border that, in economic terms, is nearly invisible. In the same way that community policing strategies attempt to reduce crime by concentrating on a series of incremental efforts which eventually add up, basic measures that make it easier for potential intra-regional linkages of all kinds to develop must serve as the basis for any coherent approach to strengthening regional manufacturing linkages.

For San Diego, policy approaches should concentrate on small and mid-level manufacturing. For the foreseeable future, it is unlikely that new large-scale manufacturing industries, such as aircraft or aerospace, will locate or develop in San Diego. On the other side, Tijuana needs to find ways to encourage the development of small manufacturers, particularly as suppliers to the large electronics companies. Both cities should also look at the potential for those knowledge-based companies usually thought of as service companies. Cross-border contracting relationships in this area could save costs for San Diego companies while providing an opportunity for entrepreneurs to create small businesses with minimal startup costs.

Specific policy suggestions are listed below:

Mexico-Side Initiatives

- Target potential technology-related growth areas that complement the television-led electronics sector for promotion and development. Such industries might include personal computer and PC component production, software development or Web development.
- Implement a strategy to develop electronics contract manufacturing at all technology levels and at all levels of production scale. A key component of this strategy should be the upgrade of air cargo transport capabilities.

- Seek more government funding for education in general and for business and technical education in particular.

San Diego-Side Initiatives

- Work with (and donate money to) Tijuana and Baja California educational institutions to promote entrepreneurial and technical education.
- Target small manufacturing industries such as musical instruments, sports equipment, custom manufacture or small-lot electronics goods for promotion and growth.

Tijuana/San Diego Joint Initiatives

- Promote the potential joint advantages of the region to both global and local manufacturers.
- Augment San Diego's and Tijuana's cargo transport capabilities, particularly air cargo at the Rodriguez and Brown Field (Otay) airports. Develop a joint strategy for both airports.
- Seek the creation of a small-scale manufacturing base capable of meeting the needs of small-scale development and manufacturing companies in the San Diego region. Work with San Diego to promote the potential regional advantage for twin-plant-type linkages in the small electronics and non-electronics manufacturing subsectors. Such promotional efforts should be aimed at businesspeople both within and outside the region. Investigate the potential for the creation of subcontracting linkages in the areas of computer programming, software development, data services and Web development for promotion and development.
- Lobby both governments for small business development funding in Baja California. Areas to target might include: 1) indigenous suppliers to TV and other electronics and appliance manufacturers, 2) "services" such as data processing and software development of all kinds, including Web development, and 3) twin-plant-type arrangements with regional small or medium-size manufacturers, including small-scale subcontracting.
- Reduce, as much as possible, those aspects of the border that serve as a barrier to both commerce and potential commercial synergies. These include, but are not limited to, reducing wasteful border wait times in both directions, enabling "local-rate" cross-border telephone and data communications, encouraging cross-border communication (seminars, parties, conferences, etc.) among young professional, managerial and technical personnel working in Tijuana's maquiladoras and other local business with their counterparts in San Diego, encouraging foreign managers of Baja California-based facilities to live and/or spend more time in the Tijuana/Baja California area, and requiring Spanish instruction for all San Diego school students and English instruction for all Tijuana school students.

Conclusion

Manufacturing will account for a smaller proportion of San Diego's economy in the future and will remain important for Tijuana in the future. It is unlikely that a new large-scale high-value-added and high-employment manufacturing industry will locate in San Diego in the reasonably near future. Tijuana needs to find ways to insert indigenous companies into the global commodity chains that pass through the region. San Diego needs to concentrate on nurturing and developing the small-scale specialized manufacturing that already exists in the region. The efforts of both sides would benefit from an integrated approach to reducing the barrier effects of the border and bringing the two sides closer together. The growth of small-scale manufacturing linkages between San Diego and Tijuana has the best chance to develop in an environment where the costs of cross-border interaction are as low as possible. The region needs to find ways to unite the Information Age entrepreneurship of San Diego and the pent-up entrepreneurial possibilities of Tijuana to create a unique and globally significant partnership.

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