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LOGISTICS ISSUES IN MAQUILADORAS

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INTRODUCTION

Co-production, production sharing, in-bond manufacturing, outsourcing and similar terms are common in today's business. The heart of these operations, regardless of the name used, is a make or buy decision. Should a company "make" its product domestically or should it "buy" those aspects of product finishing that can be procured more efficiently from an outside vendor? Increasingly businesses are answering in the latter through twin plants operating across international borders.

Division of production responsibilities between paired plants generally is split along the lines of comparative advantage between domestic and foreign locations. Capital intensive processes tend to be performed in the domestic operation. More labor intensive processes in the production of goods are performed in the foreign half of the twin plant operations.

The primary advantage of coproduction is the labor savings it affords the business. Real labor costs in the United States tend to be higher than wages in many other parts of the world, particularly labor costs in Asia, the Caribbean Basin, and Mexico. The labor costs in selected countries in these areas is shown below in Figure 1.

Figure 1
Relative Labor Costs in Selected Countries

(December 1986)

Country	U.S. $/Hour
Korea	3.65
Taiwan	2.95
Singapore	2.30
Hong Kong	2.05
Jamaica	1.25
Costa Rica	1.05
Dominican Republic	0.95
Mexico	0.89

Source: "Study: Labor Costs More Competitive," The Journal of Commerce, November 16, 1987, p. 5A

Quite clearly, Mexico has among the lowest labor costs in the world. In addition, it shares a 1,900 mile border with the U.S., one of the largest markets in the world. These two factors have combined to make twin planting on the border, or maquiladoras, one of the world's fastest growing industrial sectors in the world. Maquiladoras now produce some $7.2 billion worth of goods and services at over 1,400 plants, employing 350,000 persons in the Mexico side of the border and some 500,000 on the U.S. side of the border. Conservative forecasts for real rates of growth in maquiladoras are in the range of 8 to 12 percent per annum

Officially, "maquiladoras" do not exist under either U.S. or Mexican law. Rather, each nation has independently enacted trade preference and enhancement laws, which when combined, allow firms to operate a twin plant. Mexico's law is founded in the Border Industrial Program (BIP) enacted in 1965, later broadened to include the entire country under the Mexico Industrialization Program (MIP). The BIP/MIP permits foreign nationals to maintain 100 percent ownership of the plant in Mexico, instead of the traditional minority position in a joint venture. Alternatively, firms may opt for minority positions or even avoid an equity stake entirely by subcontracting to a Mexican firm under a shelter program. Regardless of the means of entry, maquiladoras can import their machinery, equipment, spare parts, raw materials and components into Mexico on a duty free basis for the assembly or manufacture of goods. The complement to the BIP in the U.S. is found in the Harmonized Tariff Schedules of the United States (HTSUS), formerly the Tariff Schedules of the United States(TSUS). HTSUS Item 9802.00.60 (TSUS Item 806.30) and HTSUS Item 9801.00.1010 (TSUS Item 807) are the most important provisions. Some maquiladoras also take place under HTSUS Item 9802.00.40 (TSUS Item 806.20), but this is still a relatively small sector. Although each tariff item covers a different trade, they are alike in that goods returned to the U.S. from Mexico are assessed duties only on the value added in Mexico.

It is important to note that HTSUS 9802.00.60/9801.00.1010 (TSUS 806.30/807), were first provided for in some form by the Tariff Act of 1930, as amended by the Tariff Simplification Act of 1956, and further amended in 1963 and 1988. The U.S. has always defined a special dutiable status to U.S. goods initially exported and subsequently returned to the U.S. after value has been added in another country. These tariff items are at the heart of production sharing, whether it be on the U.S.-Mexico border, in Southeast Asia or in the Caribbean Basin. Maquiladoras do not have exclusive use of value added duties.

Maquiladoras do however, enjoy logistics advantages vis-a-vis more distant twin plant locations such as, Indonesia. Compared to wholly domestic operations, the logistics of co-production can be very complicated, even when the twin plant is as close as the Mexican border.

RESEARCH DESIGN

Maquiladora operations have received considerable attention across a broad spectrum of issues. Excessive labor turnover rates are a reoccuring problem. Organized labor contends that maquiladoras are taking jobs out of the U.S. Alternatively, some have argued that twin plants are exploiting Mexican workers. However, little attention has been given to the logistical obstacles faced by managers. The purpose of this paper is to examine logistics issues in maquiladora operations.

Twin plants represent an application of the systems perspective at work. In order to remain competitors, firms are having to globalize supply, manufacturing, and distribution. High labor cost industries in particular are being driven to offshore, low cost production sites. Production efficiency is bought, however, at the expense of logistical inefficiency.

Several hypotheses were tested. Foremost, is it possible that maquiladora operations will have higher logistics costs, including transportation, inventory, warehousing, order processing, documentation and packaging, than wholly domestic operations. In addition, production costs associated with maquiladoras will vary in terms of quality control, scrap and waste rates, preventive maintenance and engineering changeover costs. So long as increased costs in the aforementioned areas are more than offset by labor savings, then firms operating maquiladoras should evaluate the operations as successful.

Each of these research questions was addressed through a mail survey questionnaire. The sample for the study was obtained from the 1987 Maquiladora Directory which is published by Mexico Communications. This publication provides the names and addresses of companies having these plants in the U.S. and Mexico. The sample populations were from companies having maquiladoras near Tijuana, California; Nogales, Arizona; El Paso, Brownsville and Laredo, Texas. The total sample from the U.S. side was 570 companies. The average number of operations in Mexico is 2.4 plants. Of the 570 companies surveyed, 100 questionnaires were undeliverable due to the company being closed. Therefore, the true sample was 470 with responses from 97. Thus, the study had a 20.63 percent return rate which is acceptable for this type of survey.

The intent of the survey was to collect data on: 1) general operations information, 2) maquiladora products, 3) logistics and production costs for the company and 4) supplier issues. Section I of the survey assessed the types of firms and briefly described their operations. Section II examined the impact of maquiladora operations on company production and logistics costs. The questions were designed to compare twin plant operations to wholly domestic U.S. operations. Section III explored issues of supplier performance, selection and quality. Again, the comparison was to domestic operations. The survey was based on a modified Likert scale and provided response categories for the respondents.

DATA ANALYSIS

Companies with low labor to total cost and to sales ratios would not be likely candidates for twin plants. Maquiladoras offer the greatest opportunity to labor intensive firms. Respondents were asked the relative proportion of total operating costs accrued in production, marketing, logistics, and administration (see Figure 2).

Figure 2
Total Operating Costs

Activity	Percent
Production	66.66
Marketing	06.47
Distribution/Logistics	09.33
Administration	14.94

Not surprisingly, twin plant operators tend to be production driven, with two-thirds of total operating costs incurred in production. Marketing and logistics costs are rather insignificant in comparison, each accounting for less costs than administration. Labor versus logistics tradeoffs then are a major part of maquiladora operations.

Overwhelmingly, respondents indicated that maquiladoras provide lower total production costs than comparable domestic operations (see Figure 3). The nature of some of these savings proved somewhat surprising (see Figure 4). Labor costs were cited as significantly lower by the vast majority of respondents, which was not unexpected. In contradiction to a research hypothesis, though, respondents indicated that quality control, scrap and waste, preventive maintenance, and engineering changeover costs were the same as or lower than strictly domestic operations.

Figure 3
TOTAL PRODUCTION COSTS

RESPONSE	PERCENT
HIGHER	01.5
LOWER	93.9
NO OPINION	03.0

Figure 4
PRODUCTION COSTS

	SIGNIFICANTLY HIGHER	HIGHER	SAME	LOWER	SIGNIFICANTLY LOWER
LABOR	0.00	0.00	00.0	18.2	81.8
QUALITY CONTROL	01.5	13.6	15.2	43.9	25.8
SCRAP/WASTE	07.6	22.7	43.9	18.2	04.5
PREVENTIVE MAINTENANCE	03.0	09.1	34.8	45.5	04.5
ENGINEERING CHANGEOVER	03.0	18.2	37.9	31.8	03.0

The rather incongruous results are difficult to explain. Several followup interviews, taken from a convenience sample, were conducted to find a reasonable explanation for lower costs in these areas. Most managers who were contacted said that while the rate of incidence for these activities, e.g., scrap rates, may be higher for maquiladoras, their cost is lower. Labor is substituted for capital to the greatest extent possible in all areas of maquiladora operations, including quality control, maintenance and engineering functions. Labor savings extend beyond the immediate per unit production cost.

Questions regarding total logistics costs likewise yielded surprising results. Over one-half of all respondents found total logistics cost of maquiladoras ever lower than in domestic operations, while less than one-third found logistics costs to be higher (see Figure 5). This seems to convincingly refute the hypotheses that the cost of improved production is logistics inefficiencies.

Figure 5
TOTAL LOGISTICS COSTS

RESPONSE	PERCENT
HIGHER	30.3
LOWER	54.5
NO OPINION	12.1

Areas within logistics are not uniformly impacted by maquiladora operations (see Figure 6). Transport and documentation costs are decidedly higher. The long supply and distribution channels maintained by border operations account for increased transport costs. The need to manufacture in-bond and other administrative activities associated with international logistics explain higher documentation costs.

Figure 6
LOGISTICS COSTS

	SIGNIFICANTLY HIGHER	HIGHER	SAME	LOWER	SIGNIFICANTLY LOWER
TRANSPORT	10.6	47.0	22.7	13.6	04.5
INVENTORY	03.0	25.8	42.4	21.2	04.5
WAREHOUSING	04.5	16.7	33.3	33.3	06.1
ORDER PROCESS	00.0	12.1	48.5	25.8	06.1
DOCUMENTATION	12.1	39.4	24.2	15.2	03.0
PACKAGING	00.0	24.2	53.0	18.2	03.0

Warehousing and order processing costs of maquiladoras tend to be lower than in domestic operations. It is important to distinguish between the amount of each activity versus the cost of each activity. Follow up personal interviews indicated that generally more warehousing and order processing are required in the border. However, capital in the region is relatively inexpensive. The cost per cubic capacity, for example tends to be quite low.

It is difficult to generalize about the impact on inventory and packaging costs. Many respondents found these costs to be approximately the same as domestic operations. Approximately one-quarter of the respondents found these costs to be higher, while an equal number found the costs to be lower. Once again, the survey yielded answers inconsistent with survey hypotheses; on an apriori basis, it would be expected that these costs would increase with lengthening supply and distribution channels.

Respondents were asked more specific questions in several areas. One area of special interest is the amount of inventory required to support maquiladora operations. Firms were equally divided on inventory level impacts (see Figure 7). This appears somewhat inconsistent with earlier data which reported that only one-quarter found inventory costs to be higher.

Figure 7
INVENTORY REQUIREMENTS

RESPONSE	PERCENT
HIGHER	43.9
LOWER	47.0
NO OPINION	07.6

Again, the answer lies in distinguishing between amounts and costs. More inventory in terms of days inventory held was greater, but the carrying cost can be lower. Several border states have no or small inventory taxes. New Mexico levies none; Texas at 1.5 percent per annum. Inventory service costs along the border also tend to be quite low.

Extra days inventory held to support twin plants shows considerable variance. For those reporting higher requirements, roughly one-quarter reported carrying less than 5 extra days. Another quarter carried up to 10 extra days. A third quarter needed to hold up to 20 extra days. The remainder held up to 30 extra days of inventory. No respondent indicated the need to hold more than one month of extra inventory.

Respondents also were asked more specific questions about transportation. Transportation costs in Mexico were lower than in the U.S. for nearly twice as many firms as those who found costs to be higher. Note that this is an evaluation of the Mexican transport costs to support a maquiladora plant, which most firms found to be higher in total.

Under bilateral agreements between the two countries, it generally is not permissible for a U.S. tractor and driver to enter Mexico, although U.S. trailers supposedly can cross. However, Mexican drivers and tractors may enter U.S. commercial zones. Thus, firms must use a Mexican carrier to service the maquiladora plant. Low wage rates explain the low cost of these carriers. The rates are not accompanied by superior service, however, as stated by respondents who were asked to evaluate transport quality across several dimensions (see Figure 8). Unquestionably, the transport system in Mexico is lower in quality than the U.S. domestic system. At best, carriers were evaluated as equal to domestic counterparts. Normally, the carriers were worse than U.S. carriers, particularly in terms of transit times, on-time performance, and paperwork quality. Each would adversely affect inventory requirements, thus confirming the responses to the immediately preceding question.

Figure 8
TRANSPORTATION QUALITY

	SIGNIFICANTLY BETTER	SLIGHTLY BETTER	SAME	SLIGHTLY WORSE	SIGNIFICANTLY WORSE
TRANSIT TIME	00.0	06.1	33.3	31.8	13.6
ON-TIME PERFORMANCE	01.5	04.5	30.3	30.3	19.7
PAPERWORK QUALITY	00.0	03.0	37.9	25.8	15.2
LOSS & DAMAGE	00.0	04.5	59.1	10.6	09.1
INVENTORY ACCURACY	00.0	07.6	48.5	19.7	07.6

It also appears that the cost of transport inefficiencies must be escaping the reporting system to at least some degree. It is difficult to reconcile the evaluation of carrier performance with the fact that a majority of respondents found total logistics costs of maquiladoras to be lower than for domestic operations. This is especially true when combined with an evaluation of maquiladora vendors.

Supplier performance for maquiladora operations is relatively worse than for domestic operations (see Figure 9). Price is the only attribute on which vendors were rated as superior. Given the relative strength of the dollar and weakness of the peso, the result is not surprising. On all other measures, maquiladora vendors are relatively inferior to domestic vendors.

Figure 9
VENDOR PERFORMANCE

	SIGNIFICANTLY BETTER	SLIGHTLY BETTER	SAME	SLIGHTLY WORSE	SIGNIFICANTLY WORSE
PRICE	15.2	15.2	45.5	12.1	03.0
QUALITY	03.0	04.5	56.1	18.2	09.1
TECHNICAL CAPABILITY	00.0	06.1	50.0	22.7	10.6
DELIVERY	00.0	06.1	47.0	28.8	09.1
FLEXIBILITY	00.0	09.1	45.5	28.8	07.6

Vendor performance, like transport system performance, is consistent with and can help explain the extra inventory requirements to support a maquiladora plant. Companies can buy from local vendors and suffer the inventory consequences. Alternatively, maquiladoras can source from traditional vendors, primarily in the Northeast. In exchange for improved vendor performance, the firm must accept longer order cycle times, and therefore higher days inventory held, and transportation system costs. This is the relatively consistent pattern which begins to emerge from the research questions.

CONCLUSIONS

Globalization of production can be expected to continue and to do so at an ever increasing rate. Less developed nations and to some extent, newly industrialized countries represent a low cost labor pool that can be tapped by firms operating in high labor cost countries. These firms can allocate production among home and foreign plants along the lines of comparative advantage in the respective countries. As long as a complementary set of trade preference laws is in place, coproduction arrangements should flourish.

Mexico now is the fastest growing twin plant partner for the U.S. since trade preference on both sides of the border and a weakening peso have made maquiladoras a success based on almost any measure. Mexico's recent admission to GATT and the removal of Taiwan, Singapore, Hong Kong and Korea from the Generalized System of Preferences should provide further incentive to the already spectacular growth of the maquiladora industry.

Some have suggested that the growth is outstripping the ability of the logistics system. The results of this survey somewhat bear out this contention. Over three-quarters of survey respondents indicated that their maquiladora operators met or exceeded expectations. Many problems are well known to firms before opening a twin plant. A relatively unskilled workforce and high turnover rate should not take anyone by surprise, as the maquiladora sector enters its third decade. Both of these problems are being overcome through technology transfer.

Logistics problems may not be so easily overcome, however. If companies cannot match labor savings with material or product turnover, the savings from maquiladora operations may be illusory. This survey found that at least some of the labor savings are being paid back to increased logistics costs. At present, firms are still realizing a net gain on the border. At some point, though, logistical problems may offset the labor gain. Particularly congested points of entry, such as El Paso/Juarez, may soon choke on the bottlenecks created by the too successful maquiladora industry. These constraints, primarily logistical, must be overcome if coproduction is to continue to thrive on the border.

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