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Maquiladora Operations for Shipbuilding

IIIA-2

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ABSTRACT

The maguiladora program was established by the Mexican government to encourage foreign investment and promote industrial growth. The success of the program encourages more and more participation each year. The low cost of labor in Mexico has attracted companies in all types of manufacturing in the United States with the exception of shipbuilding. with the focus on the domestic shipbuilding market over the last 25 years, U.S. shipyards have lacked the impetus to establish a maguiladora operation. The world market for shipbuilding has been steadily improving, while the U.S. domestic market has been steadily decreasing. The opportunities for U.S. shipyards to focus their strategies on the world market may not get any better. By understanding the complexities of establishing a maguiladora operation and then integrating the operation into its overall production plan, a shipbuilder can begin to realize that large labor cost savings are possible.

INTRODUCTION

When a labor source exists on our southern border that costs less than one third of the existing labor in U.S. shipyards, why is it not being used? What is preventing U.S. shipbuilders from taking advantage of the maguiladora program that has been in existence since 1965? If the answers to those questions were easy, there would not be any need for this paper. In fact there are many economic and political reasons why the lower cost Mexican labor has not been used. However, the industry's focus on the domestic shipbuilding market is the single most probable cause. Competition for the Navy and U.S. flag construction programs have absorbed management's attention to the point that the complexities of using a foreign labor force have discounted its consideration. The changing picture of the world shipbuilding market and the potential cost savings associated with using a maguiladora operation to build ships in the United States are now worth refocusing a shipbuilder's market and operational strategy.

"Maguiladora tl is an extension of the name "maguilala" that was given to merchants in colonial Mexico who retained a portion of the product that they produced as payment for their services. Today, a maquiladora is a plant in Mexico assembling components of a product that will eventually be marketed and sold in the United States and/or throughout the world. It is also the overall operation of transporting materials from the U.S. to Mexico, assembling the components and then transporting the completed units back to the U.S. for sale. The operation has many forms and represents many national and international policies. The success of the maquiladora operations have made a dramatic impact on the economy of Mexico and improved the prospects of the free trade agreements between the United States and Mexico. For over 25 years manufacturers in the United States have been able to retain or increase their market share both domestically and abroad by taking advantage of the low cost labor market in Mexico through various forms of maguiladora operations.

This paper seeks to establish that a maguiladora operation is a viable means of lowering the cost of shipbuilding and changing the market place for U.S. shipbuilders. The challenges that face the shipyards as the domestic shipbuilding market shrinks and new opportunities open for a global shipbuilding strategy will be used as the framework for the discussion. The structure, related costs and role of a maguiladora as part of a shipbuilder's organization will be used to highlight the complexities associated with establishing an operation in Mexico. Finally, we will present a means of estimating the cost savings that can be expected by the use of a maguiladora. The example illustrates how a hypothetical shipyard can achieve a 25% savings in labor costs.

THE WARNINGS ARE CLEAR

It is becoming increasingly apparent that U.S. shipyards must be able to compete in the foreign market in order to survive. This means that they will have to find a niche market for a special type of ship, develop a much higher productivity, or reduce labor costs drastically. Other industries have turned to maguiladoras in order to cut their labor costs. Except for isolated examples, shipyards have failed to take advantage of this opportunity.

Since 1965, while other industries have developed over 2,000 maguiladora operations, the market for commercial shipbuilding in the U.S. has continually shrunk. A projection two years ago estimated that the size of the likely available commercial market for U.S. shipyards was only 7% of the potential market and that did not include selling to any foreign shipowners (1). Although that may be a minimally adequate market for the next 5 to 10 years based on the capacity of the remaining U.S. shipyards, it is unlikely that it will carry the industry into the twenty-first century. More recently, there have been several warnings issued to the U.S. shipbuilders. Some have been direct like the statement made by Tom Duncan, Managing Director of A&P Appledore (Falmouth, UK):

> "This is the biggest and most powerful country in the world, but it is also the most insular. You have got to get out and hammer the market overseas. You have got to think outside of this country, not within it. If you don't stand on your own two feet, YOU will perish." (2)

Indirectly, the large cuts in the Navy's new construction programs can be taken as a very significant warning. Other warnings have been in the form of U.S. shipowners making decisions to use service life extensions instead of paying the high prices for new construction ships.

These warnings have not gone unheeded. The industry is clearly making attempts to counter the downward trend, and everyone knows that defense dollars will not sustain the shipyards as they have in the past. Long range strategies have to be established to take advantage of current domestic and foreign market projections. When the requirements for establishing and using a maguiladora are analyzed, it becomes clear that, although there is a great potential for reducing labor costs, the substantial start-up and operating costs must be considered as part of a long range shipbuilding strategy. There is a perception that a shipyard could make use of the low cost Mexican labor on a short range project to cut its production costs. While there are several subcontractors with maquiladora operations that can provide -selected ancillary components such as deck fittings, doors, deck gratings and some outfitting equipment, we plan to address this paper to the shipbuilder who wants to develop a more comprehensive strategy to compete as a global enterprise.

OPPORTUNITY TO ENTER THE GLOBAL MARKET

The protected domestic market has been the principal source of new construction orders for U.S. shipbuilders for decades. With the decline in commercial orders since the early eighties, the increased competition among the shipyards for the Navy and U.S. Flag ships required all yards to continuously update their operations. The yards sought new ways to cut unit production costs including establishment of new production control methods, incorporating standard designs, implementing the processes of group technology, replacing out dated

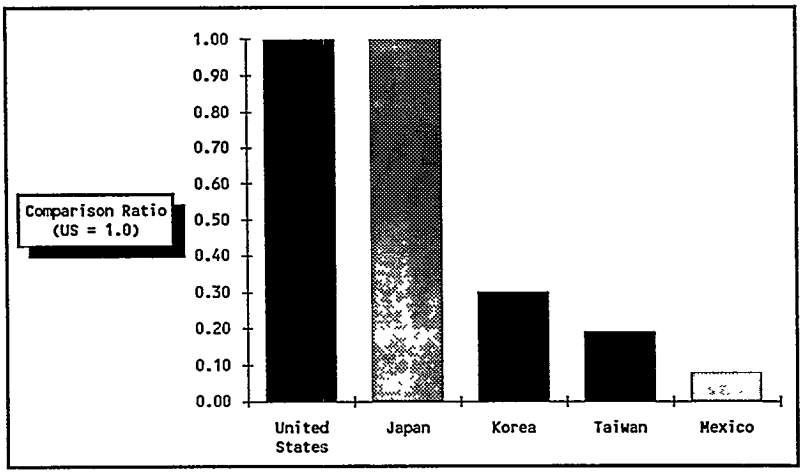

FIGURE 1
Wage Comparison

equipment with modern labor efficient machinery, and increasing the capacities of drydocks, cranes, and fabrication facilities. By the end of 1990 the surviving major new construction shipyards have significantly improved their competitive position with the Europeans with regard to productivity and capacity (1). Furthermore, the cost of labor differential has improved to the point where only the very low labor rates of the Far East shipbuilders remain below the average of U.S. shipyards (Figure 1).

Combined with the reduced demand for new ships in the 80's and the steady increase in the price of ship construction in the foreign shipyards, the downsizing and cost controls imposed by the ever narrowing domestic market have helped the U.S. shipyards to reach a better position in the world market. However, even though the continuous focus on the domestic market has helped to stabilize the cost of new construction, it still costs too much to have a ship built in the United States.

Recent projections indicate that there will be a new surge in the demand for replacements of Jones Act ships over the next ten years. This increase in the domestic market will coincide with a world wide increase in new shipbuildings. The annual projection of replacements for Jones Act ships represents only 2% of the projected world wide market. It also represents about 45% of the current commercial shipbuilding capacity of the U.S. shipyards. But, what appears to be a good opportunity for the shipbuilders has yet to materialize in orders on the books for the U.S. shipyards. New construction prices are still the major constraint to getting order books filled. Reduction of labor costs through the use of a maquiladora may provide the opportunity to bring the cost of new construction down.

Global Enterprise

Anticipating the capture of only 2% of the world market that satisfies less than 50% of the industry's capacity offers only slight improvement in the U.S. shipbuilding market. Expansion of the shipbuilding market will require U.S. shipbuilders to become global enterprises. Companies that undertake activities anywhere around the world in order to maximize their performance and enlarge market share can be considered global enterprises according to Robert B. Reich of Harvard University. He recently wrote that:

> "The new global manager's job is to exploit the opportunities created by the high-powered technologies of worldwide communication and transportation and by the relaxation of national controls over cross-border flows of capital." (3)

As a result of companies expanding their operations into the global market, the new boundaries for world economy are corporate and not geographical. This premise is illustrated by examples of corporations that have decentralized their operations to take advantage of the particular strengths of various global regions.

- Boeing's next airliner will be designed in Washington state and Japan and assembled in Seattle, with tail cones from Canada, special tail sections from China and Italy, and engines from Great Britain.

- The Mazda ME-5 Miata was designed in California, financed from Tokyo and New York, its prototype was created in Worthing, England, and it was assembled in Michigan and Mexico using advanced electronic components invented in New Jersey and fabricated in Japan (3).

In each case the products are broken down into cost elements and the components produced at the most cost effective location. For a global corporation this means establishing corporate entities in countries where the resources offer the best services for the lowest cost. The tendency is to site high value-added activities at the location where it is most cost effective.

Because of rapidly changing world political and economic events, every business publication today has at least one article related to the expansion of global corporations. The extent of the expansion is illustrated by the fact that when the foreign sales of U.S. owned companies are calculated against the total purchases by Americans of the products of foreign owned companies, America's trade deficit turns into a net surplus (3).

Competitive Advantage

Ships are not built on assembly lines like automobiles, but shipbuilders should look closely at the world wide organizations that have been established by the car makers. The U.S. automobile manufacturers have been able to retain their market share by moving operations such as engine production to maquiladoras. The Japanese have strengthened their market share by establishing assembly plants in the United States. Regardless of the product, a company that has a market outside of its own country must establish a long term global enterprise strategy. A key element in that strategy is removing the old ideas of centralization of control. The successful global corporations have decentralized their operations and repositioned their subsidiaries in other countries. Their strategies focus on placing each component of the operation

at a site where it best serves the overall company goals.

A global thinking shipbuilder could conceivably locate corporate headquarters to better service their customers, accomplish engineering at a site that offers both expertise and reduced overhead costs, prefabricate components in a region where labor is plentiful and cheap,- assemble and launch ships at the traditional shipbuilding site, and complete outfitting in a region where labor productivity is high. While a complete reorganization of a U.S. shipyard to this extent is unlikely in the near future, the fundamental aspects of a global enterprise should be included in the long range corporate strategy.

Launching a new long range strategy to lower the cost of ship construction by as much as 10% will give the shipyard a new competitive advantage. It will be necessary to gain an interim advantage over other U.S. shipyards to win the limited number of domestic contracts. This interim advantage will provide the opportunity to expand the operation to the global market.

CHALLENGES TO OVERCOME, DOMESTIC CONSTRAINTS

With the price of foreign shipbuilding rising faster than the price of U.S. constructed ships the opportunity for U.S. shipbuilders to enter the world market is good. The combination of projected saturation of the low-cost foreign shipbuilding capacity in the near future and the major productivity improvements in U.S. shipyards should make prospects better than ever. There is also a good opportunity to use the current requirements for replacement of U.S. Flag vessels as a spring-board to further reduce building costs. A.E. Gibson proposed government assistance to build a series of petroleum product carriers to replace approximately 55 tankers engaged in Jones Act trade (4). It will probably be necessary to give the U.S. shipbuilding industry that kind of boost in order to be able to implement a global enterprise strategy.

Jones Act Ships

Although a maquiladora operation may have been considered by some of the U.S. shipyards in the past, the focus on the domestic market for Jones Act ships and U.S. Navy construction precluded any implementation. The regulations for building Jones Act ships have been too restrictive to warrant the effort. These regulations are quite specific; the work must be done in a U.S. shipyard. The major portion of the hull and superstructure must be fabricated and assembled in the United States. However, the current interpretation of the regulations may allow portions of the ship related to the secondary structures to be manufactured by a maguiladora.

Secondary structures may be defined as any item that does not affect the structural or watertight integrity of the vessel. This could possibly include equipment, furnishings, non-watertight doors and windows, stairways, railings, miscellaneous deck fittings, joiner bulkheads and machinery foundations.

The federal regulations also restrict the size of the portion of the ship that is foreign built. If the weight of the foreign built components represents a "considerable part" of the overall weight of the structure then the ship will not qualify for coastwise trade. However, there is no established standard for the ratio. The Coast Guard Vessel Documentation Division considers each case uniquely. In the case of whether a vessel was rebuilt at a foreign shipyard, the Documentation Office recently considered hull replacements of less than 1% of the total hull steel to be small enough that it did not qualify as a rebuilt vessel (5). However, the ruling implied that each case would be ruled on its own merit and another request for documentation with only 1% of the hull weight built overseas may be denied.

As the regulations are currently interpreted for Jones Act vessels, it will be difficult to use a maguiladora for any thing other than some of the secondary structure. The amount will have to be determined on a case by case basis. However, it seems that a case could be made to utilize a maquiladora to construct structural subassemblies as long as the final assembly and erection of hull and superstructure modules were done in the U.S. shipyard.

U.S. Navy Construction

The other source of work for the shipyards has been the U.S. Navy. While the Navy contracts are governed by the Buy American Act, security requirements and convenience have been principal reasons for not using maquiladoras on the government contracts. For the last ten years all yards have focused on winning the numerous Navy contracts. The government has been willing to pay the high labor and overhead rates in the U.S. yards. Contract modifications are negotiated at labor rates that allow the shipyard a reasonable profit. The Navy contracts, particularly the fixed price work, have promoted many cost cutting measures in the shipyards, but these measures have been aimed at finding ways to get below the costs of another U.S. shipyard. While the efforts to improve productivity and facility efficiency have helped, they have failed to reduce the costs enough to allow access to the foreign markets.

Opportunities for Macuiladoras

For a U.S. shipbuilder to invest the time and capital to develop a maquiladora, it will be necessary to include both foreign and domestic markets in the shipyard's long range strategy. Likelihood of success in the domestic market can be improved by the ability to use the maquiladora to build components for Jones Act ships. Such success will better position the shipyard to accomplish its goals in the global market. Once the maquiladora is incorporated into the long term operation of a shipyard, a distinct competitive advantage will have been gained over other U.S. yards. The commitment to establish a maquiladora will involve considerable risk, planning, legal transactions, and financial obligations. On the other hand, the success of other industries in the maquiladora program and the potential for substantial cost reductions make the program an attractive solution for both ship owners and shipyards to reduce the cost of shipbuilding in the United States.

From a technical perspective, shipyards should be able to make extensive use of a maquiladora operation. Since approximately one third of the cost of building a ship is labor, any scheme that reduces the cost of labor by over half will be beneficial. A maquiladora would fit into a ship construction operation in the same way that U.S. shipyards now utilize other shipyards and major subcontractors to build subassemblies of ships. The principles of block construction require the shipyards to develop material flow plans within their facilities that optimize the transport of blocks and sub-assemblies to the erection site. Applying these production planning techniques to a maquiladora operation should require minimal change to the current advanced shipbuilding procedures that have become the norm in all shipyards.

The opportunities for using a maquiladora are not unbounded. Many of the same reasons that faced other industries and probably have kept shipbuilders away still must be overcome. Labor relations at home, initial investment costs and risks, and the anxiety of an unknown labor force have restrained corporate executives from establishing a maquiladora. Although these problems still exist, favorable conditions exist today that should ease the maquiladora process. More and more labor organizations are recognizing that the real competition in any industry is from overseas corporations and that the maquiladora program has established a good reputation in the last ten years as being a solution for industries in trouble. In most cases the U.S. based companies have been able to retain or even expand their U.S. work force by moving some of their operations to Mexico.

The decline of the shipbuilding industry is well recognized by workers and management, and shipyard labor has shown more willingness to accept new programs. By planning and presenting a maquiladora operation as part of the long term solution to the shipyard's workload, there is greater potential for improved workload and increased capacity when the cost of construction is competitive with other countries. The real opportunity for using a maquiladora for shipbuilding may be that there is no better time than the present to establish one.

MAQUILADORAS: WHAT & HOW MUCH?

For those who do not live along the southern border of the U.S., the term "maquiladora" may be new. However, anyone who has followed the plight of the automobile and other heavy industries over the last 20 years is well aware that they went to Mexico to seek ways to reduce their production costs. Ford Motor Company recently announced plans to spend $700 million to expand its 9 year old motor manufacturing plant to increase capacity to 500,000 engines annually. General Motors will also open four new plants for its electrical subsidiary to produce automotive electrical cables (6). As Table I shows, heavy industry related work represents approximately 35% of the maquiladora operations. Companies in all fifty states now participate in the maquiladora program.

TABLE I
Heavy Manufacturing in Maquiladoras (7)

INDUSTRY	PERCENT OF ALL PLANTS	PERCENT OF ALL EMPLOYEES
Transportation Equipment and Accessories	9.5%	19.6%
Electric and Electronic Machinery Equipment and Apparatus	7.1%	15.6%
Other Heavy Manufacturing	18.4%	12.3%

Successful Program

The growth of the maguiladora industry reflects the commitment that the Mexican government has made to the program since it was first established in 1964. The objectives of the program were to create jobs for the areas of high unemployment that were affected by the discontinuation of the Bracero Program and to promote industrial development along the U.S./Mexico border. The new policies that promoted these objectives allowed duty-free import of equipment, materials, machinery and component parts for assembly or processing within a twenty-kilometer strip along the border, provided that all imported products were reexported.

Since the program's inception there have been several revisions. Maguiladoras are now exempt from the requirement of Mexican majority ownership and are allowed 100% foreign ownership. The original 20 kilometer area restriction has been lifted and maquiladoras can be located anywhere with approval of the Mexican authorities. Foreign technicians and managers are now allowed to reside in Mexico and customs procedures have been eased. New industrial parks are now promoted to entice more industries into the maquiladora program.

The U.S. tariff laws for lesser developed countries support the maquiladora program. By allowing preferential duty treatment for products from developing nations, the Customs Tariff Regulations give the maquiladora program a boost. The only duty charged for goods manufactured in a maquiladora is for the value added in Mexico. The value added is usually for labor, overhead, and profit margin.

Growth of the maquiladora program was slow at first. As Figure 2 shows, the program has accelerated since 1972 when the authorized zone was expanded to allow establishment of plants in economically depressed areas. The steady growth has meant a growth in skill levels. Maquiladoras are now second only to the oil industry in Mexican exports. In 1988 the foreign exchange generated by oil equaled $9 billion, maqiladoras $2.3 billion and tourism $1.6 billion (7).

The objectives of the Mexican government have been achieved. Over 450,000 jobs have been created, an industrial base has been established, and technology has been transferred. The Mexican government continues to seek greater use of Mexican sources for products, and it continues to simplify the process of starting and operating maquiladoras.

Despite its successes, there is still a perception within the U.S. that maquiladoras are only for low skill, highly repetitive assembly operations. In a recent editorial in the Wall Street Journal in support for the proposed Free Trade Agreement with Mexico, Rudiger Dornbusch, a professor of economics at Massachusetts Institute of Technology, noted that the low labor costs in Mexico reflect a low level of productivity and in some areas low quality (a). Unfortunately, these generalizations are often applied across all industries. If the productivity was truly as low as professor Dornbusch implied, then the maquiladora program would not be growing at the rate of over 10% per year. As demonstrated by the successful users of the program, proper management of the maquiladora can produce a high quality product from a very productive labor force.

Maquiladora structure

Ships are unique products that are built to very tight schedule. Even in a multi-ship building program the shipbuilder will be time constrained to complete each vessel. It is important to

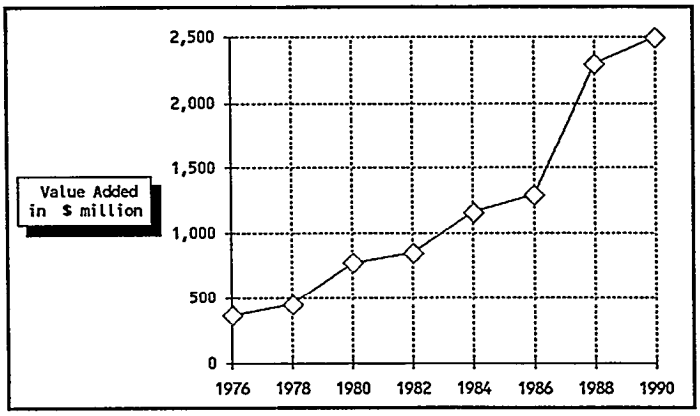

FIGURE 2
Growth of Maquiladoras (7)

maintain control over all aspects of new ship construction. This primary constraint will influence a shipyard to most likely consider full ownership of a maquiladora as opposed to using a maquila subcontractor or a sheltered maquiladora. of course the advantages and disadvantages of each type of maquiladora must be considered with regard to the existing shipyard's capacity and availability of capital.

Maquila Subcontractor. A shipyard may subcontract to a company that has a maquiladora operation. This is currently being done rather successfully on a small scale. To the shipyard there is not much difference from subcontracting to any other company. The maquiladora subcontractor will probably have an office or shop in the U.S. and a production plant in Mexico. They contract to provide the product as any other subcontractor, and the shipyard only has to carry out the normal inspection plan of the subcontractor's work. Although the shipyard will see a lower price from the subcontractor with the maquiladora operation, the difference will not be significant. After all. the maquiladora subcontractor will be pricing his work just below his competition operating in the U.S.

Using a subcontractor is the easiest way to take advantage of a maquila's low cost labor, and it has the fastest start-up to production work cycle. The subcontractor provides the maquiladora plant, labor force, and handles the import/export procedures. As with any other subcontract for ship construction, the shipyard or the subcontractor may provide the raw materials or components for the manufacturing process. The procedures for supplying materials, work schedule, and quality assurance requirements will depend on the work specification and the contract between the shipyard and the maquiladora. The shipyard only has to pay for the finished product while the subcontractor usually assumes most of the financial responsibility. Of course, the shipyard gives up some control of the production and must utilize its own management to ensure that the quality of the product meets the work specifications. The greatest disadvantage to subcontracting for maquiladora work is that the cost savings is the smallest of the three alternatives.

Sheltering. Using a sheltered maquiladora is similar to subcontracting, but the shipyard will be dealing directly with the maquiladora operation. In effect the middle man, in the form of the subcontractor's U.S. office or shop, is eliminated. Another way to consider sheltering is that the shipyard will specify the required work to be done in a maquiladora plant. A sheltered maquiladora is usually established to provide assembly services for a variety of customers. Payment is usually based on piecework, hourly, per worker basis, or some other fee arrangement. Whether or not the shipbuilding industry can find a suitable sheltering arrangement in Mexico is unknown. Currently, sheltering primarily services the electrical and electronics industries where one shop may have several customers requiring similar worker skills.

Sheltering offers a way to start small and limit the legal and financial involvement of full ownership. The Mexican "partner" in the shelter arrangement handles the legal and financial requirements to establish and operate the maquiladora, while the shipyard has more input to the labor force and manufacturing equipment. However, as with subcontracting, the shipyard has limited control over the production schedule and must still share the benefits of the lower labor costs. In the long run sheltering may be more expensive than full ownership.

Full Ownership. In consideration of the long term strategy of using a maquiladora operation, a shipyard mill probably establish that full ownership is best and has the greatest benefits. However, it requires that the shipyard establish a subsidiary as a Mexican corporation and satisfy all the requirements established by the Mexican government. The parent company assumes full control of the maquiladora and carries the financial burden of establishing the operation. The maquiladora is usually operated as a cost center to minimize the tax liabilities, and the parent maintains control of the profit margin. The maquiladora program encourages 100% ownership by the foreign company, and the real estate laws provide for direct land ownership or establishment of 60 year trusts for the land adjacent to the border or along the coast.

The disadvantages are similar to expanding an operation to a neighboring state in the U.S. It requires a long term commitment with the associated risks and visibility. The Mexican corporation is subject to all the Mexican regulations, permits, labor laws, and taxes. The shipbuilder must consider buying or leasing the facilities, importing the machinery, hiring management and work force, training the work force, and maintaining the plant and equipment. Although not necessarily a limitation to the primary function of the maquiladora for a shipyard, the maquiladora owned by a foreign company may be restricted to selling no more than 20% of its production in Mexico.

Cost Factors

The Mexican government has continually sought ways to improve the

TABLE II
Operating Cost Comparisons (7)

ITEM	MEXICO	UNITED STATES
Electricity	$.035-$.06/kwh	$.07-$.12/kwh
Water	90% of U.S. cost	100%
Natural Gas	65% of U.S. cost	100%
Gen'l Construction	$lO-$20/sq.ft.	$25-$60/sq.ft.
Lease Costs	50-80% of U.S. cost	100%

maquiladora program and make it easier for foreign countries to take advantage of the low cost labor. Combined with favorable U.S. tariff regulations, they have successfully met their primary objectives for the maquiladoras. The Mexican regulations related to maquiladoras are very similar to U.S. federal and state corporate regulations. With the exception of the Mexican Federal Labor Law, the establishment of a maquiladora requires similar cost considerations as a company would face setting up a new subsidiary or division in another state. The following cost factors will become part of the overall decision for the establishment of a maquiladora. For some of the factors a definite dollar value can be established while others can only be treated subjectively as to how they will affect the cost of the overall operation.

Financing. The process of obtaining financing and considering the assignment of inventory and assets is similar to establishing any expansion program. Most financing of a maquiladora is done through U.S. sources with the parent company. It is difficult to get Mexican financing to establish a maquiladora because the assets are usually owned by the foreign parent corporation, and operating as a cost center, it will not show revenue. Since the hard assets are located in Mexico, another foreign bank will not usually provide financing. But opportunities are available for joint ventures with private Mexican corporations which can arrange financing through Mexican institutions.

Operating Costs. The cost of operating a maquiladora plant will usually be considerably less than operating a plant of similar size in the United States. Land prices, construction costs, leasing rates and utility rates which may often be less than half of similar costs in the U.S. are dependent upon the location of the maquiladora. The maquiladoras operating along the California and Arizona borders are seeing land values and lease rates comparable to the U.S. side of the border. The construction and utility costs for this same area are similar to the rates shown in Table II which provides a comparison of the typical operating costs for a maquiladora (7).

Direct Labor Costs. The maximum number of straight time hours that an employee may work each week is 48 hours on the day shift, 45 hours on the second shift, and 42 hours on the night shift. Up to 9 hours exceeding these maximums require 200% premium pay and 300% premium pay for overtime exceeding 9 hours in any week. Most employers operate on five work days of 9.5 hours each day. The employees must be given one day of rest per week. The range of direct labor rates is presented in Table III.

Vacations and Holidays. There are 7 required holidays and the vacation requirements are similar to U.S. companies, except that employees must be paid an additional 25% of their regular pay during their paid vacations.

Bonuses. A year end bonus of 15 days salary must be paid each employee by December 30 of each year. In addition, each company is required to distribute 10% of its annual taxable income to its employees. First year companies are exempted from this requirement. The profit sharing bonus is required within 60 days of paying taxes. Since most maquiladoras operate as cost centers, an additional bonus is paid to supplement the profit-sharing distribution.

Social Security. The employer pays a registration fee of 16.6% of each employee's salary that is subject to social security. This fee relieves the employer for liability in connection with job-related illnesses or accidents, and provides certain medical and insurance benefits to the employee and his dependents.

TABLE III
Comparison of Direct Labor Rates ($/Hr)

COUNTRY	UNSKILLED	SKILLED
Mexico	$0.95	$3.50
United States	$7.00	$15.00

TABLE IV
Maquiladora Tax Obligations (7)

TAX	RATE	APPLIED TO	REMARKS
Corporate Income	35%	Taxable revenues based on services provided.	Deductions similar to U.S. taxes.
Corporate Asset	2%	Assets recorded to maquiladora.	Depends on how parent assigns plant machinery.
Value Added	6-16%	Products & services bought in Mexico.	Goods & services used by the maquiladora.
Payroll Tax	1%	Total of salaries & wages paid each month.	Several Mexican states also levy similar tax.
Real Estate Acquisition	10%	Adjusted base value of real estate.	Adjustment based on minimum wage in district.
Property	Varies	Registered value of real estate.	Levied by Mexican states.
Individual Income	Varies	Taxable income.	Type of visa determines rate.

Housing. Employers must pay 5.22% of the wages to the Federal Workers Housing Fund to assist in providing housing for employees.

Bonding Procedure. The amount of the corresponding import duty and any fine or penalty that could result should the imported goods (temporary imports) not be returned within the authorized time period must be guaranteed with a bond. If the maquiladora establishes itself as financially solvent, temporary imports require a bond for 40% of the import duties and value added tax on the raw materials and components plus possible fines and surcharges; imported machinery and equipment require a 60% bond. The cost of a bond is usually 1% of face value. Payment of import duty may also be guaranteed by pledge of machinery and equipment or a mortgage of the real estate held by the maquiladora.

Taxes The Mexican tax requirements are similar to the federal and state taxes in the U.S. They can become significant expenses and must be carefully considered when structuring the organization of the maquiladora. Most parent companies organize the maquiladora as a cost center to minimize the income and corporate asset taxes. Corporate decisions regarding the relocation of managers, supervisors and technicians and the type of visas that they obtain will affect the amount of the individuals' income taxes. Table IV summarizes the tax obligations for a maquiladora (7).

Complexities

Labor Relations. The Mexican immigration law provides that no more than 10% of the work force may be foreigners, but exceptions have been made for maquiladoras. They may bring in a unrestricted number of foreign technicians, supervisors, and managers. The number of foreign hourly employees is restricted by the immigration quotas with the exception of employees brought in to conduct a training program. Visas for either temporary (six months at a time) or for permanent immigration of managers and dependents to live and work in Mexico are relatively easy to obtain.

One law, the Mexican Federal Labor Law, governs all labor matters. It regulates the employer/employee relationship and details minimum working conditions and benefits. Mexican federal and state labor boards have jurisdiction on all labor matters arising within their limits.

All employees work under a contract either as an individual or collective relationship with the employer. If the employer has not entered into a collective bargaining agreement with a union, each employee is automatically considered to have an individual relationship or contract with the employer. The relationship may either be temporary for a specified period of time or permanent for an indefinite period of time. If the relationship is not in

writing at the time of employment, a permanent relationship is assumed. The principal difference between the two relationships is that with a written contract for a temporary relationship, the employee may terminated without justifiable cause and financial obligation. No written contract is required, but the Labor Law considers the employee to be under contract according to the law. Written contracts are highly recommended should disputes go before a Labor Board. (Generally, permenant employees terminated without justification are entitled to 3 months severance pay plus 20 days pay for each year worked. If dismissed for justified cause, the worker is entitled to accrued pay and unused vacation pay and seniority benefits.)

Mexican Unions. Mexican labor laws clearly benefit the workers. An employer must provide detailed documentation of reasons why a worker should be fired and will have to pay the worker severance pay. Labor unions exist primarily to negotiate wages and influence the Mexican Congress for labor related legislation. The strength of labor unions varies with the location of the plant. Unions are strongest along the Texas border. Experience in maquiladoras has shown that maintaining wages for skilled workers above the average for the area has improved performance and workforce stability.

Turnover. Turnover rates up to 35% have been experienced in many of the maquiladora operations. Many of the workers have come from the poorer interior sections of Mexico and after saving a little money quit the maguiladora and return home. There is also competition from other maquiladora operations. Often the workers view their job at a maquiladora as a way to learn a skill that can be used when they have an opportunity to go to the United States. Turnover rates of less than 10% are more common in the well managed, stable maquiladoras. To prevent high turnover rates, some maquiladoras have established strict recruitment policies. Experience at a maquiladora subcontractor providing secondary structural components to shipyards has shown that paying better wages has reduced the turnover rate. Furthermore, since most of the workers (welders and machinists) are male, there appears to be greater stability than in those operations which employee large numbers of women who often leave to take care of their families.

U.S. Unions. In response to a request from the AFL-CIO in 1988, the Wharton Econometric Forecasting Associates presented a study to the Secretary of Labor titled "The Implication for the U.S. Economy of Tariff Schedule Item 807 and Mexico's Maquila Program." The study quantified several possible scenarios, including eliminating special tariffs for goods originating from developing countries (tariff item 807), for goods produced only in Mexico, eliminating tariff item 807 for all countries and eliminating the maquila program. Their conclusions were that both the maquila program and tariff item 807 benefit the U.S. economy by allowing lower U.S. prices and increased demand for U.S. manufactured components. It also found that the maquila program was continuing to achieve its goals of increasing the number of skilled Mexican workers and establishing new industries in Mexico. The study supported the premise that trade expansion means more jobs on both sides of the border (7).

It can be anticipated that shipyard labor organizations will generally express the same dissent toward a maquiladora operation that other unions in other industries have over the past 20 years. Organized labor have recognized the conclusions of the Wharton study that the use of maquiladoras has not been the cause of lost jobs. They have also recognized that without the cost savings offered by the maquiladora, their companies would probably have folded or moved to Southeast Asia, and they would be out of work anyway.

Again, shipyard management must look at the long range strategy for establishing a maquiladora. When the potential for new markets for the shipyard and expansion of the workload are considered as part of that new strategy, the maquiladora can be integrated into the shipyard labor force without reduction of the current workforce.

Mexican Customs Law. In Mexico a special customs regime governs maquiladoras. The Mexican customs laws allow temporary importation of merchandise that will remain in Mexico for a limited time for a specific purpose. Imports of raw materials and components are typically authorized for a period of six months, but extensions are easily obtained. The maquiladora must authorize a customs broker to process the necessary paperwork related to temporary importation of materials.

Returns and Re-exportation. According to Mexican law some equipment may be re-exported duty-free. This would include plant operating machinery and equipment being re-exported to the United States for repair or replacement. To qualify for the duty-free status the repair value must be less than 29% of the original amount imported under the maquiladora program.,

U.S. customs Law. The Harmonized Tariff Schedule for the United States. implemented in 1989, strengthened the maquiladora program. In general only the value added to the product at the

maquiladora is subject to import duties. The Generalized System of Preferences (GSP) allows for certain products assembled in a maquiladora to qualify for duty-free entry if the value added to the product at the maquiladora is greater than 35% of the appraised value of the article at the time of entry into the U.S.

Logistics and Management. The logistics of transporting materials to the Mexican plant and the product back to the shipyard will probably be the biggest non-labor expense of a maquiladora operation. Since Mexican suppliers are limited (e.g., there are no suppliers of certified materials) most production materials must be transported from the United States. The additional requirements of clearing customs when crossing the border will cost up to an additional day of transportation time in both directions. Mexico only allows the U.S. truck trailers to cross to the maquiladora plants. While this minimizes the handling of the materials on the trailer, it still requires switching to a Mexican tractor and driver. Mexican trucking companies can deliver goods to anywhere in the U.S. within 25 miles of the border. The cost of using a Mexican trucking company is approximately the same as in the U.S. If the U.S. shipyard is located further than 25 miles from the border, it will be necessary for a U.S. trucker to pickup the assemblies at the border. Also, all oversized loads will have to be moved by a U.S. trucking company specifically licensed for that operation. Due to the anticipated larger size and special handling requirements, the shipyard will probably find that it is less expensive to operate their own hauling equipment.

The availability of experienced maintenance contractors in Mexico is extremely limited. Most maquiladora plant operators maintain full time maintenance crews to service their plant machinery. Power failures and disruptions of other utilities have received much notoriety for the new maquiladoras, but with the build up of the program the Mexican infrastructure has shown significant improvements in recent years.

Management of a new subsidiary can cause complications regardless of where it is located. A maquiladora has the differences in culture and language to offer new challenges to management. Although the Mexican government allows an unlimited number of foreign managers and technicians to live in Mexico, most maquiladoras use Mexican nationals for many of their staff positions. Early selection and training of Mexican management personnel will help to eliminate many of the start-up problems including the hiring of a production work force, establishing facilities, and liaison with the Mexican federal and state governments, and will generally shorten the implementation process.

Training. Maquiladoras in other industries have had much success in training new workers in Mexico. There has been an ample supply of workers with some training for the skills needed for shipyard work. The oil industry in Mexico has provided initial training for many of the welders and machinists. The length of time to train and certify a new welder is equivalent to the times experienced in U.S. shipyards. The productivity of the trained workers will depend on the quality of the shop equipment. Companies with maquiladoras have found that the productivity of the Mexican shops will be equal to their U.S. counterparts if the shops are equally equipped.

The cost of training will probably increase for a shipyard due to the requirement to duplicate training equipment and personnel. Most maquiladoras have found it necessary to have a training team on site in Mexico. The cost of certifying welders is comparable to the costs in the U.S. There are few welding certification labs in Mexico and the certification of test pieces will still have to be done in a U.S. lab or the shipyard.

Quality Assurance. Non-destructive Testing (NDT) can currently only be done with U.S. certified companies. Mexico does not have similar certified companies. The shipyards will have their own NDT shops to conduct the necessary inspections of welds and other regulatory requirements. Most sizable maquiladora operations will have their own NDT facilities for required tests and inspections.

The shipyard's quality assurance team will have to be increased to handle the work at the maquiladora. Test plans and schedules will require additional management attention to incorporate additional inspections at the maquiladora.

Additional coordination may also be required to schedule inspections from government inspectors and regulatory agencies. U.S. government inspectors have been regularly crossing the border to inspect the work being done on some U.S. government contracts. In other situations the completed components are first delivered to a receiving area in the U.S. where the government inspector completes the necessary inspections before delivery to the shipyard. It has been common that the government inspectors have initially been doubtful of the quality of work coming from Mexico, but they have generally found good workmanship from the maquiladora.

Classification societies are well represented in Mexico. Although there

will be a resident surveyor in the shipyard, the classification society will probably rely on their Mexican representative for any surveys of the work at the maquiladora. This will usually require that the shipyard pay for a surveyor in the shipyard as well as a surveyor at the maquiladora.

Environmental Compliance. New Mexican laws have been developed over the past 10 years. They include substantial penalties, including criminal sanctions for violators. Under the new statute that went into effect in 1989, generators of hazardous waste must comply with the reporting and disposal requirements and technical standards that have been centralized in the federal government through the Secretaria de Desarrollo Urbano Y Ecologia or (Ministry of Urban Development and Ecology) SEDUE.

Maquiladoras that generate hazardous waste must register with the government. The maquiladora must meet the reguirements and maintain records related to the handling, labeling, storing, transporting, and disposing of hazardous materials. The Mexican laws closely follow the U.S. laws and in some cases as with the classification of hazardous waste they are more inclusive. It is anticipated that state and local authorities will also pass their own regulations. Since SEDUE is a new agency, the full impact of the laws and how much self regulation a maquiladora will be allowed remains to be determined.

The definition of "residue" under Mexican environmental laws could become an important cost consideration for a shipyard. It is generally defined as hazardous by-products of the maquiladora production and manufacturing process. The generator must determine if it is hazardous. The Mexican environmental laws require that the residue be returned to the origin of the original materials. Additional documentation and customs forms are required. The requirements for transporting and disposal in Mexico are similar to those in the United States. Transportation of hazardous waste from the maquiladora back to the U.S. may require a duplicate set of documents, one for Mexican requirements and one for the U.S. The worst case situation would be if hazardous materials are first picked up by a Mexican trucking company and the disposal site is not in the border commercial zone, the hazardous waste has to be transferred to U.S. trucks at the border with all the proper waste handling requirements in place.

Production Sequence. How would a shipyard utilize a maquiladora operation? The-first step is to look at the overall production sequence for the construction of the ship. What parts of that procedure are the most labor intensive? Which of those labor intensive portions could be done off-site? For example, the fabrication of the hull and superstructure, the installation of the distributive systems and the installation and alignment of major machinery are all labor intensive. However, the alignment of machinery usually can only be done after the ship is assembled on the ways or in the water. On the other hand, with the proper planning, the pre-outfitting of distributive systems and the assembly or prefabrication of structural subassemblies could be done off-yard.

The next step will require engineering to establish the maximum sizes that will be fabricated by a maquiladora. The size will be restricted by:

. The lifting capacities at the maquiladora and the shipyard:

. The means of transporting the completed assembly. If by water, the weight will probably be limited by the lifting capacity restriction. If by land (road or rail) then the weight will probably be restricted by state load carrying regulations;

• Volume of the assembly will be restricted by road or rail clearances. If water transportation is used volume restrictions are not as critical: and

. The assembly sequence for the ship. Although this may not be a physical restriction, additional engineering will be required to restructure the production sequences from previous work that was done entirely in the shipyard.

Scheduling completed assemblies from the maquiladora will be one of the biggest tasks to consider. With additional handling requirements imposed on the construction sequence, there is a greater chance of delay due to the maquiladora operation. Existing maquiladora operations even on a small scale experience their greatest problems with delays related to the transportation of completed goods to the shipyard. The processes of releasing the goods from the maquiladora plant, loading them on to a truck in Mexico, passing through customs at the border and coordinating transportation to the shipyard and finally off-loading the goods in the shipyard can cause the accumulation of many small delays that can significantly disrupt the overall production sequence.

HOW MUCH CAN BE SAVED?

Anticipated Cost Savings

A maquiladora for a U.S. shipbuilder offers a means to reduce the high cost of shipbuilding and increase the capacity of a U.S. shipyard. At the

TABLE V
Comparison of Cost Structures

COST GROUP	CONTENT MULTIPLIER	UNITED STATES	US with MAQUILA	JAPAN	NORTHERN EUROPE
Labor	0.24	1.0	0.78	0.69	1.24
Material	0.40	1.0	1.00	0.85	0.90
Overhead	0.36	1.0	1.00	0.70	0.85
Total Cost	1.00	1.0	0.95	0.75	0.96

current wage levels (Figure 1), establishing a maquiladora may not lower the cost of a U.S. ship enough to compete with the Korean shipyards, but it will make it more competitive with the Japanese and European shipyards. Although the labor rate in a maquiladora is as little as 10% of the U.S. wages, that difference does not translate directly to the overall cost of the ship. The cost of direct labor for a new ship can represent 25% to 35% of the total cost (9). The portion of the labor that could be done in a maquiladora could be as much as 50% of the total labor effort. It seems unlikely that a newly established maquiladora could provide 50% of the manhours in the total construction of the ship, however, with the proper training and production planning, that amount is not infeasible. Assuming that a maquiladora would be initially established to fabricate and assemble structural blocks, it could be expected that 20% to 30% of the total labor would be accomplished at the lower labor rates. Thus, if just the direct labor costs are considered and 25% of the total labor is accomplished at a 90% reduction in labor rates, the labor cost savings would be 22.5%. For a ship construction project where the direct labor without a maquiladora represents 30% of the total cost to build the vessel, the 22.5% savings for direct labor translates to a 5.3% savings in the total cost. While the addition of non-labor costs related to a maquiladora operation will reduce this overall savings, the large savings in direct labor will continue to dominate.

In their 1989 SNAME paper, Carson and Lamb introduced a cost comparison table that shows the relationship of the costs to build ships in Japan and Europe to those built in the United States (1). Table V adds a column to the cost comparison to show how the introduction of maquiladora may change the cost comparison factor. The maquiladora column assumes that the cost ratios for material and overhead for the U.S. shipyards remain constant and only the labor multiplier changes. The above example using only direct labor costs established a labor multiplier of 0.78 instead of 1.0 for a shipyard without a maquiladora. This analysis shows that on a comparison with Japanese and European shipbuilders, the introduction of a

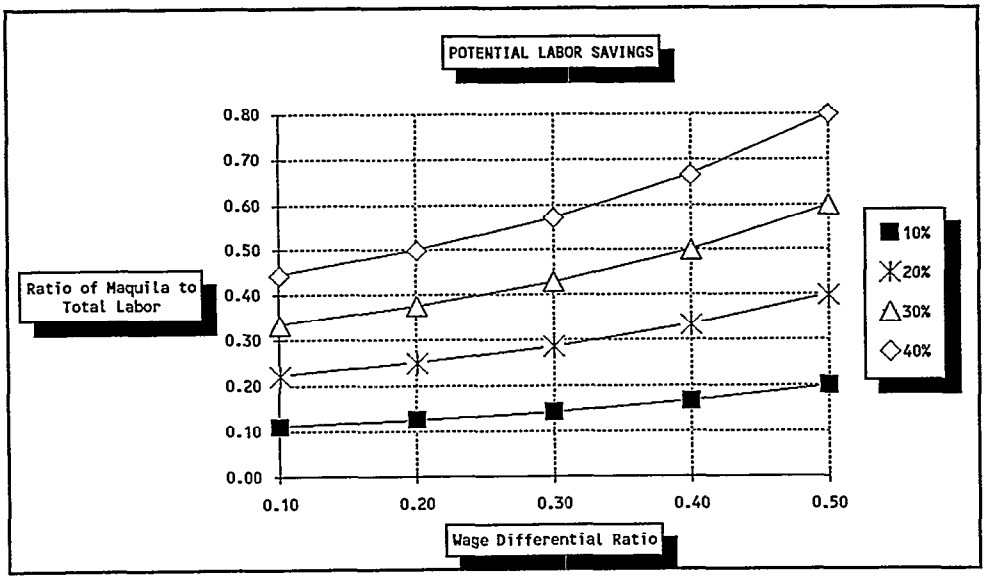

FIGURE 3
Potential Labor Savings

maquiladora can offer approximately an overall 5% cost improvement.

This first look at the potential cost savings has only considered direct labor costs because of the large number of variables that must be considered for the full analysis. Earlier sections reviewed a number of other significant start-up and operating costs associated with a maquiladora. Most of these can not be quantified until the specifics of a maquiladora operation are established. The costs will vary with the size and location of the maquiladora plant, the location of the parent shipyard, the methods and routes of transportation between the shipyard and the maquiladora, and the organizational relationship between the maquiladora and the parent shipyard.

These cost factors can be grouped into three key elements that affect the cost savings analysis of a maquiladora for any shipyard.

.Known wage differentials between the U.S. and Mexico.

.The amount of the total labor that is accomplished at the maquiladora.

.The additional direct and indirect costs of operating a maquiladora plant that offset the lower labor costs.

The dependency of the shipyard's cost savings on these elements is presented graphically in Figure 3. The lines on the graph represent four arbitrary percentages of savings. By selecting a wage differential ratio on the horizontal axis and projecting up to the selected percentage savings line, the maquiladora to total labor ratio can be read from the vertical axis. The equation for each of the savings lines is:

$$s = P(1 - L)$$

where;

P = Ratio of Maquiladora labor to the total labor.
L = Ratio of Maquiladora wage rate to the U.S. labor rate.
S = Cost Savings of using a maquiladora. (expressed in %)

A Case Study

Since these ratios will be different for each shipyard and probably for each type of ship constructed, Figure 3 offers a means of projecting the potential savings of using a maquiladora. To illustrate, consider a shipyard located in Southern California that has established a maquiladora in the Tijuana area. The following assumptions are used.

- The maquiladora is a fully owned subsidiary of the shipyard.
- The start-up and financing costs are amortized and included in the shipyard's overhead.
- The maquiladora is located in the free trade zone and the shipyard is located less than 25 miles from the border.
- The shipyard utilizes its own trucks and drivers.
- The shipyard has a steady workload building product carriers (approximately 40,000 dwt).
- The maquiladora is used to fabricate structural blocks for the hull of 20 tons or less.
- The shipyard burdened labor rate is five times (L= .2) the average burdened rate of maquiladora.
- Thirty percent of the total labor will be done by the maquiladora (P = 0.3).

With the maquiladora already in operation, an overhead rate will have been established. Current operations in the Tijuana area have an overhead rate of about 200% of the direct labor rate. The elements of the maquila burdened labor rate are listed in Table VI. The maquila burdened rate factor for this example is 3.0 (i.e. if the average direct labor rate is $2.00/hr then the maquila burdened rate is $6.00/hr).

The maquila burdened rate must be adjusted to account for the additional costs of operating the maquiladora. These additional costs are converted to a element of the maquiladora overhead cost. They are valued as fractions of the direct labor cost for the maquiladora and are assumed to be constant over the period of steady workload (multi-ship contract). As each additional cost element is added to the maquiladora burdened labor rate, the value of the wage differential ratio increases. Table VI also lists the additional cost elements and their estimated fractional value to the maquiladora direct labor rate.

The total burdened rate factor for this example is 3.88 (i.e. if the direct labor rate is $2.00, then the new burdened rate equals $7.76). The additional cost factors have increased the burdened labor rate by 88% of the direct labor rate. The new wage differential ratio is increased in direct proportion to the increase of the burdened rate factor.

TABLE VI
SUMMARY OF MAQUILADORA OVERHEAD COSTS
For Case Study

Cost Item	cost Factor	Remarks
Maquila Direct Labor	1.00	Base for cost factors
Maquila Overhead Indirect Labor Vacations & Holidays Lease/Rent Utilities Plant Maintenance Vehicles Taxes Housing Fund Bonuses	2.00	*** NOTE *** All normal overhead costs for the maquiladora operation are combined as one factor of the Direct Labor. The factor is representative of the actual overhead costs of a current maquiladora providing services for shipyards.
Maquila Burdened Rate Factor	3.00	
Additional Overhead Costs		
Customs	0.04	-Customs broker fee
Tariffs	0.00	-Assume GSP applies
Bonding	0.00	-Assume in free trade zone
Transportation & Handling	0.36	-Movement from Maquila
Management	0.05	-Additional Program Mgt Pers
Training	0.15	-Additional Training Team
Quality Assurance	0.15	-Additional QA/NDT Pers
Classification Society	0.03	-Mexican representative pay
Engineering	0.10	-Add'l shop drawings & plans
Add'l costs Rate Factor	0.88	
TOTAL BURDENED RATE FACTOR	3.88	

Original Wage Differential Ratio: L = 0.2

New Wage Differential Ratio: $L = 0.2 \times \frac{3.88}{3.00}$

or L = 0.26

Before the additional cost elements were entered;

- the shipyard could achieve a 24% savings in labor costs (for a wage differential ratio equal to 0.2 and maquila to total labor ratio equal to 0.3).

With the additional costs;

- the new wage differential ratio is 0.26 which reduces the labor cost savings to 22% for the same maquila to total labor ratio.

If this example ship construction program has the same relationship among labor, material and overhead as Shown in Table V, Content Multipliers, the 22% savings in labor could result in a 5% savings for the contract.

The example has demonstrated an effective approach to evaluating the savings that can be expected from a maquiladora operation. By converting each of the start-up and operating cost to an overhead factor, their individual affect on the savings can be analyzed. If in the above example, the transportation and handling costs are doubled so that the cost factor equals 0.72 of the direct labor rate, the new wage differential ratio equals 0.28. The labor savings would be reduced by 0.04% to 21.6% for this change in operating cost. Each of the other cost factors can be analyzed in a similar manner.

CONCLUSIONS

Maquiladora Operation Can Reduce Labor costs

Maquiladoras have proven that they can reduce labor costs enough to allow many U.S. companies to remain competitive globally. They have become an integral part of U.S. manufacturing. Even when all maquiladora operating costs are added to the direct labor costs the fully burdened labor rates for a maquiladora can be expected to be less than one third of the U.S. shipyard labor rates. Labor cost savings of 25% should be achievable for most U.S. shipyards.

Effective Maquiladora Management Necessary to Achieve Savings

The establishment of a maquiladora will not in itself improve the productivity of the shipyard. In fact, it could adversely affect a shipbuilding program if it is not properly integrated into the production schedule. However, U.S. shipbuilders have often successfully incorporated major subcontractors and even other shipyards into a new construction program. Utilizing the same effective planning and management, the introduction of a maquiladora operation will enhance the current productivity and provide additional flexibility to improve the overall shipyard efficiency.

Maquiladora Operations Can Increase Capacity

The capacity of an existing shipyard should be increased with the use of a maquiladora. The maquila should open new areas in the shipyard previously used for prefabrication and block assembly. The new areas will provide an opportunity to improve yard efficiency by establishing better material flow patterns. Using a maquiladora may open up enough real estate to consider an additional outfitting pier, graving dock or building ways. In any case, the relocation of the work planned for the maquiladora should allow the shipyard greater flexibility with its valuable waterfront property. If the goals of the long range strategy are achieved, the increased capacity will be necessary to accommodate the increased workload.

Maquiladora Can Owen New Markets

The combination of reduced labor costs, enhanced productivity, and increased capacity will allow the shipbuilder to increase market share. These steps to increased market share are not sequential, but must be planned and executed in parallel. The maquila won't be effective unless it is carefully integrated into the overall production plan. Likewise, the new opportunities for increasing capacity must also be a part of that overall plan. The consequence will be significantly lower costs for labor and an opportunity to be price competitive with Japanese and European shipyards. The starting point is a redefinition of the shipyard's long range strategy to include the establishment of a maquiladora.

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