# Understanding Mexican High-tech Organizations: A Conceptualization Problem?

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## ABSTRACT

This study investigates the differences between intensive technology and low-tech firms located in Mexico, focusing on the Human Resources Management functions. 31 interviews and 50 answered questionnaires were used in this analysis. The results show that while Mexico is not yet a fully developed technological country. Indeed, technologically intensive firms are rare cases. Mexico is progressing rapidly towards a technologically developed country in some sectors. Moreover, Mexico's technology intensive firms and its technological hubs have different implications and connotations as comparison to developed countries. Finally, Human Resources Management is still a traditional/manufacturing management style, for Mexico's technology intensive firms.

KEY-WORDS: Intensive technology firms, low-tech firms, technology hub, Human Resources Management, Mexico.

## INTRODUCTION

Since the 1940's, Mexico has been promoting its key competitive advantage of cheap labor, starting with the birth of import substitution in Mexico during World War II and culminating in the *maquila*, foreign investment through subsidiaries which enables "in-bond assembly-for-export", a program created in the 70's (Jarvie, 2000). Foreign firms, specially from the USA, realize substantial savings by relocating their labor intensive manufacturing components to facilities in Mexico, where labor rates can range between 15-30% of USA labor rates for comparable work (INEGI, 2000; Jarvie, 2000). Thus, the '*maquiladora*' program in Mexico has paved the way for the formation of a host of strategic partnerships between firms on either side of the Mexico-USA border, indeed, one of Mexico's strengths for years has been manufacturing of products.

Furthermore, Mexico's manufacturing organizations, *maquilas*, are one of the most important economic sectors for its industrial and economic development. According to *SECOFI,* a Mexican organization charged with promoting and expanding industrial trade, by September 2000, 19,574 organizations with operations in Mexico are funded from foreign investments. Additionally, the manufacturing sector is where the foreign investment is being placed in Mexico. It represents US$6,503.3 million accounting for 62.8% of the total foreign direct investments in Mexico. One interesting figure is that 1,054 foreign direct investment (FDI) firms registered in Mexico belong to the Industrial Chamber of electronics and electrical equipment. This figure represents 5.4% of FDI based in Mexico. It is interesting because the figures shown represent some of what Mexicans refer to as 'high-tech' firms. Indeed, the number of FDI in electronic, electrical and computer manufacturing firms in Mexico, have been increasing by 30% in the last 5 years (SECOFI, 2001).

This paper has two main purposes: The first one is to define understand and discuss technology intensive in Mexican companies and the second one is to analyze the extent to which HRM differs between intensive technology and low-tech organizations in Mexico. Moreover, the paper examines the transition from repetitive manufacturing to designs in electronics production in a newly industrialized sector in Mexico. The paper is structured in four sections. The first basically refers to concepts definitions where the theory used for this research is explained. In the second section, we presented our four research questions; we explained the importance and the relation of each research question to this study. This section includes the methodology that we focused in, as well as interviews and questionnaires are explained. Additionally, this section includes and explanation of

how the database was constructed as well as the participants in this research and the data that was collected. The third section refers to the discussion section where we explained the general and particular findings from the methodology used. Finally, in the four section we listed the six majors conclusions that emanated from the full research conducted in Mexico.

## 1. Concepts definition

### 1.1. Low-Tech Firms

Most of the low-tech firms have a workforce of 'non-professional/non-knowledge' workers, specialized knowledge workers are not important for the kind of duties that manufacturing firms demand. Moreover, 'non-professional/non-knowledge' workers main deal with repetitive tasks, that most times are very simple functions that can be learned within a short period of training. "Non-professional workers possess a public knowledge that can be purchased easily in the labor market" (Leonard-Barton, 1995). Furthermore, "the number of engineers that implement or develop technology in low-tech plants is not more than the 5% of the total workforce" (Jolly & Therin, 1996).

In manufacturing organizations, the most important human resources processes are recruitment and selection because the turnover figures are high. Furthermore, traditional manufacturing organizations, still focus on resolving daily work activities/problems; struggling to have the money for the pay-roll or recruiting workers at the last minute, because it is not a surprise that some workers do not show up after the first pay-check (Towers, 1992).

### 1.2. High-tech firms

There are several studies that have defined intensive technology or 'high-tech' organizations. One definition that most of the studies agree with is the McQuaid & Langridge, 1984 research cited by (Breheny & McQuaid, 1987). They define a core set of ‘high technology’ industries on the basis of their occupational structures (an above average share of engineers, technologists and scientists) and the relative amount that they spend on research and development, at least equal to 5% of sales revenue. This idea has been shared by a large number of researchers (Pottier, 1987); (Kleingartner & Anderson 1987); (Balking and Gomez-Mejia, 1992); (Stuart & Quinn, 1992); (Saura & Gomez-Mejia, 1997); (McGovern, 1998); (Jolly & Roche, 1999).

Additionally, other broadly distinguishing characteristics of high-tech firms include a high proportion of engineers, scientists, and technicians, the importance of research and development, and the application of science (Kleingartner & Anderson, 1987). In addition to this, intensity in technology refers to the level of capital expenditure committed to advance technology (Noori, 1998). Above all, these distinguishing characteristics led Cascio (1988) cited by (Cardy & Krzystofiak, 1991) to conclude that "innovation, science, and research are hallmarks of high technology firms".

### 1.3. Technology Hubs

"A 'hub' is defined as a center of activities" (Noori, 1998). "In terms of technology in a global company, a technology hub can be defined as the location where many of the R&D, design and process engineering activities are concentrated" (Chamers , 1994). Some examples of technology hubs around the world, are the "big-3" technology centers in the USA: Santa Clara's 'Silicon Valley', Boston's Route 128 and the 'research triangle' of the Carolinas. (De Noble & Galbraith, 1992). In Europe, they are: The M4 corridor from West London to Bristol and into South Wales. Oxford, Cambridge and Scotland's 'silicon glen' in the UK, (Breheny & McQuaid, 1987). Paris region, Rhone-Alpes, Sophia Antipolis Region and Southwest in France (Pottier, 1987).

The proliferation of technology hubs responds to different factors, rather than only supply/demand of a specialized workforce. Furthermore, attracting and retaining high-tech firms in a regional area, would be characterized by the Government's regional development plan, to lead the development of the existence of high technology enterprises. However, it would be necessary for the region to develop as well as to retain the establishment of local venture capital sources through an adequate supply of skilled technical and professional workers, major investment for basic and apply research which might linking universities, research centers and firms. Another activity, should be the encouragement of private and public activities in order to develop and commercialize the new technological advances that could lead the region to growth ( De Noble & Galbraith, 1992).

In fact, because of the attractiveness of Latin American markets, many high technology firms are allocating greater proportions of their advanced resources to foreign partnerships in Latin America in general, and to Mexico in particular (Robinson, 1988).

### 1.4. Human Resources Management

Human Resource Management is a series of organized activities, conducted within a specified time and designed to produce behavioral change. Within HRM the most common activities are training (learning for the present job) and education (learning for the future job). Human Resource Management includes other dimensions of personnel activities such as health and safety, compensation and incentives, performance evaluation, as well as other HRM activities such as staffing, career development and internal communication (Nadler, 1994).

#### 1.4.1. Implications to HRM

Some studies have found that HRM have different approaches when referring to a high-tech or low-tech firms. In order to make some distinctions, we are citing those studies for four HR activities distinctions amount high-tech and low-tech firms:

- **Recruitment and Selection:**

High-tech firms tend to hire employees who are young in age, average 35 years old (Bowman et al, 2000); another characteristic is that people working in high-tech firms usually have intangible abilities such as flexibility, capability to learn fast, commitment. Also, high-tech employees can fit into a dynamic and flexible working environment (Cutcher-Gershenfeld, *et al*, 1998). Therefore, the recruitment market for these kind of employees has an international even global focus (Jolly & Roche, 2000). Thus, the use of Internet for recruitment purposes, is a common practice (Denis, 2000); and assessment centers are a frequently practice as a tool for evaluating candidates (Gatewood & Feild, 1994). On the other side, low-tech firms tend to hire employees for an individual task (only technical), in the way that the fit a person into a pre-defined job (Cutcher-Gershenfeld, *et al*, 1998).

- **Training**

High-tech firms tend to be proactive for training purposes, they try to anticipate the training needs for their workforce (Cascio, 1990). It is common that high-tech firms view training as an employees' development and personal growth (*ibid*). Training programs in high-tech environments tend to focus on problem solving, communication, technical skills, job rotation, mentoring relationships (Lepak & Snell, 1999), (Cutcher-Gershenfeld *et al*, 1998).

Employees in low-tech environments do not received much training, because the skills and abilities that they need to perform their daily repetitive activities, are not unique to a particular firm. It is

public knowledge (Lepak & Snell, 1999). Therefore, low-tech firms tend to develop training programs for a specific task, or even just fall into some wording just to complete legal requirements (Towers, 1992).

- **Organization**

High-tech firms tend to delegate their employees with a high degree of autonomy and empowerment in management daily work (Frerichs, 1998). At the same time, managerial skill and style tend to involve employees participation, with considerable efforts devoted to a team-based work structure (Cutcher-Gershenfeld *et al*, 1998). Another organization characteristic is that high-tech jobs are in a constant state of flux and can not be easily defined (McGovern, 1998). Contradictory, low-tech jobs do not require substantial operational changes but require a greater deal of employee supervision and control (Stuart, 1992).

- **Compensation**

High-tech firms tend to determine wages based on skills, personal attributes and contributions to the firm, rather than job evaluation procedures focused on daily work tasks as low-tech firms tend to do. (Saura & Gomez-Mejia, 1997; Gomez-Mejia & Balking, 1992). Another characteristic is that the compensation system tends to be flexible and adaptable, which offers: sign-on bonuses, stock options, profit-sharing, among other incentives; also focuses to R&D group incentive compensation (Balkin & Gomez-Mejia, 1992; Jolly & Therin, 1996; Stuart & Quinn, 1992).

Low-tech firms design their compensation systems in such a way that they place a heavy reliance on traditional job evaluation procedures. For example, the payroll assigned to security employees is just short-term oriented. (Balkin & Gomez-Mejia, 1992; Saura & Gomez-Mejia, 1997).

## 2. Research Questions

Based upon the above discussion, we developed four specific research questions to guide this investigation. The aim for this investigation is to understand the behavior of Mexican 'high-tech' organizations, as well as examine HRM distinctions amount high-tech low-tech firms in Mexico. We believe that it is important to mention that most studies in high-tech and low-tech environments have been carry out in developed countries, little research has been conducted in Mexico in comparing HRM differences between high-tech to low-tech firms. Furthermore, as we have mentioned before, the number of FDI firms in electrical and electronic equipment has been increasing since the last five years in Mexico. These firms are considered as high-tech firms, however to our knowledge no research has been made in order to confirm this idea.

1. Can a Mexican technology intensive firm, either Mexican owned or a foreign subsidiary at a Mexican site, be defined as a high-tech firm?
2. Does Mexico have technology intensive firm and therefore, a 'Silicon Valley' such as the ones in the USA or Europe? If there is one, where is the 'Mexican Silicon Valley' located.
3. Are there significant differences between Mexican operations that are subsidiaries of foreign firms and those that are Mexican-owned?
4. Are there significant differences between HRM in high-tech/low-tech firms located in Mexico?

### 2.1. Methodology

We developed a methodology that enabled us to have first hand information from Mexican firms in certain specific industrial regions and economic sectors in Mexico, as well as to get a general overview of Mexican firms. As a means of collecting information, semi-structured interviews were conducted which lead to the creation of a questionnaire.

#### 2.1.1. Interviews

Semi-structured interviews were held with the HR and technology managers. As part of the interview process, a tour of the plant facilities was included. The purpose of the interview was to have first-hand organizational information, to confirm the Government classification data base, to be able to classify the organization as a high or low tech and the creation and testing of the questionnaire.

#### 2.1.2. Questionnaire

The questionnaire was written in Spanish. It had 2 main objectives. First, to classify Mexican companies as high-tech or low-tech organizations. Secondly, to establish the different approaches to HRM activities, among high/low tech Mexican organizations.

The questionnaire was designed to research information in two different areas. First, information regarding the organization profile, in order to be able to classify the sample as a low or high tech organization. Questions included: economic sector and industrial chamber, whether the organization had a technology area and the number of engineers working in it. Other questions in this section were items such as what was the percentage R&D to sale revenues and the number of employees

working in R&D along with their educational backgrounds. Questions such as total number of employees at the site and the percentage of employees in each organizational areas, also were asked.

Meanwhile, the second questionnaire section focused on HRM processes. The HRM processes covered were recruitment and selection, training, organization and compensation. The differences among high/low tech organizations mentioned earlier (Concepts definition, -Implications to HRM) were used when constructing this questionnaire's section. A five-point Likert scale, was used for this section. However, there were four open-ended questions.

**2.2. Data Base**

The data base was constructed using the following sources:

a. The Mexican Commerce and Industrial Chamber (SECOFI).
b. ITESM Industrial data base (Private Graduate Business School).
c. MB magazine, issue October, 2000, Mexico's top 150 organizations.

The economic sector of manufacturing (assembling processes) was looked at as well as service, commerce and transformation (firms that make an end product from rough materials). For the industrial chamber, organizations in electronic and telecommunication, metal mechanic, computer (hardware/software) and manufacturing equipment were concentrated on.

It is important to note that the Economic Sector refers to the main focus of the organization as being manufacturing, service, or transformation. The Industrial Chamber refers to the type of product and/or service that the company manufactures, transforms or offers.

The Data base included organizations with more than 500 employees because these kinds of firms tend to have a formal HR Department with structured processes.

## 2.3. Participants

The study focuses on a sample of Mexican companies from electronic, telecommunication, computer and equipment manufacturing. 250 questionnaires were sent by regular post on March 26, 2001. Until April 27, 2001 a 20% response rate was achieved. In addition, 31 semi-structured interviews were conducted (from January 15 through April 10) in 11 organizations. 5 of these organizations are funded by foreign investment in Mexico, working as a *maquila* while the other 6 are Mexico owned firms. In addition to this, the 11 interviewed firms belong to the areas of electronic/telecommunication, computer, cement, glass, equipment manufacturing, photographic, e-commerce, metal mechanic and textile/chemistry. Please refer to details in figure 1.

**Figure 1**
**Interview's Sample**

**Foreign Direct Investment Firms**

| Firms | Industrial Chamber | No. Interviews |
|---|---|---|
| A1 | Computer hardware equipment | 5 interviews |
| A2 | Manufacturing air conditioners equipment | 2 interviews |
| A3 | Manufacturing plastic equipment | 2 interviews |
| A4 | Photography | 1 interview |
| A5 | Electronic/telecommunications equipment | 5 interviews |

**Mexican Owned Firms**

| Firms | Industrial Chamber | No. Interviews |
|---|---|---|
| A6 | Glass manufacturing | 6 interviews |
| A7 | Cement | 1 interview |
| A8 | Steel producer | 1 interview |
| A9 | Textile/Chemistry | 2 interviews |
| A10 | e-commerce | 3 interviews |
| | ***and*** | |
| A11 | Education and Research Center | 3 interviews |

*Note: Classifying Sample Interviews*

## 2.4. Data Collected

High-tech and low-tech organizations were empirically classified according to the official classifications (the data base sources mentioned earlier). High-tech organizations were those in the areas of electronic and telecommunications, pharmaceutical, computer (hardware/software), e-

commerce and photography. While low-tech organizations were in the areas of equipment manufacturing, glass, cement, metal mechanics, and textile.

However, the danger of official classifications is that there may be a case where an organization is involved in computers or electronic industrial chamber, but is a 100% manufacturing site. This means that a company is producing high-tech equipment with low-tech processes (*'non-professional/non-knowledge' workers that are mainly dealing with repetitive' tasks focused on assembly materials*) without any R&D activity. "Official classifications tend to be product technology driven" (McLoughlin, 2001).

Therefore, acknowledging the risk of classifying high-tech and low-tech organizations based on official classifications, was the reason for performing semi-structured interviews. It was necessary to look in detail at the intensive technology Mexican organizations in order to be sure if they could be classified as such, according to the 'high-tech concept' mentioned earlier. Moreover, before sending out the questionnaires, it was important to have a clear idea if the official classifications were product or process classifications.

## 3. Discussion

### 3.1. Describing and understanding the Mexican Technology Firms

For the first research question, we were concerned with the concept of high technology firms that go hand in hand with Mexican standards. We also wanted to figure out if we could match that concept to the literature review and academic debates found in this area of high-tech. Therefore, we started interviewing foreign organizations based in Mexico as well as Mexican owned firms.

- **Foreign Direct Investment Firms**

From the sample, we interviewed the HR manager and some engineers at the A1 organization, which is a computer hardware manufacturing foreign subsidiary firm. We found that the people we interviewed considered the firm as high-tech since the firm is well known around the world as a high-tech firm in computer hardware. Additionally, firm A3 has a hardware lab in Guadalajara City, Mexico with 39 researchers working full-time.

Labor cost is one of the reasons for having the lab in Mexico. According to the Engineer Project Manager we interviewed, it is 30% to 40% less expensive having the lab in Guadalajara than in Palo Alto, USA, Silicon Valley. The labor cost is not the only reason for locating R&D labs

overseas. Indeed, the firm A1 mentioned diversity was another reason for having the R&D lab site in Guadalajara City. The organization wants to have a global research workforce, international people from around the world; with different cultures and backgrounds. Moreover, as the firm's A1 Engineer Project Manager said, "in the USA, there are not enough researchers, therefore, they have to be brought in from others countries". Furthermore, the increased cost of R&D, as well as the limited resources and knowledge available in the home country, have led companies such as A1 to look beyond their national borders and seek opportunities overseas for R&D (Noori, 1998).

When it comes to firm A1' s lab deals in developing accessories for specific defined projects, there is no basic engineering. They do not have a Ph.D. researcher working in this lab. The lab adapts technology from the company headquarters and applies it to a specific project. Therefore, according to the definition, *(5% or more of sales revenues spent on R&D and an above average share of engineers, technologists and scientists)* firm A1 could not be considered as an intensive technology site. We can conclude that by Mexican standards the firm A1 is a high-tech organization. This is based on the fact that it has a research center dealing with applied R&D. It also adapts technology from its own company (developed in the USA), for manufacturing procedures in the Mexican site. Besides, these types of activities are rarely found in Mexican firms.

Visiting the manufacturing areas and interviewing engineers as well as HR managers from firms A2, A3, A4 and A5 (from the sample), we have found that all of them work in Mexico under the *maquila* scheme. These companies produce high-tech equipment with 'low-tech' processes. More than 70% of their workforce are *'non-professional/non-knowledge' workers that are mainly dealing with repetitive' tasks* focused on assembly materials brought from foreign firm's home country. The engineers working in these firms focus their duties on production efficiency. The organizations visited (A2, A3, A4 and A5) did not have an R&D lab, nor researchers trying to improve or make changes to the technology transferred to the Mexican site from the foreign organization. We had found this to be the case in firm A1.

Interviewing the firms A1, A2, A3, A4 and A5 we noticed that some engineers working in production had a deep understanding of the manufacturing process for high-tech equipment. These engineers frequently go through a training process in high-tech manufacturing equipment in and out-side Mexico. In addition to this, the engineers work with state-of-the-art equipment, as well as traveling regularly to the site of the foreign parent company for training on technology transfer.

This occurs primarily when a new product or process is to be implemented at the Mexican site. As a result, it was interesting to notice that the Mexican engineers are beginning to develop technology and innovation, even though they may not realize that this is occurring. For example, the firm A4's HR manager explained that in their site, Mexican engineers have made changes for the better, in materials for the manufacturing processes. Other 'innovations' includes lay out, timing, and so on. Similar examples were found in all the organizations visited. This fact may indicate that Mexican engineers are ready to move from 100% manufacturing to R&D processes.

- **Mexican Owned Firms**

Organizations A6, A7, A8, A9 and A10 which are Mexican owned firms, have formal organizational technology departments with applied research and development processes. These organizations have technology partners and joint ventures with global technology leaders in their field. We can say that these Mexican firms are technology intensive organizations, because they have an organizational technology department and engineers working in R&D activities. However, Mexican owned firms do not fall exactly into the high-tech definition mentioned earlier because none of them spend at least 5% of sales revenues on basic engineering. Additionally, the engineers and scientists, working in the Mexican owned firms do not figure in numbers of employees in the organizations global structure.

Nevertheless, each Mexican technology intensive firm has its own technology strategy. For example, firm A6 defines itself as a technology follower. According to the firm A6 Technology Director, the Organization's Global Technology Strategy was capable of accessing state-of-the-art technology, through a link developed with its technology partners. Development of A6's specific strategy for technology projects is done with the help of the organization's technology division. This division involves Private and Public Research Organizations, especially for basic research and investigation, which was the case for all the Mexican owned firms visited. According to the engineers interviewed at A6's site, Mexico and the technology development of the firm are still 20-30 years behind international standards. Additionally, A6's engineers claim that the Mexican Government and the private organizations had made little effort to improve R&D. This is because there are not enough incentives or easy access to progress with developments in technology. They agree that in Mexico, there was not enough respect for valorization in the R&D areas. The A6's engineers have the perception that the Government institutions do not care about R&D and the benefits that can come with this.

On the other hand, for firm A7 which is Mexican owned, technology development is one of its key advantages. This organization is one of the few Mexican examples of a technology intensive firm that competes world wide. It is ranked as the 3rd biggest in the world. In 1995, firm A7 started the Technology Cement Center, which is the first of its kind in Mexico. In the last two years, the Center has developed seven patented new products for specific construction purposes. The firm has 200 employees working in technology areas. 50 of them hold a Ph.D. degree, while 100 have a masters degree, and the remainder engineering titles.

With reference to the Mexican owned firm A8, its strategy is to have leading edge technology, the very best processes and services with an excellent human team. They are also looking for investments in high value-added products, in order to become the strongest steel producer with the highest margin in North America. Furthermore, this strategy has helped the company to achieve technology innovations, as well as national (Mexican) and international prestige. Additionally, the organization has an R&D department with 15 researchers and 3 technicians. The staff comprises 73 employees working in 4 laboratories, in 4 pilot plants. In 1943, firm A8 began operations, and to date, it has become one of the technology leaders of flat steel production in the world. The firm has state-of-the-art technology and certified quality systems across all its processes.

In creating a definition of Mexican high-tech organization, it is difficult to target Mexican engineers because there is a great debate in the term definition. The other problem is that each person interviewed had a different concept of what this terms meant. For some R&D Mexican engineers, Mexican intensive technology firms are the ones that develop improvements in production process. Others say that in Mexico there are no technological developments at all. Altogether, it might be unfair to conclude that Mexico does not have intensive technology organizations based on international standards. There are some examples of Mexican developing R&D as mentioned in the section. Mexican organizations that have technology departments and engineers working in R&D, however, the Mexican high-tech firms visited could not match exactly in the definition of high-tech firms from developed countries, mentioned in the concepts definition section. Nevertheless, there are not many similar cases of technological development, either Mexican owned or foreign subsidiary at a Mexican site. The most important issue is that Mexican industries, institutions and engineers are starting to build a continuos progression from basic research to applied research to development.

### 3.2. A Mexican Silicon Valley?

The second research question concerns whether or not Mexico has it's own 'Silicon Valley'. Thus, interviewing all the firms from the sample and traveling to some of the Mexico's industrial concentration; we found that competition among regions, and municipalities to attract and retain high technology firms has become more intense and complex (De Noble & Galbraith, 1992). Mexico is not an exception to this and this can be seen among the Northern States in Mexico. These States represent the highest technology concentration of manufacturing electronic and computer equipment firms in Mexico. This is because it is extremely close to the United States border and therefore it is heavily influenced by the United States. Nevertheless, there are two exceptions which are Mexico City, which is in second place with 209 firms and the State of Mexico with 70. For the Northern States of Mexico, with Mexican-USA border, are Baja California, with 239 firms, Chihuahua has 153, Tamaulipas 78, Nuevo Leon 65 (SECOFI, 2001). However, we believe that this alone is not a reason to consider that there might be a 'Silicon Valley' in the Northern Part of Mexico. This is because many of the organizations located are in general *maquila* firms. Furthermore, we could not find Research Centers or Higher Educational Centers located around that region, which are the characteristics of hub technology clusters and one of the best ways to define them.

Arriving in Guadalajara City, Mexico, international airport, and going by car, to the city of Zapopan, a metropolitan Guadalajara's City area, you can see a big road sign that says: 'Welcome to the Mexican Silicon Valley'. But, is it a true Silicon Valley, as the ones mentioned in the concepts definition section?

Guadalajara is the second largest Mexican city, located in the North Eastern part of the country. It has been several years since the State Government of Jalisco planned its industrial development focusing on the Industry Chamber of Electronic, Software, Tequila, Shoes and Clothing. A clear illustration of this rapid development in the electronic sector can be used as a very good example since it alone employs 80,000 people in Jalisco, State (SECOFI, 2001; INEGI, 2000).

Although the number of electronic and electrical equipment sectors in the Guadalajara area is not the highest in Mexico 62 firms (SECOFI, 2001), Guadalajara is considered the 'Mexican Silicon Valley' because the State Government has managed to accomplish the State's strategy of attracting and retaining electronic firms. Locating and sponsoring Research and Educational Centers in

engineering, design and manufacturing programs with institutions such as the CIVESTAV, ITESO, State University, as well as private higher educational Centers such as ITESM, UDG, has been very important in accomplishing the State goal as a technology hub. In addition to this, the State of Jalisco has the reputation for a stable workforce, without union conflicts, as well as a reasonably large labor pool of technical and skilled workers. Over all, even though there are a large number of organizations that have R&D, technology is still a weak area. We can say that Guadalajara is moving towards the goal of being a Mexican Technology hub.

### 3.3. Implications to HRM

With regards to the third research question, significant differences between Mexican operations that are subsidiaries of foreign firms and those that are Mexican owned are discussed next.

Two major differences were found: Operational Activities and HRM. The second major finding relates to the main idea for the fourth question. However, it will be discussed separately through an analysis of the interviews results.

#### 3.3.1. Operational Activities

- **Foreign Direct Investment Firms**

Concerning the Operational Activities resulting from the findings of visits and interviews, the results reveled that most of the foreign based organizations with operations in Mexico, are working in the form of *maquilas (90%),* therefore, their ties to Mexico are not strong enough. As a result, the foreign firms do not make substantial investment in Mexico, specially in R&D areas.

One of the reasons for the lack of investment in R&D, relates to cost, especially labor costs. When the foreign manufacturing site becomes non-profitable for the global company, the foreign firm just closes down its manufacturing site. A clear example of this is the case of firm A6, as this firm used to have a manufacturing site in Monterrey City, Mexico (besides the Guadalajara site), with 4,000 employees, unfortunately this operation was not profitable enough for the company in terms of labor cost, compared to the Asian countries. Therefore, firm A6 closed down operations in Monterrey City, Mexico and moved its production site to China. Furthermore, competition coming from manufacturing at the different sites around the world, from the same foreign company, is one of the major concerns of foreign manufacturing site with operations in Mexico. The Mexican subsidiary site has to prove, especially in terms of labor costs, that the site is profitable for the

foreign firm. By contrast, Mexico being geographically closed to the USA represents one of the biggest advantages for the *'maquilas'*, (foreign manufacturing firms locate in Mexico), enabling them to be competitive with other manufacturing sites around the world.

By visiting foreign organizations with operations in Mexico from the sample (A1, A2, A3, A4 and A5), we observed some common characteristics among them. These sites work with state-of-the-art equipment, for manufacturing purposes; where the Director of the site is a foreigner, he is likely to be from the firm's headquarters. This is not the case for site A1 where they have a Mexican Director. Another common characteristic we found was that the lay-out of the plant is similar among the firms visited. They have the main offices, HR, engineering, traffic, etc. on the second floor, with a big window that makes it possible to see the manufacturing area. For the manufacturing area, each site has there own processes, however, the layout was generally similar. A 'clean-room', with specific signs of the process and materials being used as well as security signs, among other specific signs were seen for each manufacturing site.

- **Mexican Owned Firms**

By conducting the interviews and visiting the Mexican-owned firms from the sample (A6, A7, A8, A9 and A10), we found some differences regarding the operational activities when compared to a foreign manufacturing site operating in Mexico. Mexican firms are concerned with competing not only among Mexican firms but also with organizations around the world, since Mexican borders are open, almost any firm can come to Mexico to sell their products with low import taxes.

Furthermore, most of the firms visited cannot afford to have state-of-the-art equipment and materials. Although they have this equipment just for some specific products and projects, but in general the resources do not flow as easily as in the foreign firms. The CEO and the directors are Nationals, Mexicans, 90% of them hold a MBA degree.

Regarding the site, Mexican firms are not only manufacturing sites as the foreign firms visited. Therefore, Mexican sites do not look as 'clean room' as the foreign firms do. We saw Mexican firms in the Industrial Chamber of glass, metal mechanic, cement and textile firms. The workshops are different in the sense that they involve noisy processes, and sometimes imply a certain risky, since they deal with high temperatures, chemical materials, etc. Thus, processes do not look smooth as the foreign firms. Mexican firms have located the main offices, administration and some of the technology areas, in a different building, most of the time in a fancy location away from the plant.

Another important issue of significant differences between Mexican operations based upon ownership status that relates to their operational activities. That is, whether the operation is a subsidiary of a foreign firm (one form of *maquiladora*). We found that while foreign subsidiaries still place their R&D development in their respected country sites, Mexican-owned firms must have either their own technological developments with the help of national or international institutions. They also tend to buy *ready-to-use* technology from international technology leaders in order to keep alive in the national and global market.

### 3.3.2. Human Resources Management

In terms of the fourth research question, we were concerned with the differences between HRM in high/low tech organizations located in Mexico. We conducted semi-structured interviews, following a model taken from the *Implication to HRM*, in the concepts definition section. Moreover, the questionnaire was constructed following again the same source, the different approaches to the HRM activities. However, it is important to notice that the questionnaire was statistically analyzed by nonparametric test approach (Sidney & Castellan, 1988). From the 50 answered questionnaires received it was not possible to have more than 11 organizations that could fall into the classification of high-tech firms regarding the Mexican high-tech concept, discussed in the first research question.

- **Recruitment and selection**

Comparing differences in recruitment and selection based upon high/low tech firms in Mexico findings revealed one significant difference. High-tech firms ranked recruitment market with an international even global scope significantly higher (Mann-Whitney Test 0.003) than low-tech firms located in Mexico. This finding reflected that the high-tech firms workforce in technology areas and management levels has a tendency to recruit foreign staff members. Firm A1, has 2 foreign researchers in their hardware lab, while firm A9 employs 4 foreign employees in the technology area, and, firm A6 and A7, respectively employs 10 and 15 foreign employees in management levels.

Nevertheless, FDI firms from the sample (A2, A3, A4, A5), are considered low-tech firms, because they focus their processes on manufacturing products. As discussed, all the CEO and top Managers are foreigners. This fact is understandable, because those firms are defined as funded by foreign direct investment in Mexico and one of their characteristics is that *'maquilas'* have foreign engineers and top managers from the headquarters. Moreover, another interesting finding among

low-tech firms from the sample is that 100% of them prefer to hire workers, at all levels, with intangible abilities such as the capacity to learn fast, be flexible and, with knowledge of English. Moreover, for the Mexican high-tech firms these characteristics were essential as well, however, only among their engineers and top level employees.

- **Training**

Thus, with regard to training non-statistic significant differences were found, although, interesting findings were noticed when conducting the interviews. One interesting figure was that 100% of Mexican high-tech firms from the sample, have agreements with State and Private Universities for specific training programs for their engineers, as well as, for some managers. In an interview conducted with the director of a Graduate program in Engineering from the State University in Monterrey, N.L., he explained us the cooperation agreements that some firms are having with universities in order to provide training to engineers in different technical areas. For example, he mentioned, in the interview, that the firm pays the tuition fees and in some cases sponsors the construction and equipment for a research lab. He also mentioned that academic programs are organized by the firm and the University, and the final project has to be in a research area within the firm that is sponsoring a graduate student. This has been the case in firms A6, A7, A8 and A9 from the sample, however, firm A7 has started, 2 years ago, sponsoring new students that are not necessarily working for the company at the time of doing their Master program.

When interviewing engineers and HR managers from foreign manufacturing firms in the sample, we found that training out-side Mexico is making a change in the profile of Mexican engineers. As mentioned in the first research question, foreign firms regularly send their engineers for training purposes to their company home country site. According to the interviews made, training out-side Mexico has led to a change in the Mexican engineers way of thinking, being pro-active, with open-minded; a global mentality knowing that the products they manufacture are competing world-wide. However, most of the HR departments (90%) are not fully aware of this phenomena, because little attention they paid to training in the areas of communication mechanisms, exchanges programs, job rotation, mentoring relationship. Nevertheless, HR departments of Mexican owned firm A8 and foreign owned firm A1 have started a program of knowledge management. One of the objectives is to establish a program which could facilitated the information sharing and the transfer of knowledge necessary for joint decision making and productivity within the organization.

- **Compensation**

A significant difference was found in the questionnaire responses regarding compensation based on competencies and abilities in relation to performance (Wilcoxon-Mann-Whitney Test 0.019). Interviewing the low-tech firms we found that most of the firms (80%) were more focused on the end result of the employee and performance of their daily duties than the level of knowledge or abilities for compensations allocation system. However, interviewing the high-tech firms we found a change regarding compensation system among engineers working in technology areas. These organizations are trying to change in a such way that the engineers do not have to become a manager in order to have similar compensations levels and status, as the managers. Therefore, the Mexican high-tech oriented firms are trying to move the engineers working in technology areas from seeking to become a manager to aiming to work in research and innovation activities.

Although we have found some different approaches to HRM in both low-tech and high-tech firms among foreign and Mexican owned organizations. It was not possible to find all the different implications to HRM mentioned in the concepts definition section, for the Mexican based high-tech firms. Overall, in our analysis we have found that HRM is still a traditional/manufacturing management style, for the Mexican technology intensive firms visited.

**Conclusion**

In this paper we introduced the idea of 'technology hub and high/low tech firms' in Mexico. Furthermore, we explored the high/low tech situation in Mexico in order to determine whether or not Mexico has the potential to have high-tech firms, therefore, to reach a technology hub status. The present results might suggest that there is a different approach to the concept of high-tech firms and to the HRM activities among Mexican organizations. Overall, a number of conclusions can be drawn from the results of the survey and interviews, and these are listed below:

1. There seems to be a mismatch trying to compare Mexican and American (or from a developed country) intensive technology organizations. Developed countries, which are intensive technology organizations, tend to invest and develop serious technology programs in basic engineering and R&D. Mexican 'intensive technology' organizations refer to technology mostly for production improvement.
2. The Mexican foreign manufacturing organizations are largely progressing forward, completing the first stage of industrialization. Mexican engineers have understood the manufacturing process of high-tech products. Therefore, as Mexico is becoming the home

base of manufacturing high-technology equipment, these companies are improving as they become more involved with higher value-added activities such as product design and engineering.

3. It was found that Mexican owned organizations with R&D areas, have similar HRM processes to the manufacturing foreign organizations based in Mexico.
4. The Mexican based companies, are moving towards co-operation with public and private R&D institutions, as well as with foreign technology partners for basic engineering and production improvements. Therefore, projects of basic engineering are more frequently seen in Mexico.
5. Almost all of the indigenous anchor companies in the sample initially developed as assemblers of final products for American, Japanese and EU Brands. While there is an apparent move to pass this stage, most of them are not engaged in higher value-added activities such as design and basic engineering. In fact, the level of higher value-added R&D is minimal among many of the sample companies visited. The challenge for these companies and the local manufacturing industry in general, is to accelerate their restructuring toward higher value-added activities.
6. The foreign owned companies in the sample are very product specific and mostly manufacturing mature products that require stable processes. The challenge for Mexico is to encourage the companies in industrial countries to locate more of their valued-added activities within the country. The low value-added assembly tasks are always subject to further migration.

Nevertheless, additional research is needed to develop and deepen the field work among high-tech vs. low-tech in HRM areas. It could also be interesting for further research to focus on the way HRM has been changing in Mexico due the proliferation of intensive technology firms in the country and the way Mexican firms are dealing with knowledge management in their organizations.

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