Chapter 5

# Mexico's Workers:
## Bonanza for U.S. Companies?

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# Chapter 5

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## SUMMARY

This chapter compares Mexico's workers with their counterparts in the United States and Asia. Mexican workers have generally poor levels of education and training. But so do many millions of U.S. workers, both older blue-collar workers and young people with a high school education or less. The proposed North American Free Trade Agreement (NAFTA) is controversial in part because of fears that it would aggravate the impacts of 'globalization' on U.S. workers, especially those in traditional manufacturing jobs.

From Mexico's perspective, the fundamental intent of a NAFTA is to attract new foreign investment. This could affect U.S. workers both directly and indirectly. It might encourage U. S.-based firms to:

1. transfer existing production from the United States to Mexico, or
2. build new factories in Mexico that would otherwise have been located at home.

At the same time, firms based in Japan, Europe, and elsewhere might find it attractive to locate plants in Mexico to serve the U.S. market, some of which might otherwise have been built in the United States. In doing so, some U.S. jobs and job opportunities would inevitably be lost. While a NAFTA would also stimulate job creation in U.S. firms that serve Mexican markets through exports, the rate at which exports grow will depend in part on the ability of Mexican workers and unions to win wage increases reflecting true productivity improvements (ch. 4). Immigrants from Mexico, finally, compete with U.S.-born workers for jobs. As discussed in the next chapter, a NAFTA could increase immigration in the short and medium terms before rising wages and living standards in Mexico slowed the flow of migrants northwards.

Mexico's future development will depend heavily on its capacity to absorb technology and management practices accompanying foreign investment, and Mexicos human resources will be critical in this process. After decades of import substitution industrialization (ISI), Mexican industry is backward and Mexican workers are poorly prepared by U.S. standards. A NAFTA would force Mexican firms to become more efficient or go out of business. As Mexican productivity improves, the labor market will absorb fewer new entrants relative to output. At the same time, increasing productivity will make Mexican workers better able to compete with U.S. workers. If wages increase to reflect productivity improvement, Mexican workers will become better customers for U.S. goods and services. But if an excess supply of labor holds down wage increases while productivity improves, more jobs will flow to Mexico at the expense of U.S. workers.

So far, Mexico has made only limited progress in building the foundations for continued development. By Third World standards, Mexico has a reasonably well-educated labor force, but compared with Asian countries like South Korea, Mexico has not put a high priority on human capital. Today, Mexico is short of skilled workers, experienced managers, and entrepreneurs. Most fundamentally, Mexico confronts the dilemma of all industrializing countries: its advantages lie in cheap labor at a time when cheap labor is becoming less important in many types of manufacturing-which is no consolation for U.S. workers who find themselves competing for the same kinds of lower skilled jobs.

No one knows what the balance of the job creating and job destroying effects of a NAFTA might be. As explained in appendix 5A, at the end of this chapter, there are too many uncertainties for quantitative predictions. For example, the impacts in the United States will depend in part on how work is organized. Currently, many U.S. manufacturers rely on low-skilled workers in narrowly defined jobs, exactly the kind of jobs most at risk. None of the many economic models that have attempted to predict the impacts of a NAFTA include the full range of relevant factors, which go well beyond those mentioned above. All suffer from assumptions that cannot be independently validated-notably, future levels of investment and its impacts on Mexico's productivity growth. Thus, the models provide little insight useful for policymakers seeking to understand the ways in which a NAFTA might be 'good' or ''bad' for the United States.

# COMPETITION FOR JOBS: MEXICO AS A LOCATION FOR PRODUCTION

U.S.-based firms produce in Mexico for two major reasons—access to markets and access to cheap labor. Table 5-1 summarizes industry views of Mexican investments. The advantages and disadvantages listed in the table will shift, for instance, as educational levels in Mexico improve, or environmental enforcement becomes more stringent (ch. 6). The dynamic nature of these changes is one reason future levels of investment cannot be predicted with any confidence.

## *Why Companies Go Abroad*

U.S.-owned firms locate plants abroad for two primary reasons: to serve foreign markets and to reduce costs of delivered products (box 5-A). Companies put up plants for processing tomatoes or freezing broccoli near growing regions (ch. 10). Governments may require companies to manufacture locally in order to sell into their markets, as Mexico did during the years of ISI. Or a company may feel it necessary to manufacture inside a market to understand what customers want and need; as noted in chapter 8, Hyundai is moving most of its personal computer operations from Korea to the United States—the world's most demanding market for such products.

For commodity-like products where little differentiation is possible, price competition has driven many labor-intensive operations to developing countries. Offshore production has been common not just for low-end television receivers (many of which are now made in Mexico), but for high-technology integrated circuit chips (for which assembly moved to Southeast Asia in the 1960s and 1970s). Little high-technology work has gone to Mexico because the country's infrastructure (water, electricity, transportation) and workforce skills and discipline are poor compared to countries like Singapore, and because products like chips can easily be shipped by air. Now, with automation, some assembly has moved back to the United States. For other products, bulky or heavy in relation to their value (e.g., TV sets), transportation costs are a major factor in location of production (ch. 8).

**Table 5-l—Production in Mexico as Viewed by U.S.-Based Firms**

| Advantages | Disadvantages |
|---|---|
| • Low wage/benefit costs for "unskilled" and "semiskilled" workers. | • High turnover and lack of previous industrial experience among production workers. |
| • Trainable workforce averaging about 6 1/2 years of schooling, with higher educational levels among younger workers in urban areas. | • Can be difficult to hire grey-collar technical workers, administrators, and managers with training and experience. |
| • Unions pliable in many parts of the country. | • In principle, Mexican labor law gives unions considerable power. |
| • Proximity to United States eases many logistics problems. | • Poor transportation, communications, utilities, and other services. |
| • Lax enforcement of environmental and workplace health and safety regulations, at least until recently. | • Traditionally intrusive government contributes to uncertain business climate. |
| • Growing domestic market. | • Lack of local suppliers. |

SOURCE: Office of Technology Assessment, 1992.

## *Choice of Technologies*

Technological change also affects jobs and job opportunities, in both number and skill requirements. Productivity improvements-greater output with fewer workers-can entail much more than simply automation of the production process. Companies redesign products so they are easier to build. They reorganize to improve efficiency, product quality, and responsiveness to customer needs--on the shop floor and through corporate wide reorganizations involving computer-aided manufacturing and ''lean production. '

Make-or-buy decisions—whether a company chooses to produce parts, components, and subassemblies itself or purchase them outside-depend on a company's technological capabilities and strategic choices. Generally speaking, end-product manufacturers prefer to reserve high value-added production for themselves, while purchasing relatively standardized items. Nonetheless, in recent years these familiar patterns have been in flux. Automakers have been asking first-tier suppliers to undertake more design and development work, and to deliver parts of guaranteed high quality on a just-in-time basis. Electronics firms develop products in which the essential functions are incorporated in chips purchased from suppliers, so that the end-product manufacturer of, for example, a desktop computer or a FAX machine is best viewed as a

### *Box 5-A--Globalization and Offshore Production*

Put simply, globalization entails:

. "Offshore' 'production *in low-wage* Locations consistent with needs for quality, flexibility, and on-time delivery. Mexico is the only large, low-wage economy close to the United States.
• Development of *products for worldwide rather than national markets.*

Factory location decisions require balancing production costs (including wages and benefits for skilled workers, administrators, and managers, as well as production workers) against transportation, communications, and other indirect expenses. To the extent that products must be tailored for local markets, costs of technical and marketing activities must be considered as well. Energy costs differ from country to country, along with environmental regulations and political stability. Multinational corporations (MNCs) seek to manage their exposure to currency fluctuations. Local and national governments sometimes grant tax holidays to attract jobs.

Generally speaking, Mexico has suffered in its ability to attract manufacturing investment because of its poor infrastructure and lack of local suppliers and service firms (e.g., tool and die shops). It may take twice as long to build a factory and get it into production in Mexico as in the United States, even though the total costs are about the same.

Only in unusual cases does cheap labor in a country like Mexico make it attractive to shut down an efficient U.S. plant and move. But when companies have excess capacity, perhaps because of declining market share, they close less productive facilities. Inefficient capacity can normally be traced to some combination of:

• outmoded equipment and/or plant layout and design, driving up costs and/or driving down quality;
• outmoded managerial, organizational, and labor practices, so that productivity, up-time, quality, and/or delivery suffer (even though hourly direct labor costs might be competitive);
• long distances to customers and/or suppliers, which raises transportation costs and precludes just-in-time production.

Strategy as well as costs guide location decisions. Within the United States, companies have moved south and west not only in search of lower wages, but also in search of 'right-to-work' laws and a labor force likely to remain nonunion. Internationally, a company may believe that early entry into a country will enable it to preempt rivals, preserving a large part of the market for itself. This was one motive for investments by U.S. auto firms in Mexico during the 1920s and 1930s.

Today, firms adding production capacity to serve the North American market might see strategic advantages in placing efficient new capacity in Mexico. OTA's interviews indicate that this is a particular concern for some companies in the U.S. auto parts industry. Many parts suppliers have old plants and find themselves with excess capacity because their traditional customers--the Big Three U.S. auto firms--have lost sales to Japanese automakers who buy primarily from suppliers at home or transplant suppliers in the United States (ch. 7). If a parts firm sees itself as burdened with poor labor-management relations and an inflexible workforce, and believes it can organize production more efficiently in a new plant, it might well choose to invest in Mexico. In OTA interviews, managers of auto parts firms characterized by limited economies of scale, high capital costs per unit of output, easily shipped products, excess U.S. capacity, little proprietary technology, and corporate cultures resistant to change expressed considerable concern over the threat posed by new entrants setting up in Mexico.

Overseas production operations take many forms. Table 5-2 outlines three of these.

**Table 5-2—International Production**

| Type | Motives | Mexican examples |
|---|---|---|
| Unaffiliated-contract with local firm. | Take advantage of low-cost foreign labor while preserving flexibility through short-term contracts. | Many *maquiladoras* engage in contract production for U.S. companies while U.S.-based agribusiness firms contract with Mexican farmers. |
| Wholly owned affiliate. | Market access—to avoid trade barriers, provide responsive delivery and customer service, or tailor product attributes to local renditions. Labor cost advantages may be secondary or irrelevant. | Automobiles and computers during import substitution industrialization. |
| Strategic partnership (or alliance). | Partners typically motivated by differing combinations of costs, market access, financing, and technology. Strategic alliances may or may not involve equity links. | Joint venture announced in 1991 between Vitro (Mexico) and Corning (U. S.) to make and market household glassware products. |

SOURCE: Office of Technology Assessment, 1992.

systems integrator-in the extreme as little more than an assembler of purchased components. As such examples suggest, the collection of skills and capabilities needed in a world-class manufacturing firm extends well beyond low-wage production labor. It is in technologically based skills and managerial expertise that the United States excels compared to Mexico. The question then becomes: how fast can Mexico improve?

## MEXICO'S HUMAN RESOURCES

Given the competitive imperatives of cost, quality, and flexibility, employers increasingly balance labor quality against labor costs in deciding whereto locate plants. MNCs seek workers with basic skills, acquired through education, good enough that they can be trained in the fro's production technologies and operating procedures. To compete for foreign direct investment (FDI) with other low-wage countries-and to compete through local production with the imports now entering its own markets-Mexico will need to improve its human resource base.

Because no more than 50 to 60 percent of Mexican children enroll in secondary school, compared with 95 percent here, the disparity in workforce skills between Mexico and the United States will not close in the near future.[1] But education is only a starting point. On the shop floor and in the front office, practical skills and experience count for more than years of schooling.

Some of the needed skills are relatively easy to learn. A factory technician maybe reasonably good at his or her job after 3 or 4 years. For other kinds of work—planning and managing factory production, developing new products, negotiating with distributors or bankers-3 or 4 years is only a start. Because Mexico has relatively small numbers of people entering these kinds of career paths, the country will be limited for years by lack of experienced people. That is one reason why know-how acquired through FDI is so important for Mexico.

Historically, Mexico has voiced strong commitments to education, but it has not followed through with sustained efforts to improve the quality of its workforce. Recent policy initiatives have been modestly funded, partly because of the economic crisis. Current education and training programs seem inadequate to deal with a large and complex problem-o ne that will continue to grow because of Mexico's rapidly increasing labor force.

To improve its human resource base, Mexico must:

- raise the average level of education of its population, improving literacy and other basic skills for those already in the blue-collar workforce, as well as young people;
- increase its pool of workers with vocational-technical training in grey-collar skills (tool-making, equipment repair and maintenance, quality control); and
- train more college graduates for white-collar jobs in engineering, administration, and management (computer programmers, accountants, financia1 planners).

### *Education and Training*

Average educational levels of Mexican workers are much lower than those here (box 5-B). Mexico spends about $70 per elementary school student per year, compared with $4,070 in the United States.* While U.S. employers and politicians are concerned about 'functional' or "marginal' literacy, Mexico still has a large number of absolute illiterates who cannot read or write their own name. In 1992, 12 percent of the population was illiterate, 14 percent of children of school age were not in school, and 6.7 million adults had no education at all.[3] Despite a long series of government literacy programs, Mexico's 1990 report to United Nations Educational,

1 *Digest of Education Statistics* (Washington, DC: Department of Education, Office of Educational Research and Improvement, 1988), pp. 340341.

Only about 6 percent of young Mexicans enter college, although admissions standards are almost nonexistent and tuition at the national university the equivalent of about 6 cents. "Students Close U. of Mexico to Protest Tuition Increase," *Chronicle of Higher Education,* July 8, 1992, p. A35. A proposed increase to nearly $700 per year would close off higher education to many students from the lower classes.

2 "Staff Appraisal Report: Mexico Primary Education Project," World Bank, Washington, DC, Aug. 28, 1991, p. 41; *Digest of Education Statistics,* 1991 (Washington, DC: Department of Education, National Center for Education Statistics, 1991), p. 155. The U.S. figure is the average for both elementary and secondary students.

3 ~&, Cawthorne, "School Reforms Spark Debate, ' *TheNews* [Mexico City], May 21, 1992, p. 4. Also see "Report on Education in Mexico," Mexico Ministry of Public Education, paper prepared for Forty-Second Meeting of the International Conference on Education, Geneva, Switzerland, September 1990. Illiteracy in the United States is about 1/2 percent. Estimates for both countries are based on self-reporting of complete inability to read and write, and probably understate true levels of illiteracy.

### *Box 5-B—Basic Education in Mexico*

The Federal Education Ministry controls Mexico's system of free public schools, paying 70 percent of the costs (with the rest paid by the states). Education is not only free but in principle compulsory for all children aged 6 to 15, although, as shown in table 5-3, educational attainments do not yet reflect that much schooling. The crisis of the 1980s forced many children out of school and into the labor market.[1] Public expenditures on education fell (see ch. 3, table 3-8), and teachers' salaries along with them.

**Table 5-3-Average Educational Levels for Mexicans Aged 15 and Above**

| Year | Years of schooling completed |
|---|---|
| 1970/71 | 3.4 |
| 1980/81 | 5.4 |
| 1989/90 | 6.3 |

SOURCE: Nora Lustig, "Mexico at the Threshold of Prosperity," unpublished draft, September 1991, table III.8.

The figures in table 5-3 conceal considerable variation by age (younger people have more schooling than older people), socioeconomic status (children in poor families often leave school at an early age to help earn money for the family), gender (boys get more education than girls), geography (urban children stay in school longer), and race (Indian and ***mestizo children*** get less education). Thus, a U.S. automaker opening anew engine plant in Mexico was able to hire the cream of the local labor force-half of the 1,500 people applying for 149 slots as technician trainees had had 9 or more years of school.[2]

Like many other countries, Mexico continues to suffer from discrimination against women and minorities. Unless educational opportunities improve, Mexican women will continue to find work predominantly as domestics, in personal services, in the apparel industry, and doing simple, unskilled jobs in ***maquilas*** or ***maquila-like*** plants. Closing the gender gap would help Mexico tap the skills it needs to industrialize rapidly. Better educational opportunities for farmers and farm workers, many of whom are Indians-and practical training in agricultural technologies--could help Mexico improve its agricultural productivity and cope with the problems that reform of the ***ejido*** system will bring. But differences in wealth and population density between northern and southern states will make this difficult. Although millions of poor families have moved to Mexico's large cities, the worst poverty remains in the countryside. Low population densities in rural areas hamper efforts to maintain adequate schools. Teachers prefer urban areas, and sometimes resign if assigned to a village school. For U.S. firms considering Mexico as a production site, variation in levels of education creates an incentive to locate in the northern two-thirds of the country.

[1] Nora Lustig, "Economic Crisis, Adjustment and Living Standards in Mexico, 1982-85," *World Development,* vol. 18, 1990, pp. 1,325-1,342. In interviews, teachers note that the cost of school materials and uniforms are a burden for many families, while primary-aged students sometimes work to help with family finances. Susan Rippberger, ' 'Insiders' Perspectives on Strengths and Weaknesses of the Mexican Education System,'' unpublished report, 1988, pp. 5-6.

[2] Harley Shaiken and Stephen Herzenberg, *Automation and Global Production* (La Jolla, CA: Center for U.S.-Mexican Studies, University of California, San Diego, 1987), p. 10. The MIT International Motor Vehicle Project found ears produced at Ford's Hermosillo, Mexico, factory had the best quality of those from any high-volume assembly plant in the world; it was, they said, the result of a young, motivated, and intensively trained workforce that "embraced lean production with the same speed as American workers at the Japanese transplants in North America.'' James P. Womack, Daniel T. Jones, and Daniel Roos, *The Machine That Changed The World: The* Story *of Lean Production (New* York, NY: HarperCollins, 1991), p. 87.

Once up and running, multinationals that had initially looked for high school graduates started hiring junior high school graduates more typical of the Mexican labor force as a whole. ''The Auto and Electronics Sectors in U.S.-Mexico Trade and Investment," report prepared for OTA under contract 13-1815 by Harley Shaiken, May 1992, p. 5.

Scientific and Cultural Organization stated that "illiteracy is a serious problem to which a solution has not yet been found.'

### The Vocational-Technical System

Duriring the 1980s. Mexico's government declared an 'Educational Revolution, ' with special attention

[4] ''Report on Education in Mexico,'' ibid., p. 90. President&hevarria(1970- 1976) renewed and refocused government efforts to combat illiteracy, but his National System of Adult Education (SNEA) failed to attract absolute illiterates, and dropout rates were high. SNEA programs included "cultural missions" to rural communities involving local teachers, telesecondary school offerings, and mobile libraries. Daniel A. Morales-Gomez and Carlos Alberto Torres, *The State, Corporatist Politics and Educational Policy Making in Mexico (New* York, NY: Praeger, 1990), pp. 107-135.

Echevarria's successor, President Lopez Portillo launched a new initiative, the National program for Literacy Training (PRONALF), which relied heavily on temporary employees and volunteer university students to avoid the teachers union. Reductions in illiteracy over this period appear to result more from the growing reach of the public school system than from PRONALF.

to vocational educations But technical training in Mexico remains weak. Many young people drop out or fail in primary and middle school, reducing the numbers who get advanced training of any sort, while most Mexicans-like their U.S. counterparts—view vocational training as inferior to academic education. Despite heavy investments in secondary vocational education over the past two decades, about 60 percent of Mexico's 2 million high school students take college preparatory courses, while another 20 percent attend dual-track vocational and preparatory high schools (most of whom then go on to a university). Only 20 percent enroll in vocational schools leading directly to work.[6]

The current vocational education system evolved from crafts schools created in the 19th century and agricultural schools established in the 1920s. Today, three groups of vocational-technical schools coexist somewhat uneasily:[7]

1. Dual-purpose technical high schools. Some are operated by the National Technological Institute (established in 1937) and its network of colleges, while others are overseen by the Secretariat of Public Education (SEP). Graduates of these schools can go on to attend college and most do so.
2. Schools known as *Centros de Enseñanza Terminal* (CETS, dating *from* 1958), originally intended for those going directly into the labor market. Most of the 163 CETS centers have evolved to become similar to the dual-purpose technical high schools. Only 40 percent of the young people enrolled in these two types of schools are preparing to go directly to work, while 60 percent are on a dual-purpose track (table 5-4).
3. In 1978, with fewer than 5 percent of Mexican students (at all levels) enrolled in technical fields, the government established a quasi-autonomous agency under SEP known as CONALEP. A network of 250 CONALEP centers offers 3-year training programs in about 90 occupations (in fields ranging from agriculture to health care and tourism). CONALEP training qualifies graduates for work, rather than advanced education. Three World Bank loans, totaling $323 million, have helped CONALEP grow rapidly.[8] By the 1989/90 school year, CONALEP enrolled nearly 20 percent of the 800,600 young people enrolled in one of Mexico's three vocational education programs (table 5-4). Recently, CONALEP has offered more short courses and evening courses, in part because many young people cannot afford to spend 3 years studying rather than working.[9]

**Table 5-4—Vocational-Technical Education in Mexico**

| School or program | Enrollment (1989/90) | Graduates (1989/90) |
|---|---|---|
| Dual-purpose technical high schools | 383,200 | 82,400 |
| Terminal technical schools (CETS and others) | 262,100 | 72,900 |
| CONALEP | 155,300 | 33,200 |
| Total | 800,600 | 188,500 |

SOURCE: *Staff Appraisal Report: United Mexican States, Third Technical Training Project (CONALEP III)* (Washington, DC: World Bank, 1991), p. 8.

Despite the growth in CONALEP, both Mexican and foreign firms complain of inadequate skills in the workforce. Shortages of technical and professional workers have pushed up salaries in *maquiladoras.*[10] *In* Guadalajara, electronics firms have been unable to hire mid-level technicians trained in quality control methods.[11] To alleviate such shortages and cope with the rising unemployment, the

[5] Wayne Riddle, "Education Concerns, " *North American Free Trade Agreement: Issues for Congress* (Washington DC: Congressional Research Service, July 12, 1991), p. 46.

[6] "Report on Education in Mexico", op. cit., footnote 3, p. 91.

[7] Victor L. Urquidi, "Technical Education in Mexico: A Preliminary Appraisal," Prospects, vol. 12, 1982, p. 115.

[8] Jaime Luis Padilla, Director General for Training and Productivity, Ministry of Labor and Social Welfare, personal communication% Jan. 16, 1992; Juan Pravda, World Bank, personal communication, Feb. 6, 1992.

CONALEP programs are closely job-related, overseen by industry boards and employ part-time teachers from industry. The Ministry of Education claims that 62 percent of CONALEP graduates find jobs within 3 months of graduation 84 percent in the specialties for which they have trained, compared with 52 percent of CETS graduates and 25 percent of university engineering graduates.

[9] Ing. Diodoro Guerra, Director General, CONALEP, personal communication, May 19, 1992.

[10] "The Maquiladoras: Present Status, Future Potential," report prepared for OTA under contract No. H3-7040 by Leslie Sklair, December 1991, p. 22.

[11] "NAFTA and the Electronics Industry in Mexico, " report prepared for OTA under contract No. H3-7200 by Patricia A. Wilson, February 1992.

Ministry of Labor and Social Welfare (STPS) launched a pilot program in 1984 to retrain displaced workers, expanded the next year with the help of an $81 million World Bank loan. About half of all retraining has taken place at CONALEP centers, with STPS paying tuition and the minimum wage for enrollees in 1 to 6 month courses.

## Worker Training

Most company training in Mexico takes the form of on-the-job instruction and short in-plant courses (box 5-C). Although the Mexican constitution guarantees workers the right to employer-provided training, the government did not follow through on this promise until 1978, when it enacted Article 153-A of the federal labor law. This article requires companies and their employees (through unions, where they exist) to jointly develop training plans, to be submitted to STPS for approval, and provide graduates with certification of their skills. During the first several years after passage of Article 153-A, STPS concentrated on informing companies of the new law and urging compliance.[12]

With the opening of the economy, and the anticipation of pressure on small and medium-sized fins, STPS officials decided that active training assistance would be needed; as in the United States, most smaller firms did little or no training and had no experience to draw on. In addition to the CONALEP program for retraining displaced workers mentioned above, STPS initiatives included:

- upgrading of the Public Employment Service;
- research on the impact of retraining and on-the-job training programs; and
- the CIMO program described in box 5-C.

STPS put more than $100 million into these efforts. About 12,000 small and medium-sized firms have participated in the CIMO program, in sectors including metalworking, electronics, garments, textiles, shoes, furniture, and tourism. Some 70,000 people have received training, and the government is planning to expand the program. Funding promises to be the principal obstacle: large numbers of workers, supervisors, and managers need training in depth, requiring longer and more costly programs than have been common in Mexico. In 4 years, when anew World Bank loan for CIMO runs out, given the Mexican Government's limited resources, the private sector would almost certainly have to pay much of the cost.

## Higher Education

Except for inexpensive consumer goods, Mexican firms make few products of their own design. To move into more complex production and more demanding markets, both indigenous firms and the subsidiaries of MNCs will need capable engineers and managers. During the past decade, engineering enrollments in Mexico's public and private colleges and universities grew faster than enrollments in any other field, reaching 342,000 in 1990-nearly as many as in the United States.[13] It takes 5 or 6 years to earn the equivalent of a bachelor's degree in engineering, and attrition is high. Even so, Mexico graduated 28,200 engineers in 1989, two-thirds more than in 1979—and nearly half as many as the United States (table 5-5).[14] Mexico lags further behind in its stock of engineers, with 4,3 engineers per thousand people in 1989, compared with 11.6 in the United States.

About half of Mexico's engineering students enroll in polytechnic institutes; the remainder study at colleges and universities. The National Polytechnic Institute was intended to supplement a university system strongly oriented toward the humanities. Graduates of either polytechnics or universities become *licensorios in an* engineering discipline (or in such related areas as marine technology, business administration, architecture, or economics).

12 Large firms-and unionized firms-are more likely to comply than smaller establishments. Agustín Ibarra, General Director of Employment, Ministry of Labor and Social Welfare (STPS), personal communication, January 1992. Article 153-A requires that labor contracts in unionized companies specify training to be provided.

13 Undergraduate enrollments in U.S. engineering schools have been declining since 1983, when they peaked at 441,000. The 1989 total was 378,000, to which some 128,000 engineering technology students should probably be added for comparisons with other countries. *Science & Engineering Indicators* 1991, 10th ed. (Washington, DC: National Science Board, 1991), p. 234.

14 *El Estado del Arte de la Ingenieria en México y en el Mundo* (Mexico City: *Academia Mexicana de Ingenieria*, 1991). Graduation rates for engineers in Mexico are the lowest among all academic disciplines, with, in 1989, only 8.4 percent of the students enrolled in engineering programs graduating, compared with 11.8 percent in nonengineering fields.

Mexico compares less well with the United States if scientists are included, graduating 31,900 at both undergraduate and graduate levels in engineering and the natural sciences in 1990, compared with almost 250,000 in the United States. This comes to about 3.9 graduates per 10,000 in the Mexican population, compared with about 10 per 10,000 in the United States.

### *Box 5-C-Training and Industrial Adjustment*

**Skills and Training of Mexican Manufacturing Workers**

A 1988 survey of Mexican manufacturing establishments found that most workers had quite limited skills.[1] The profile:

- unskilled workers, 20.1 percent;
- semiskilled workers, 24.9 percent;
- skilled workers, 32.5 percent;
- technicians, 14.9 percent; and
- professionals, 7.5 percent.

**Half the workforce (49.9percent) reported no more than a primary school education (i.e.,6 years or less of schooling), one quarter had had some secondary school, and just 15.6 percent had earned a high school diploma. Another 8 percent reported college or university degrees (with 0.6 percent having completed postgraduate studies). The study concluded that about 20 percent** of those surveyed lacked adequate **training, with 23** percent of semiskilled **workers** and *27* percent of unskilled workers rated as poorly prepared for their jobs. Small companies reported the largest skill deficits.

Plant managers commonly responded to skill deficiencies with short courses on an ad hoc basis for selected employees. Forty percent of workers surveyed had received some job-related training.[2] Three out of five workers reported courses lasting less than a month, 26 percent courses lasting 1 to 3 months, and the remainder 4 months or longer. Mexican firms rely primarily on internal trainers (51 percent) and other workers (37 percent) for instruction; there has been little involvement by private training centers (6 percent), secondary schools and technical institutes (2 percent), or government training centers (1 percent).[3]

**Training and Adjustment: The CIMO Program**

During the ISI period, when customers had no choice but to accept the goods produced by Mexican firms, neither employers nor government Worried much about training. Most large fins, as in the United States, organized work around simple, unskilled tasks. Today, Mexican companies not only face competition from imports, but many would like to export their goods. This means achieving world-class standards. To help them, STPS, backed by World Bank loans, created the ***Capacitación Industrial de la Mano de Obra*** (CIMO) program.[4] CIMO operates 26 training centers, staffed by a total of 90 "promoters," whose job is to analyze the needs of local industry and identify companies' immediate training needs.

In Tlaxcala, for example, Mexico's least populous state, CIMO promoters have worked with small fins, including a number of apparel shops in which managers had little familiarity with modern production practices. The promoters found volunteers willing to allow a consultant into their shops. In two shops visited by OTA, the consultant had helped managers master the basics of standardized garment production under the "bundle system" (ch. 9).

In a very different setting, the large industrial city of Puebla, local promoters worked with Volkswagen to upgrade the local supplier base. The first stage of this undertaking, funded jointly by VW, the suppliers, and CIMO, focused on defining training needs for supervisors, skilled workers, and key production employees (e.g., total quality control, just-in-time inventory management). Most of the subsequent training programs lasted a few days to a few weeks. A planned second stage may evolve into a more comprehensive industrial extension program, including technical and business assistance.

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1 "*Características del Personal Ocupado y Requrimientos* de *Capacitación en Establecimientos Manufactureros Mexicanos*," *Instituto Nacional de Estadística, Geografía e Informática* (INEGI), *Mexico* City, 1991. The survey covered 3,189 plants in sectors including textiles and apparel, paper, printing, plastics, metal fabrication and food products.

2 This figure exceeds the 35 percent of U.S. workers who reported in a 1983 survey by the Bureau of Labor Statistics that they had received some training for their current job. See *Worker Training:* Competing *in the New International Economy* (Washington, *DC:* Office of Technology Assessment, September 1990), pp. 227-228. Moreover, training was more evenly distributed among occupational groups than in the United States, where managers and professionals arc more likely to get training than unskilled or semiskilled workers.

3 *Maquiladoras* report substantially lower skill levels than found by the survey discussed above. See, for example, Jorge Carillo, "*Mercados de Trabajo en la Indústria Maquiladora de Exportación*" [Labor Markets in the Assembly Plant Exporting Industry], unpublished report, *El Colegio de la Frontera Norte*, Tijuana, 1991. Carillo's 1991 survey of *maquila* plants in the auto parts, electronics, and apparel sectors, located in Juarez, Tijuana, and Monterrey, found that more than three-quarters of workers bad qualifications and were performing unskilled tasks, half of them assembly. Most training was done internally; only 29 of 43 technical schools surveyed had any relationship with local *maquiladoras*.

4 Agustín Ibarra, General Director of Employment, Ministry of Labor and Social Welfare (STPS), personal communication, January 1992.

**Table 5-5-Engineering Graduates by Country, 1989**

| | Number of graduates | Graduates per 10,000 population |
|---|---|---|
| South Korea | 28,141 | 6.70 |
| Japan | 77,009 | 6.62 |
| Singapore | 1,452 | 4.84 |
| Taiwan | 7,994[b] | 4.0 |
| Mexico | 28,193 | 3.32 |
| France | 16,658 | 2.97 |
| United States | 67,214 | 2.70 |
| West Germany | 9,579 | 1.55 |
| India | 28,500[b] | 0.34 |

[a]Bachelor's level equivalent
[b]1988.

SOURCES: *El Estado del Arte de la Ingenieria en México y en el Mundo* (Mexico City: *Academia Mexicana de Ingenieria, 1991),* p. *153;* and *Science & Engineering Indicators 1991,* IOth ed. (Washington, DC: National Science Board, 1991), p. 263.

At the graduate level, about 5,300 students were enrolled in engineering programs in Mexico in 1990, compared with 109,000 in the United States.[15] U.S. graduate engineering programs enrolled some 38,000 foreign nationals in 1990, but most came from Asia and very few from Mexico. Data from the U.S. National Science Foundation (NSF) indicate that as a fraction of national populations, Mexican students received only one-tenth as many doctoral degrees in engineering and science from U.S. institutions between 1960 and 1988 as Korean students, and one-fortieth as many as those from Taiwan.

Academic training is only a starting point for the development of industrial competence. OTA's interviews with managers in Mexican firms-MNCs like IBM or Hewlett-Packard (H-P), as well as Mexican-owned companies-indicate that the country's universities and technical institutes graduate capable bachelor's level engineers.[16] H-P's plant in Guadalajara, once strictly an assembly site for impact printers and personal computers, now conducts some design and development. Graduates of local universities fill most of H-P's engineering positions.[17]

But there are relatively few such jobs in Mexico today. A recent survey in Guadalajara found that IBM and H-P were the only two foreign-owned electronics firms conducting R&D.[18] In 1988, 350 students applied for internships at IBM; the company found 150 qualified for positions, but could only hire 20. It appears that, while Mexico graduates engineers in considerable numbers, many have trouble finding technical positions and leave engineering. Some go to work as skilled production workers or enter nontechnical fields such as accounting and marketing.

Effective deployment of Mexico engineers must seemingly await demand. Mexican industrial policies and tax laws provide few incentives for MNCs to conduct R&D locally, while Mexican-owned firms rarely pursue technology-intensive lines of business (with the primary exception of the steel and petrochemical industries). Mexico's R&D expenditures are significantly lower than other developing countries. According to NSF, Mexico invested 0.2 percent of its gross national product in R&D in 1987, compared with 1.4 percent for Taiwan and 1.8 percent for South Korea. The government pays for almost all of Mexico's R&D, often in educational institutions that have little contact with industry. So far, then, it appears that Mexico has not been able to generate a self-sustaining technological infrastructure; the country has a surplus of academically educated engineers and a shortage of those tested and tempered by experience.

## Mexico *Compared with Developing Countries in Asia*

Might Mexico nonetheless follow the trajectory of East Asia's newly industrializing countries (NICs)---Korea, Taiwan, Hong Kong, Singapore--which moved rapidly from reliance on low-wage, low-skill production into more sophisticated manufacturing? How does Mexico match up today with Indonesia, Thailand, and Malaysia (sometimes referred to as the newly industrializing economies, NIEs, to distin-

15 *El Estado del Arte de la Ingenieria en México y en el Mundo,* ibid., p. 151; Science& *Engineering Indicators 1991, Op.* cit., footnote 13, p. 239. Eighty-seven percent of the Mexican students were enrolled in master's level programs, the rest at the doctoral level. Whereas engineering students comprise 32 percent of total emollients in Mexican universities, graduate engineering students comprise only 12 percent of the graduate student population, a percentage that has declined in recent years.

16 Almost half of IBM's permanent workforce in Guadalajara consists of engineers, mostly electrical and mechanical, many of whom have been recruited from local universities. Harley Shaiken, *Mexico in the Global Economy: High Technology and Work Organization in Export Industries* (La Jolla, CA: University of California, San Diego, Center for U.S.-Mexican Studies, 1990), p. 110.

17 "NAFTA and the Electronics Industry in Mexico, " op. cit., footnote 11; and OTA interviews.

18 "NAFrA and the Electronics Industry in Mexico, ' ibid.

**Table 5-6-Education in Mexico Compared With Asian Developing Countries**

| | Mexico | Korea | Singapore | Malaysia |
|---|---|---|---|---|
| **Spending on education** | | | | |
| As a percentage of GNP (1986) | 2.8% | 3.0% | 5.0% | 7.9% |
| As a percentage of federal budget (1989/90) | 11.7 | 19.6 | 18.1 | 5.3 |
| **Percentage of age group enrolled (1986-88)** | | | | |
| Primary grades | 990/. | 100% | 100% | NA |
| Secondary (all) | 53 | 86 | 69 | 57 |
| Secondary technical | 12.6 | 15.9 | NA | 1.7 |
| College/university | 15.2 | 37.7 | NA | 6.7 |
| **Science and engineering majors as percent of higher education students** | 36%O | 31% | 29% | 34% |
| **Average years of schooling in the adult population (1988)** | 6.2 | 8.O[a] | 6.O[a] | 7.0 |

NA= Notavailable.

[a]1980

SOURCES: Average years of schooling—George Psacharopoulos and Ana Maria Arriagada, "The Educational Composition of the Labor Force: An international Update," unpublished paper, January 1992.
Government spending— Mexico, *Government and Financial Statistics Yearbook 7991* (Washington, DC: International Monetary Fund, 1992), Mexico table 3; others, Steven Schlossstein, *Asia's New Little Dragons: The Dynamic Emergence of Indonesia, Thailand, and Malaysia* (Chicago, IL: Contemporary Books, 1991), p. 24.
Other entries—Hwnan *Development Report 1991* (New York, NY: Oxford University Press, 1991), pp. 146, 148.

guish them from the more advanced NICs)? The NIEs, in particular, have developed in large part through foreign investment, much of it Japanese, while the Salinas administration hopes that welcoming foreign capital will speed Mexican development.

## Education

Table 5-5 showed that Mexico graduates as many engineers as Korea, and many more than Taiwan or Singapore (though not on a per-capita basis). Table 5-6 shows that Mexico also compares reasonably well with Asian NICs and NIEs in primary and secondary education, although it spends the least. Mexico's dropout rates also tend to be high--45 percent from elementary school, 48 percent from technical secondary education—while Taiwan and Hong Kong graduate 80 percent of those enrolled in secondary education.[19]

## Industrial Structure

**In the** Asian NICs, in several European countries, and in Japan, communication and cooperation within corporate organizations (for example, between manufacturing engineers and production workers) and among companies have been critical factors in the spread of best practices and in the development of flexible networks of manufacturing firms.[20] Generally speaking, these channels and networks are poorly developed in Mexico.

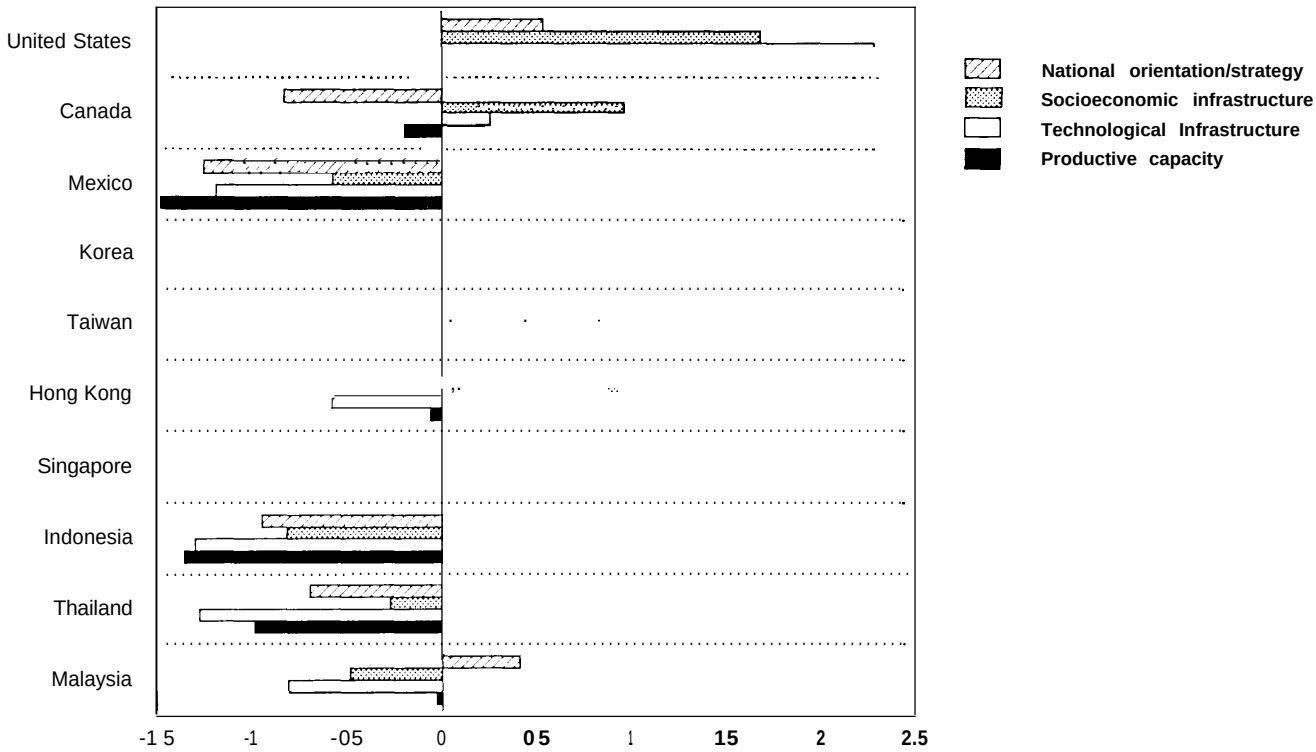
Monterrey, home of many of Mexico's most dynamic companies, is one exception. There, longstanding family ties have contributed to the formation of manufacturing networks.[21] At the same time, foreign firms have pushed local enterprises to improve quality through reorganization and training. Monterrey firms that have been leaders in flexible work organization include Conek, a Caterpillar affiliate, and Metalsa, a supplier to Mexico's foreign-owned automakers. But most companies that reor-

19 Jose Dominguez, World Bank, personal communication April 1992; Steven Schlossstein, *The End of the American Century* (New York, NY: Congdon & Weed, 1989), p. 250. On the relationship between education and economic growth, see Robert J. Barre, "Economic Growth in a Cross Section of Countries," *Quarterly Journal of Economics*, vol. 106, 1991, pp. 407-443,

20 See, for example, Paul Hirst and Jonathan Zeitlin, eds., *Reversing Industrial Decline? Industrial Structure and Policy in Britain and Her Competitors* (Oxford, UK: Berg, 1989); Robert E. Cole, *Strategies for Learning: Small-Group Activities in American, Japanese, and Swedish Industry* (Berkeley, CA: University of California Press, 1989).

21 Lourdes Melgar, "Emerging Alternative Forms of Economic Development: The Industrialization Process of Monterrey, Nuevo Leon," paper presented at the Annual Meeting of the Latin American Studies Association, Washington DC, Apr. 4-6, 1991, pp. 11-12; Maria de 10S Angeles Pozas, "Modernization of Labor Relations in Companies of Monterrey, " University of California, San Diego, Center for U.S.-Mexican Studies, forthcoming [translated by Deanna Haremend, Congressional Research Service].

**Figure 5-1—indicators of Technological Capacity[a]**




*National orientation/strategy is* **intended to indicate "directed action to achieve technological competitiveness" based on government policies, government-business relations, and social values.**

*Socioeconomic infrastructure* **incorporates measures of capital formation, inward direct investment, and spending on education.**

*Technological infrastructure* **incorporates measures of R& D spending, alliances involving multinational enterprises, technical personnel in the labor force, and investments in capital stock (e.g., telecommunications infrastructure, computers).**

*Productive capacity* **is based on such measures as manufacturing productivity and investments in machine tools and other manufacturing equipment.**

[a]Normalized t. median values of zero for 29 countries, based on surveys of expert opinion conducted in 1990 and statistical data for the late 1980s.

**SOURCE: Alan L. Porter and J. David Roessner, "Indicators of National Competitiveness in High Technology Industries," Executive Summary, Phase I Report, and Phase II (Final) Report under National Science Foundation Award Number 8808909, Georgia Institute of Technology, May 1991.**

ganized work or introduced modern quality control practices have done so on a piecemeal basis, and remain committed to methods rooted in Taylorism and ''scientific management. ''

Although manufacturing networks are poorly developed, Mexico's institutional structures-labor unions, business and industrial chambers at the local, State, and national levels--could become vehicles for dissemination of government-to-business assistance and interfirm cooperation. Along these lines, the Ministry of Commerce (SECOFI) recently initiated economic development planning, in cooperation with business chambers and labor, in each of the 31 Mexican States.**

## Technological Capacity and Organizational Competence

Figure 5-1 presents a set of broad comparisons of technological capability among Mexico, the United States and Canada, and the NICs and NIEs. Each of the four indicators is itself a normalized composite

22 The Technological Institute of Monterrey supported development of the plan for the state of Chihuaha by evaluating the needs of business and industry sector by sector. Labor unions, the state government, and CANACINTRA (the association of small manufacturers) participated in formulating the plan itself, and have signed a formal agreement to implement it. Luis Miguel Pando Leyva, General Director, CANACINTRA, personal communication, May 20, 1992.

based on statistics (e.g., levels of education, capital stock in industry) and expert opinion (e.g., evaluations of openness to foreign investment, managerial capabilities). While any such set of indicators will be open to question on almost innumerable grounds, there is little alternative for attempting extensive cross-country comparisons.

Mexico's profile on the four indicators in figure 5-1 is much like that of the NTEs but indicates that Mexico is well behind the Asian NICs. To the extent that competition for jobs depends on level of economic development, Mexican workers will be competing against their counterparts in Indonesia and Thailand rather than those in the United States or Japan.

To improve its capabilities, Mexico must improve its human capital at many levels. The country needs capable farmers and bankers, skilled production workers, experienced technicians and engineers, able managers, and sensible administrators. Japan's postwar economic performance reflects a stress on skills over knowledge, and on organizational knowledge and skills over those of individuals. This is a lesson that the Asian NICs appear to have learned, but Mexico has not yet grasped. Traditionally, a small elite received a good education on classical European lines, with much of the rest of Mexico's school-age population largely neglected. This pattern has begun to change, but countries like Korea have viewed education and training in more nearly ''universal' terms for decades, and thus built strong foundations for continuing development.

The pacing factors in Mexico's development thus promise to be institutional and organizational. Human capital must become embedded, taking on the form of organizational capital, before it can contribute to productivity growth. The recent troubles of the domestically oriented portion of Mexico's economy suggest that it will take time for Mexico to move beyond the "branch plant" stage of development, regardless of how much know-how might be available in principle through direct investment by multinational firms.

## CONCLUDING REMARKS

With or without a NAFTA, Mexico's economic structure promises to change rapidly in the years ahead. New jobs will require new skills. Companies will have to adapt to competition or close their doors. The adjustment pressures on Mexico will be even greater than those on the United States. Mexico's government has launched a series of initiatives aimed at improving workforce skills through adult literacy programs, modernization of the vocational education system, and worker training. However, it is not clear whether these programs will succeed.

Mexico's earlier choices in education and training leave it in the 1990s with a relatively modest capacity to absorb sophisticated technologies and business practices. This means that large numbers of Mexicans will have to improve their knowledge and skills as the economy develops. It also means that whatever impacts economic integration with Mexico has had on U.S. workers in the past, these are likely to be dwarfed by future effects—positive or negative-particularly if Mexico succeeds in improving its capabilities in relatively sophisticated manufacturing.