Work Reform in the High-Technology Industries of Route 128 and Its Effects on Cambodian Immigrant Labor

by

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Submitted to the Department of Urban Studies and Planning in Partial Fulfillment of the Requirements for the Degree of

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May 18, 1994

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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ABSTRACT

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By Caroline Jooyong Kim

Submitted to the Department of Urban Studies and Planning on May 18, 1994 in partial fulfillment of the requirements for the degree of Master of City Planning.

U.S. high-technology firms are undergoing work reform and are changing the skill requirements of its production operators. In changing from a Taylorist mode of production, where operators are limited to manual tasks, firms now are borrowing elements of production systems from abroad in order to stay competitive in a global marketplace. The high-technology industries of the Route 128 corridor are restructuring their work organization to one similar to the Japanese lean production system, which relies upon an upskilled workforce, where operators must possess more verbal communication and math skills. This thesis examines firms' requirements for an upskilled workforce and its effects on Cambodian immigrant labor that are concentrated as production workers in Route 128, high-technology industries.

The changing skills requirements undertaking high-technology industries will significantly impact all immigrant groups who may not possess a mastery of the English language and have little formal education. I present a case study of Cambodian immigrants because Lowell's Cambodian community represents the second largest Cambodian community of America. Focusing on this community provides the richness and depth offered by a physical community, with the experience and historical knowledge of community-based organizations and service-delivery agencies that serve the Cambodian community. Most Cambodians entered America as refugees, coming from the rural countryside and having little formal education, leading one to believe that they will be disadvantaged due to a lack of English-language skills and math skills currently required of production workers in high-technology industries.

Cambodian individuals moved into Lowell during the boom period of 1984 to 1988, attracted to employment opportunities along the Route 128 corridor. Because there was a labor shortage during this time, many gained employment as assemblers in firms practicing a Taylorist work organization. Many suffered during the decline of the electronics industry during the 1988 to 1992 period, as they were the first to be laid-off since they were employed at the bottom of the firm's hierarchy. But currently, business is picking up along the corridor as firms realize that they must adopt more productive measures to stay competitive in the global marketplace.

I present six high-technology firms that are employing a leaner production system based on continuous improvement processes and hiring Cambodian immigrants. Because many Cambodians have been employed in the firms for an average of seven years, they
possess valuable production knowledge and therefore firms have invested in training them by providing English-language and math classes.

In most of the six firms interviewed, managers said that their demand for increased skills is a prevailing trend, but do not plan to offer training for future workers. They saw the training programs as a one-shot investment, holding negative implications for future Cambodian applicants who do not possess the required skills.

Thesis Supervisor: Frank Levy
Title: Professor
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CHAPTER 1
INTRODUCTION

The intersection of work reform and the use of immigrant labor in the Route 128 area provides a rich source of research on how the changed organization of firms affect immigrant labor. In the literature, there is a void as to how immigrants will be utilized in the context of the upskilled requirements that these firms require. Traditionally, the literature has viewed immigrants as unskilled labor, segregated to the secondary labor market, unable to access positions in skilled, unionized sectors of the primary labor market. But increasingly, employment opportunities for immigrant and native production workers are changing as jobs become concentrated in high-technology industries adopting leaner production methods, similar to the Japanese lean production system. This system relies upon continuous improvements in the production process through the input of a workforce possessing English-language skills and math skills, far beyond those traditionally required of the production operator.

This trend towards work reform, and specifically towards a leaner production system, is prevalent in the firms of the Route 128 corridor of Eastern Massachusetts. This corridor is noteworthy because of its concentration of high-technology industries and is one of the most renowned industrial districts of America. Especially concentrated in this district is the electronics industry. It was the minicomputers industry which launched the growth of the regional economy in the 1984 to 1988 period. And because the Route 128 firms are trying to recover their once dominant position in the electronics market, many are switching towards a leaner production system based on quality in the face of increased global competition.

It was the growth of the minicomputers industries during the 1984 to 1988 period that acted as a magnet for immigrant labor coming into the Route 128 area. Suburban towns, such as Lowell and Lawrence, although historically having served as a gateway for
European immigrants, again received more immigrants but this time from the countries of Latin America and Asia. The most dramatic influx of an immigrant group into the area during this period was the secondary migration of Cambodian immigrants from other U.S. states into the city of Lowell. Although an existing Cambodian community was present before this migration between 1984 and 1988, the community began to thrive during this time as approximately 9,736 Cambodians came into the area primarily for employment opportunities in the high-tech industries of Lowell and of the Route 128 corridor.\(^1\) It has been documented that due to a shortage of production operators, many corporations were actively recruiting in the Cambodian community of Lowell. Specifically, Wang Laboratories reached out to community leaders in order to hire production workers (O'Connell, 1993). Additionally, at the Department of Employment and Training in Lowell, Cambodian immigrants would line up outside the door of an employment coordinator and would be placed in a job upon hours of arrival in Lowell. Many Cambodians attained employment without finishing any training (McQuaid, 1994).

Currently, the Cambodian community of Lowell has declined from a peak of 35,000 in the boom period to 25,000 (Pen, 1993). Many Cambodians have moved out of the area during the decline of 1988 to 1992; but currently, as the regional economy picks up, many Cambodians are moving into the area from states currently undergoing recession, such as the state of California, and hence causing a constant migration into and out-of the state of Massachusetts and of the city of Lowell (Pen, 1993). Although during the economic decline of 1988 to 1992, there was vast unemployment with an

\(^1\) This estimate of the number of secondary migrants is derived from Jyothi Nambiar, "Lowell's Cambodian Population: Representative of the 'Urban Underclass'?" (Undergraduate thesis, Swarthmore College, 1992). As monitored by the International Institute of Lowell, there were 2,215 families in 1988 and 412 families in 1984. I derived the number, 9,736, by subtracting 412 from 2,215 and getting 1,803, as the number of families migrating between 1984 and 1988. I then multiplied this number by 5.4, representing the number of individuals per household, and got a total of 9,736 Cambodian individuals migrating between 1984 and 1988. That there is an average of 5.4 individuals in each family is lifted from a household survey conducted by a Lowell Cambodian community organizer, Sambok Sok, in 1992. I am indebted to Jyothi Nambiar's thesis as it provided me with relevant sources and primary data on the Cambodian community of Lowell.
unemployment rate of 12.5% in Lowell alone, currently employment opportunities for all workers are picking up in the industries along the corridor (The Economist, 1991).

The regional economy is improving, but researchers assert that the firms of the Route 128 corridor and the city of Lowell will never reach the high of the 1984 to 1988 boom period (Saxenian, 1994). Many high-technology firms that are recovering realize the necessity of adopting more productive measures in order to remain competitive. The President of the Center for Quality Management (CQM) in Cambridge, a non-profit, private organization composed of 40 high-technology firms that receive consulting on total quality management (TQM) practices, confirmed that many high-technology industries were practicing TQM in the area, with estimates of 20 to 30 firms outside of the Center for Quality Management undergoing TQM (Lee, 1994). There are numerous other groups providing consulting to Route 128 firms, such as Organizational Development Inc. in Burlington. Also, in a recent study undertaken by the Industrial Services Program of Massachusetts electronic industries, 42% of those surveyed said that they had improved quality control capabilities to offset defense losses (Cann and Forrant, 1993).

Many firms along the corridor are adopting strategies in order to cut costs by: reducing overhead by outsourcing to suppliers; moving labor-intensive production facilities abroad; pursuing market-segmentation strategies; investing in management methods -- such as TQM -- that are customer-oriented, which allow for shorter throughput time and hence meet more rapid demand conditions; increasing productivity due to the minimization of waste in production processes; and worker participation in continuous improvement activities.

Out of the six high-technology firms I examined along the Route 128 corridor, all of them have switched over to a production system based on continuous improvement and were training their workforce in order to meet the new skills requirements. An educated workforce is necessary under this new production system, creating a feedback mechanism
allowing for workers' input. It is assumed under system that operators know the best means to improving the production process because they perform the tasks themselves.

Whereas previous immigrant groups, entering the country in the earlier part of the twentieth century, were employed as production workers in labor-intensive industries, immigrants now increasingly must possess more communication, reading, and writing skills usually not associated with the production operator. This shift towards upskilling is changing the employment opportunities of immigrants who are seeking jobs in industries undergoing work reform. There are greater skills requirements in firms instituting work reform than there are in firms organized around an assembly-line approach. Firms practicing a leaner production method are distinguished by more teamwork where workers are given more responsibility for activities like: planning and control; cross-training of operators who learn a variety of tasks; and responsibility for machine repair, parts ordering, and staff scheduling.

With this changeover towards a production system requiring an upskilled workforce, my thesis examines how Cambodians fare under the context of these new requirements. I have chosen to focus on Cambodian immigrants in order to provide more depth and richness to my study, seeing that the Lowell Cambodian community is heavily impacted by the decline of the Route 128 economy. Also, given the context of their entrance into the United States as refugees with little formal education, many Cambodians are limited to production jobs.

**Methodology**

In trying to uncover the dynamics of the internal labor market of firms undergoing work reform and studying their effects on Cambodian immigrants, I examined six firms. Two firms began to re-organize their production towards a leaner system in an attempt to downsize; they had suffered much economic decline during the down period of 1988 to 1992 and saw a switch as one means of further cutting costs. While the other four had
done well in the past, they saw that future market conditions, given increased global
competition, warranted that they look towards streamlining their work organization.

I examined five corporations that had both global and national divisions, but the
division I visited ranged from having 395 employees to 1,500 employees, while the one
small firm I examined has 30 employees in manufacturing. All of them hire Cambodian
immigrants, and they ranged from composing 7% to 30% of the workforce. All firms are
non-unionized and offer the same array of benefits to both production workers and office
staff. Production workers' wages range between $8.00 and $16.00 an hour. Most of the
firms I visited did not have the image of the "electronic sweatshop" evoked of firms that
utilize immigrant labor, but were clean because most firms had rationalized the shopfloor
in order to speed-up the throughput process.

I targeted firms that hired Cambodians by contacting people within the Cambodian
community and sought people in employment-training agencies that had direct experience
placing Cambodians into jobs. The result of a long search in tracking down high-
technology firms hiring Cambodian employees produced interviews with managers from
six firms. I interviewed managers from: Medical Manufacturers Inc., a medical catheters
manufacturers regulated by the FDA, employs a total of 400 in manufacturing; Oxygenics,
which manufactures electromagnetic interferon (EMI) a shielding product for commercial
and military applications, hires 395 employees; Printed Circuit Boards Inc., which
manufactures printed circuit boards and backplanes (used in communications systems)
employs 750 in manufacturing; Integrated Circuits Inc., which manufactures integrated
circuit for both the commercial and the military markets, employs 1500; Compu-Tech,
which produces medical equipments for private industries and is regulated by the FDA,
employs approximately 600 to 700; and Personal-Alert Systems, which manufactures
emergency personal response systems for the elderly and the infirm, employs 30 in direct
labor.2

2I disguise firms' names due to managers' wishes that firms' names be anonymous
As these six firms restructured their work organizations, their job contents changed and workers are more responsible for a variety of tasks including critical hand-assembly operations, reading and interpreting blueprints, and performing quality checks. Human and interaction skills are also a priority as assemblers must work with individuals of different cultures, possess proficiency in written and oral communication, and have the flexibility to change job assignments. Technical skills requirements include that the person report quality problems, be proficient in the metric system, fill in statistical process control (SPC) sheets, and suggest solutions for quality problems. With the job description listed above, more English-language skills, math skills, and soft skills are necessary.

In trying to gain a perspective on how the rise the Route 128 economy affects Cambodian immigrant labor, I talked with many community leaders and sought people in social service agencies that work in the Cambodian community. These social service agencies are the Cambodian Mutual Assistance Association of Lowell, the Department of Employment Training in Lowell, the Merrimack Valley Skills Center in Lowell (which is also the Regional Employment Board), the International Institute of Lowell and of Lawrence, and Employment Connections in Chelsea.

**Chapter Outline**

My thesis will be arranged in the following order. Chapter 2 will describe the growth and the decline of the Route 128 corridor, providing the context for understanding why Route 128 firms are moving towards work reform. Chapter 3 will be a history of Cambodian immigrants and the conditions by which they entered the country, fleeing genocide and the political persecution consuming Cambodia in the 1970s. Although there are many Cambodians dispersed throughout the state of Massachusetts, I focus on the Cambodian community of Lowell because they represent the largest concentration of Cambodians in America, outside the city of Long Beach in Southern California (Nambiar, 1992; Kiang, 1994). Chapter 4 will present an outline of the mass production and Japanese lean production systems and provide a framework for understanding the
changing skills requirements of the six firms examined. Chapter 5 will be drawn on evidence from interviews with managers in the six firms, as the skills content of jobs change. Also, in this chapter I depict the problems Cambodian immigrants encounter, such as for example, a lack of English-language skills and cultural differences that may represent problems of gathering workers’ input, which is crucial under a lean production system. And finally, Chapter 6 will focus on policy recommendations for education and training programs necessary for Cambodian immigrant labor under the context of work reform.
At the outset, I questioned the fate of the Cambodian community in relation to the rise and decline of the Route 128 economy. Because many Cambodian were drawn into the Lowell area due to the employment opportunities arising from the growth of the high-technology industries along the corridor, I was curious about what happened to Cambodians in the context of the decline of the region. To understand the microeconomic dynamics and the changed skills requirements of Route 128 firms currently, one must examine the conditions that led to growth and decline of the corridor. I will elaborate upon the regional infrastructure and describe how competitors overtook the minicomputers industry of Route 128.

**The Regional Infrastructure**

The highway, Route 128, creates a ring around Boston but is a name used to describe a region of Eastern Massachusetts. Electronic firms such as Digital Equipment Corporation, Data General, Prime, and Wang have their headquarters along the corridor. Geographically, these industries extend out towards Worcester in Central Massachusetts and north, to Southern New Hampshire and encompass the city of Lowell in Northeastern Massachusetts.

Some researchers attribute the growth of the Route 128 corridor to the regional infrastructure, rich with research institutions that nurture research and design efforts. For example, the telephone, the vacuum tube, and the transistor were invented in the Eastern Massachusetts region. And because graduates of top research institutions, such as Harvard University, the Massachusetts Institute of Technology (MIT), and Boston University, stay and become employed in the area, universities play an important role in fostering the intellectual capacity of the region.
The growth of the electronics industry was also helped by the personal connections between MIT alumni and Washington during the World War II period. It was Vannevar Bush, an alumnus and a professor of electrical engineering at MIT, who helped steer defense contracts to MIT's research facilities and Route 128 firms through his appointment as the director of the Office of Scientific Research and Development (OSRD) during the World War II period (Rosegrant and Lampe, 1992, 80).

In the 1970s, a regional recession hit the area, heavily impacting the electronics industry. Due to the end of the Vietnam War and the end of the "space race," the Department of Defense (DOD) withdrew government contracts from industries that relied upon them. Compounding the regional recession was the flight of the textile, shoe, and apparel manufacturers, resulting in the demise of these industries in what had begun as corporate's drive in search of low-cost labor overseas beginning in the 1960s (Vernon, 1966). As these traditional base industries declined or moved out of the region, Eastern Massachusetts became a center of electrical manufacturing (Hekman and Strong, 1981).

**The Minicomputers Industry**

The growth of the minicomputers industry encouraged the development of the corridor beginning in the 1970s. Route 128 minicomputers corporations, such as DEC, Data General, Wang, Honeywell and Prime, were big employers in the regional economy as they created approximately 100,000 net new jobs between 1970 and 1985. Additionally, they had a monopoly in the minicomputers industry since they controlled about two-thirds of the minicomputers market (Saxenian, 1994; Kuhn, 1982).

But the miracle soon faltered with the decline of the market, as Route 128 producers reported great losses during the late 1980s. More than 50,000 high-technology jobs were lost along Route 128, when the regional economy followed the minicomputer manufacturers into a downturn from which they would not recover (Saxenian, 1994).

The decline of the minicomputer market was brought on by the development of the microcomputer by firms in the Silicon Valley. These innovators drastically restructured
how the industry would compete and market its products in the future. The industry increasingly became fragmented as the competitive advantage of computer firms would be determined by their ability to carve market niches (Saxenian, 1994; Manasian, 1993).

The personal computer and workstation are examples of the fragmentation of the industry. The industry, in the era of the minicomputer, was organized on the ability of the corporations to produce a product line and to take advantage of the economies of scale afforded by a vertically-integrated corporations, using dedicated technology. Corporations would derive cost advantages by producing in great volume and bring down the product's cost. But the strategy of the minicomputers industry brought on its own demise. Because the advantage of the Route 128 economy was organized on the advantages afforded by the industrial maturity of its hierarchical corporations, Route 128 firms could not compete with the Silicon Valley (Saxenian, 1994).

In the late 1980s, the nature of competition in the computers industry was changing so that start-ups and small firms were better organized to introduce new products and to shape markets (Manasian, 1993). For example, microcomputer manufacturers brought down the cost of the computer and made them available to the consumer in homes. Product lines changed rapidly as firms segmented markets in order to create demand for the microcomputer. For example, Sun Microsystems of the Silicon Valley introduced five new generations of workstations during its first four years of existence (Saxenian, 1994).

The advantage of Silicon Valley manufacturers was that they were small and hence could adjust rapidly to manufacturing new product lines. The small firms of the West Coast collaborated with each other in order to share information and build a cultural infrastructure that would add to their regional advantage. The local industrial system was built on the normative ties, embedded in Silicon Valley's computer industry. Also the culture of the free-spirited West, encouraged more risk-taking, which allowed firm-owners
to venture into experimenting with new product lines. This element of risk-taking was missing in the hierarchical industrial district of Route 128 (Saxenian, 1994).

Route 128 minicomputers manufacturers had become profitable by creating customers' dependence on their products since the minicomputer was built on a proprietary model that could use products only from the original vendor (Saxenian, 1994). But the new competition from the Silicon Valley was organized on products that were non-proprietary. Microcomputers used publicly available operating systems, such as MS-DOS or Unix, which allow customers to run application software produced by other vendors. A manufacturer of the microcomputer, Sun Microsystems, was innovative in using standard, readily-available components and relied on outside suppliers for the design and manufacture of parts in order to cut down on production costs (Manasian, 1993; Saxenian 1994).

By the end of the late 1980s, Route 128 had ceded its position as the center of research and design in the electronics industry to the Silicon Valley, just as the Silicon Valley had lost the commodity memory business to the Japanese. Contrary to public opinion, during this period defense cutbacks were not the major catalyst for decline. The cutbacks only served to accelerate the decline, as the region had undergone a major downturn already. Rather, it was the demise of the minicomputers industry that brought on the descent of the Route 128 economy (Saxenian, 1994).

A symbol of the decline of the Route 128 area is the downsizing of Wang Laboratories, which marks the northern-most tip of the corridor and was one of the first to market the minicomputer in 1992. The closing of much of Wang's manufacturing facilities marks a watershed in Route 128's industrial history, and currently Wang is moving towards marketing software and does little manufacturing (O'Connell, 1993).

**Status of Firms Now**

Since 1992 when the regional economy began to revive, industry experts and managers are realizing that the pace of the industry has changed. The economic stability,
which was present with the minicomputers industry, no longer exists and product lines are innovating at a faster rate than before. With those corporations remaining from the turmoil of the 1988 to 1992 period, managers are increasingly adopting strategies such as: the vertical disintegration of manufacturing facilities and services; management methods geared towards quality; and human-resource based strategies which attempt to cross-train workers in order to diversify the workforce.

The ability of firms to rapidly come up with new product lines depends on the organization of the firm. In order to remain competitive, corporations are streamlining their production processes by changing their work organization to one based on the continuous improvement of production processes.\(^3\)

\(^3\)This account of Route 128 is drawn from Saxenian, 1994 and Manasian, 1993.
CHAPTER 3
CAMBODIAN IMMIGRANTS

In the following, I provide the context for the labor market position of Cambodian immigrants and illustrate the tragic circumstances by which they entered America as refugees, pushed out of their homeland by the conflict overtaking much of Southeast Asia in the 1970s. After being settled in various parts of the America, many Cambodians came to Massachusetts as secondary migrants, pulled in by the employment opportunities of the electronics industry. Cambodians migrated into the state of Massachusetts, creating the growth of Lowell's Cambodian community with an influx of approximately 10,000 individuals between 1984 and 1988. Because a majority of Cambodians are rural immigrants, possessing little formal education and having minor mastery of the English language, Cambodians sought employment as production workers. At the same time, employers actively recruited Cambodians, who were noted for their manual dexterity and because there was a labor shortage. But between 1984 and 1988, as a result of a regional recession affecting the high-tech industries along the corridor, Cambodians workers were laid-off in great numbers causing much unemployment in the community and a large outmigration of Cambodians from Lowell. For those remaining, employment opportunities are shifting as firms change their organization of work.

Cambodians in the Southeast Asian Conflict

Cambodians were pulled into the United States as refugees resulting from a conflict orchestrated by foreign forces. The U.S. involved Cambodia in the Vietnam conflict by deposing Prince Sihanouk and by backing General Lon Nol in the 1970s. Hence, Cambodia became a base for U.S. involvement in South Vietnam as bombers were sent into destroy the North Vietnamese forces, backed by the Soviet Union and China (Takaki, 1989).
Lon Nol’s puppet government fell to Pol Pot’s backed Khmer Rouge, a nationalist, pro-Communist force, in the midst of Saigon’s fall in 1975 to the North Vietnamese. Attempting to establish a classless agrarian society, the Khmer Rouge enforced the mass killings of many of the educated elite, government officials, and the ethnic Chinese, eliminating much of the country’s social infrastructure, including traditional family structures and government institutions. Approximately two million people, which constitute roughly a third of the country’s population, died directly from mass killings and indirectly from starvation and disease under Pol Pot’s regime (Takaki, 1989).

In 1979, the Vietnamese invaded Cambodia, and subsequently Cambodia was consumed by the continual fighting among anti-Vietnamese elements. At this time, hundreds of thousands of Cambodian refugees fled to Thailand to escape persecution. While in Thailand, most Cambodians spent an average of three years in these camps, living in squalid living conditions, with limited formal education -- 216 hours of English-as-a-Second-Language training with 100 hours of cultural orientation (Nambiar, 1992).

In 1993, United Nations forces withdrew from Cambodia and a free election resulted in the enthroning of Sihanouk as King. Currently, Cambodia stands largely ravaged from past conflicts, with the current government facing great instability.

Leaving a country consumed by war and largely impoverished, Cambodian refugees fleeing their homeland left to come to the U.S. and to other countries. In America, many refugees were initially settled into states such as California, Washington, Utah, and Massachusetts, and most received refugee assistance for a period of time. Although Cambodian refugees are from different strata of Cambodian society, many were from the rural class, having little knowledge or mastery of the Cambodian written language, Khmer.

**Immigration Waves into the U.S.**

Each successive wave of immigration brought individuals from the lower strata of Cambodian society. The first wave of Cambodian refugees came to the United States
between 1975 and 1979, after the Khmer Rouge overtook the country, and were comprised largely of the educated elite, government officials, and urban professionals. The second wave, who had been in the Thai camps between 1978 and 1979, arrived in the United States between 1980 and 1981. Although the second wave contained the country's elite, it also contained many peasants, farmers, and fishermen. The third wave entered America between 1982 and 1984 and included mostly rural farmers, with some educated Cambodians. The fourth wave of immigrants were comprised largely of peasants, farmers, and street peddlers and has continued from 1984 to the present. By the mid 1980s, most of the educated elite had fled the country or had been killed by the Communists (Nambiar, 1992).

Many Cambodians, immigrating into America, came lacking years of formal education and hence entered the labor market at the bottom of the queue. As shown in Table 1 below, a majority of those entering America came after 1979 and thus were from the lower strata of Cambodian society, possessing little formal education. Out of 140,800 of the total number of Cambodian refugees entering the United States between 1975 and 1987, 127,500 came after 1979, composing 91% of the total number of Cambodian refugees entering the country during this period (See Table 1).

Secondary Migration into Lowell

Many Cambodians moved into the Route 128 area during the boom period primarily due to employment opportunities as production workers. Sizable Cambodian communities of Eastern Massachusetts are located in Fall River, Chelsea, Boston, Revere and Lynn, but the centerlode of the Cambodian community is in Lowell, Massachusetts, where many came as secondary migrants. Between 1984 and 1988, approximately 10,000 Cambodians moved into Lowell, mostly as secondary migrants. Currently the Cambodian
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<tr>
<td>1987</td>
<td>1,900</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>140,800</td>
<td>100.0</td>
</tr>
</tbody>
</table>


Note: All numbers are rounded to the nearest hundred. Total will thus vary from overall rates provided in other sources. Source: Gordon (1987: 156); OPR (1987a, 1987b).
community of Lowell numbers 25,000 and has declined from a peak of 35,000 during the boom period (Pen, 1993). The growth of Lowell's Cambodian community mirrors the growth of firms along the Route 128 corridor, as Cambodians migrated primarily due to employment opportunities, as well as for the welfare benefits offered by the Massachusetts government. The state continued their refugee cash and medical assistance (RCMA) for a longer period of time than did other states (Nambiar, 1992). Many Cambodians also immigrated into Lowell due to the growing Cambodian community, which includes a prominent Buddhist temple.

Immigrant networks were in place to inform Cambodians of the employment opportunities along the corridor and spanned across national and state boundaries. Conducting research in the field verified the strength of these ties that even informed Cambodian refugees in the Thai camps and in the Cambodian community of Madison, Wisconsin, of the employment opportunities in Route 128 firms. A Director of the Regional Employment Board in Lowell said that only one in ten applicants, for a job in his agency in 1986, had initially settled in Lowell. The other interviewees had heard about the employment opportunities along the corridor while in the Thai camps and had moved into Lowell from other states (McQuaid, 1994). Another story of the magnetism that Lowell held for Cambodians is told by a student at the University of Wisconsin, Madison, who, in the summer of 1987, noted that over ten Cambodian families in Madison -- which constitute 15% of the total Cambodian population in the city -- left for Lowell in search of employment opportunities (Nambiar, 1992; Smith, 1987).

After reaching Lowell, Cambodians would stand in line outside the office of an employment coordinator at the Department of Employment and Training and be placed in a job upon hours of arrival in Lowell (McQuaid, 1994). They would be funneled to nearby corporations, such as Wang Laboratories, a minicomputers manufacturer in Lowell; BASF, a magnetic tape manufacturer in Bedford; and USCI, a medical instruments manufacturer in Billerica.
Many companies had recruiting drives within the Cambodian community, as there was a shortage of labor during the boom period. Many of these companies were attracted to Cambodian immigrants because of their reputed dexterity, as most of the companies between 1984 and 1988 still used a Taylorist mode of production. So intense were these companies demand for labor that they hired bilingual supervisors to translate in addition to providing transportation at times (Nambiar, 1992). These amenities were offered due to the nature of a weak labor market.

Wang Laboratories outreached to community agencies and did radio spots in order to recruit Cambodians. In part, Wang Laboratories recruited within the Cambodian community, as well as in other Asian communities nearby, because Asians met the affirmative action requirements, whereas the Portuguese, the previous immigrant group utilized, did not (O'Connell, 1993). Incidentally, between 1984 and 1988, Lowell's unemployment rate was at an all-time low of 4.6%, while the unemployment rate for Massachusetts during this time was at 5.8% (The Economist, 1991).

Corporations' demand for labor, which steered many Cambodians into positions as production workers, were reinforced by managers' perception that Cambodians were more productive workers than native workers. Employers were impressed by Cambodian's willingness to work overtime in entry-level jobs that consisted of repetitive manual labor.

An employment placement manager of Employment Connections, a training center in Chelsea that worked with many Cambodians between 1984 and 1988, succinctly voiced how firms used Cambodian immigrants during this time:

During this time, employers viewed Cambodian immigrants as being more productive than native workers because they were willing to put in more hours than native workers and partly because they were seen as being more dexterous. But also, because Cambodians were new to the area, employers took a curiosity in them and saw them as a novelty item. But the exploitation of Cambodian immigrants in Route 128 high-technology industries worked both ways; because Cambodians were unfamiliar with their rights in the American workplace, Cambodians put up with more than they needed to. But as the Cambodian community
matures and becomes more acculturated to the U.S., immigrant networks are in place to forewarn new entrants to firms of what working conditions to expect. Cambodians will no longer put up with bad working conditions (Prins, 1994).

Support for English-Language Classes and Employment-Training Programs

Since the arrival of Cambodian immigrants into Lowell in the mid-1970s, many social service agencies have targeted assistance specifically towards this community. Lowell's Cambodian Mutual Assistance Association (CMAA), the most prominent Cambodian, community-based organization in Massachusetts, began in 1983 as a service organization, which provided housing services and counseling to the Cambodian community. Currently they provide vocational ESL classes, direct job-placement, and training. When Cambodians began to arrive in great numbers to Lowell in the mid to late 80s, the International Institute of Lowell provided adult basic-education courses to help out refugees (McQuaid, 1994). Additionally, in the late 1980s, the Cambodian Mutual Assistance Association, along with the City of Lawrence, received a grant from the federal government to provide English-as-a-Second-Language classes, job-placement, and social service programs for Cambodian immigrants (Sao, 1994).

Decline in Employment Opportunities

The decline of the Route 128 corridor between 1988 and 1992 had a devastating effect upon the Lowell Cambodian community, as it did on other production workers. In 1989, Lowell's unemployment rate increased from the boom period average of 4.6% to 5.7%, while the 1990 average increased to 8.1% (Nambiar, 1992; Federal Census Demographics, 1990). The Economist notes that Lowell's unemployment rate in 1991 increased to 12.5%, when the statewide unemployment rate was 9.2% (The Economist, 8/3/91). It is ironic that the demise of Lowell's economy was foreseen by researchers, seeing that Lowell's economy was heavily dependent upon one corporation, Wang Laboratories, which during times of economic prosperity employed a total of 12,000 from the surrounding area, with 1,500 in production. After declaring Chapter 11 and
undergoing major restructuring, Wang is concentrating on software development and currently employs a total of 3,300 employees, with only 500 in production (O'Connell, 1994).

Other corporations that downsized or moved their manufacturing facilities overseas significantly impacted Cambodian workers; these firms include USCI, a medical instruments manufacturer, and BASF, a magnetic tape manufacture. USCI, which hired a significant number of Cambodians in manufacturing, has downsized and cut their manufacturing by more than half, from 1,000 to 440 (McKernan, 1994). Whereas BASF moved all of their production facilities overseas by 1992, after having begun to experiment with quality improvement activities (Hehir, 1994).

In a survey, given by the Cambodian Mutual Assistance Association in 1992, of Cambodian immigrants in the Acre -- an impoverished section of Lowell, where approximately 30% of Lowell's Cambodian community live -- 28.7% of the 101 Cambodians interviewed said that they were employed, leaving 71.3% most likely unemployed (Nambiar, 1992; Sok, 1992).

In the face of economic decline, which appears structural, employers are adopting strategies to cut costs. At times, Cambodian individuals benefit from firms' strategies; for example, a system of mutual use exists where both the employers and employees benefit when Cambodians are used as a source of contingent labor. Cambodians, receiving welfare, may pocket earnings without reporting it, while firms do not pay medical benefits or taxes.

But this situation is only one example where Cambodian immigrants may be benefiting from firms' changing employment practices. No longer can Cambodians walk into permanent employment situations as they did during the boom period. Opportunities are shrinking while job requirements are changing rapidly.
CHAPTER 4
CREATING A FRAMEWORK

As firms change their work organizations, the skills requirements for their operator change from one requiring their dexterity to one requiring their general skills. General skills include English-language skills, math skills, and soft skills -- which include decision-making and interaction skills. All of the six high-technology industries interviewed have adopted elements of the Japanese lean production system, where productivity is defined by the continuous flow in production and impediments -- bottlenecks, machine down time, and changeover times -- disrupt the production flow. All firms had switched, between the mid-1980s and the early 1990s, from a Taylorist mode of production. They realized that they must employ more productive measures in order to maintain their current market position, or had downsized in reaction to the regional recession and had begun to practice lean production measures. All firms examined, although practicing some aspects of the Japanese lean production model, did not lift the model entirely. But all firms practice statistical process control (SPC), requiring workers to be directly responsible for quality control measures.

An elaboration of the mass production system, which relies upon Taylorist scientific management principles, and the Japanese lean production system, which employs an upskilled workforce, are useful only to the extent that they help build a framework for understanding the changing skills requirements that the interviewed firms are undergoing. Hence, the following description will not attempt to characterize the two production systems completely, but instead focus on the changing work organizations of these firms that influence their skills requirements. I first describe Taylorism in order to illustrate the skills used under the mass production system, and go onto outline this system; then I continue to describe the Japanese lean production system in order to characterize the skills required of the production operator in the six firms examined.
Taylorism

The standardization, and hence the interchangeability of product parts, spurred the need for accuracy in production. Eli Whitney, a successful American rifle manufacturer, stunned the world by producing rifles in the mid-nineteenth century, made with interchangeable components and could produce rifles more rapidly and more accurately than could his competitors (Best, 1990, Schroeder and Robinson, 1991). Similarly, at the Springfield Armory of Massachusetts, the U.S. government manufactured rifles in interchangeable components and created what was the first system of modern factory management (Chandler, 1977). The standardization of parts diminished the need for a skilled craftsman and demanded the dexterity of the machine operator.

Subsequently, in the late-nineteenth century Frederick Taylor engineered the "one-best method" to production. He created a management system, where scientific methods were applied towards production, and conducted time-motion studies to increase throughput time. Under scientific management, managers are responsible for engineering the production method, whereas the production worker carries out his/her task according to the production method laid out by management. Shopfloor workers' discretion are eliminated, as there is only one approach to performing tasks by following the standardized documentation of production knowledge (Perrow, 1987).

Mass Production

Taylorism's approach to breaking down production tasks to one-best method was integral to the spread of mass production that relies upon the economies of scale derived from reductions in unit labor costs and the use of dedicated capital equipment.

The mass production system was effective for American producers between the 1945 and 1970 period. During this period, unions of manufacturing facilities bargained for wage increases aligned with average productivity gains of the economy, and thus could share in firms' increase in productivity as international competition had not surfaced to disturb the oligopolistic position of American firms during this time (Appelbaum and Batt,
1993). Additionally, consumption was encouraged with unions sharing in firms' productivity gains as the price of mass produced goods fell, further feeding demand for mass produced goods. The passage of the National Labor Relations Act in 1935 and the Wagner Act in 1937 are two legislative measures that insured unions a share in productivity gains (Piore and Sabel, 1984).

The productivity gains realized in the mass production system between 1945 and 1970 can be better analyzed by looking at operations management literature, which utilizes the learning curve framework to look inside the firm. In the learning curve framework, productivity is related to the reduction in labor hours; as operators learn their tasks, they become more efficient and thus direct labor input per unit is reduced. Productivity increases as products become standardized; there is an investment in dedicated capital equipment and services are brought in-house resulting in the vertical integration of the firm. Processes are segmented in order to capitalize on economies of scale so that facilities offering these advantages are centralized as volume increases. A Taylorist work organization guides the separation of conception from execution, as the division of labor results in a decrease in direct labor and an increase in throughput time. The result is an increased reliance upon specialized labor skills, as dexterity is demanded of the operator (Abernathy and Wayne, 1974).

**Japanese Lean Production**

The Japanese lean production system is also based on the economies of scale afforded by high-volume production, but the organization of work revolves around a different set of principles than that of mass production. A main principle that governs the Japanese lean production system is that impediments to the production flow reduce productivity. Hence, a compartmentalized department, such as a distinct quality control department, reduces the firm's productivity by impeding the flow of production; thus production workers, in the lean production system, are directly responsible for quality control measures. Other mechanisms created towards smoothing the flow of goods is by
rationalizing the plant's layout, facilitating quick changeovers, and reducing defect rates. The practice of total quality management (TQM) elicits input from production workers and employs problem-solving activities through quality control (QC) circles, in order to continuously improve production processes (Abegglen and Stalk, 1985).

Aligned with the upskilling of production workers is a changeover to machinery based on microprocessor technology, such as computer-numerically-controlled (CNC) machinery. CNC allows operators to independently re-program machinery and to input statistical information into the computer, and thus under the lean production system, operators are required to possess math skills and computer programming skills. Technology, in lean production, replaces traditional, dedicated, capital equipment, which produces one component or product and requires long changeover times. Under a system utilizing flexible machinery, highly-diversified outputs allow firms to achieve a variety of customized quality-competitive products, where changeover times are short.

Quality control circles elicit input from production workers because under lean production, workers are assumed to know the best means to production. But unlike the work teams employed by the Swedish sociotechnical system, where teams function autonomously and partake in structuring management policies, quality control circles in the lean production system do not help to shape policies. Rather, QC circles are parallel structures and leave management's authority largely untouched. In the lean production system, foremen still play a role in performing administrative tasks, supervising workers and applying standardized work procedures, although the relationship between the foremen and workers are more horizontal in the lean production system than they are in mass production (Appelbaum and Batt, 1993). For example, workers help engineers in standardizing work procedures that continually undergo improvement through quality circles. Recommendations to management travel through a "ringi-sho" process, where they bypass many layers of hierarchies.
Quality circles overturn the learning curve framework of the mass production system -- where productivity improvements is based on the use of dedicated technology and the operator's dexterity. Instead, the productivity gains of the lean production system rely upon the active learning process of quality circles that breeds improvement (Imai, 1986).

The success of the continuous improvement process is attributed to the effectiveness of total quality management (TQM), as begun in Japanese firms after World War II, with the teaching of statistical quality control (SQC) by Edward Deming. It is a comprehensive management approach attentive towards quality throughout the production line. Under TQM, problem-solving techniques are taught to hourly workers with an assumption that defect rates hinder the productivity of the firm. Deming's approach to management was as scientific and as engineered as Taylor's but instead he advocated for the use of educated workers to improve quality and productivity through the use of statistical methods, rather than relying upon labor's specialized skills (Best, 1990). In the lean production system, workers collaborate with engineers to simplify the product design to facilitate the flow of goods on the production line.

Statistical controls are effective because they allow workers to distinguish the systemic from the idiosyncratic cause of defects. For example, defective parts can be traced to either suppliers or workers, and SQC helps workers identify targets for problem-solving efforts (Imai, 1986). Tools that help workers to identify targets are graphs, check sheets, pareto diagrams (a bar chart showing the frequency of causes of some defective results), Ishikawa diagrams (a tool that helps to identify the systemic causes from accidental causes), scatter diagrams (which helps to establish correlations between cause and effect), histograms (which shows the statistical distribution of quality), and control charts (which shows statistically-significant deviations). In order to insure workers that their contribution towards productivity gains would not result in their lay-off, the Japanese put employment guarantees in place.
By utilizing an educated workforce, the Japanese can reduce indirect labor, by delegating non-value-added positions, traditionally performed by middle-management, to production workers. Workers are responsible for such tasks as staffing, repairs, and scheduling, and hence workers are required to be more skilled (Abegglen and Stalk, 1985).

The advantage of the Japanese lean production system is that they provide high-quality products at a low-cost due to the efficiency of the system. The Japanese were able to undercut American automobile manufacturers beginning in the early 1980s, partially because they reduced the number of non-value-added positions and also because they produced better quality products. Non-value-added positions, or indirect labor, are those positions that do not directly transform the product. In the table shown below, Abegglen and Stalk estimate that the Japanese produced 140 more units that the Americans, but used two and a half times less labor (Abegglen and Stalk, 1985) (See Table 2).

All of the six firms examined reduced the number of non-value-added positions by restructuring their work organization. They changed their organization from one based on Taylorist scientific management principles to one based on the Japanese lean production model. As firms change their work organization, the skills requirements for their operators change as operators are given more responsibility for a variety of tasks. A changeover towards different work roles for operators require that they possess more English-language, math, and soft skills.
<table>
<thead>
<tr>
<th></th>
<th>Japanese Competitor</th>
<th>American Competitor</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit Produced</strong></td>
<td>1,000</td>
<td>860</td>
<td>140</td>
</tr>
<tr>
<td><strong>Per Day</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Factory</strong></td>
<td>1,000</td>
<td>2,150</td>
<td>1,150</td>
</tr>
<tr>
<td><strong>Workers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Workers Per Unit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Per Day</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>0.79</td>
<td>1.25</td>
<td>0.46</td>
</tr>
<tr>
<td>Indirect</td>
<td>0.17</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td><strong>Indirect + Salaried</strong></td>
<td>0.21</td>
<td>1.25</td>
<td>1.04</td>
</tr>
<tr>
<td>Salaried, other</td>
<td>0.04</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1.00</td>
<td>2.50</td>
<td>1.50</td>
</tr>
</tbody>
</table>

CHAPTER 5
EVIDENCE FROM SIX FIRMS

In this chapter I present the changed skills requirements of the six firms examined and their effects on Cambodian immigrants. I interviewed human resource managers and production managers in six firms to gain their insights on how the changing skills requirements are affecting Cambodian immigrants. All six high-technology firms examined had begun to practice some aspects of the lean production method, based on continuous improvement processes. Additionally all firms employ quality control circles and workers are cross-trained and taught operations skills. All of the firms required an upskilled workforce due to changing job requirement and all firms had begun to offer training in commensurate with a switch over to a lean production system.

Because employers viewed the experience of Cambodian workers as valuable, all of the firms invested in English-language classes and math classes to upskill their workforce but saw this training as a one-shot investment. Whereas Cambodians were hired between the 1984 and 1988 boom period because demand was tight and firms were still practicing a Taylorist production system, now with looser demand conditions managers believe that they can get a more skilled labor force in future applicants who possess the upskilled requirements.

Many Cambodians, who participated in the training programs benefited. The fact that most Cambodians have been in the country for a decade also facilitated their learning of new work roles, which includes speaking English. But implications for future Cambodian applicants not possessing the new requirements are bleak seeking that all firms interviewed demand that future employees possess the English-language skills, math skills, and soft skills, for which their current workforce has been trained.
Six Firms

Out of the six firms interviewed, two had recently downsized and subsequently adopted elements of the lean production system in order to further cut costs. The other four organizations had adopted measures from this system foreseeing a need to pare down their work organization in order to stay competitive in the future. I examined five corporations and one small firm. There was great improvement in productivity rates after they switched to the lean production system, with one firm, Compu-Tech, having experienced a 400% improvement in cycle time. Most of the five corporations had both global and national divisions, but the divisions I visited ranged from employing 395 to 1,500 in both manufacturing and office staff. The one small firm interviewed has 30 employees. All hire Cambodian immigrants, who represent between 7% and 30% of the firms' workforce, and all firms examined employ Cambodians in their primary labor market. All firms were non-unionized and offered the same array of medical benefits to both production workers and office staff. Wages for entry-level operators started at $7.00 to $8.00 an hour, while they peaked at $16.00 an hour. All firms compensated workers based on individual performance instead of on team performance. Most of the firms visited did not have the image of the electronic sweatshop evoked of firms that utilize immigrant labor, but were clean because managers had rationalized the shopfloor in order to speed-up the throughput process.

I consciously targeted firms that hired Cambodians by contacting community leaders, who knew in which firms Cambodians were employed. Also, I sought people working in social service agencies that placed Cambodians into jobs. A long search tracking down high-technology firms hiring Cambodian immigrants resulted in interviews with managers of six firms. I interviewed managers from Medical Manufacturers Inc., a manufacturer of medical catheters regulated by the FDA, employs a total of 400 in manufacturing; Oxygenics, which manufactures electromagnetic interferon (EMI) a shielding product for commercial and military applications, hires 395 employees; Printed
Circuit Boards Inc., which manufactures printed circuit boards and backplanes (used in communications systems), employs 750 in manufacturing; Integrated Circuit Inc., which manufactures integrated circuit for both the commercial and military markets, employs 1,500; Compu-Tech, which produces medical equipments for private industries and is regulated by the FDA, employs approximately 600 to 700; and Personal-Alert Systems, manufactures personal response systems for the elderly and the infirm and employs 30 in direct labor.4

Many firms examined asked for a high school diploma or a GED, whereas other firms said they would require them of applicants in the future. But all required that operators have some mastery of the English language and possess math skills. One progressive company, Compu-Tech, practiced continuous improvement measures beginning six years ago -- although not labeling as such during that time. This company also granted employees eligibility in the profit-sharing program if they had been with the company for six months. Employment guarantees had been in place for two companies while switching over to a lean production system. All but one firm said that English-language skills would be important for their future workforce, while Oxygenics said that they would formally conduct English language tests in order to screen for future applicants.

**Cambodian Immigrants of the High-Technology Industries**

To show the distribution of Cambodians employed in Route 128 high-technology firms, I illustrate a table of Route 128 employees broken down by race across different job categories. The employees were derived from five industries including: office and computing machine (SIC 357); communications equipment (SIC 366); electronic components and accessories, including semiconductors (SIC 367); measuring and controlling devices (SIC 382); and optical instruments and lenses (SIC 383). This sample represents 155 firms and thus only 40,870 employees were surveyed, yet still shows the

4I disguise firms' names due to managers' wishes that firms' names be anonymous.
distribution of employees by race and job categories in the interviewed firms. Although
the chart does not distinguish between Asian immigrants and Asian Americans, or between
Cambodians and non-Cambodians, it roughly represents Cambodian immigrants' participation in Route 128 high-technology industries, since most production workers are
drawn from immigrant communities and Cambodians compose one of the most significant Asian population in the Route 128 area. As illustrated in the chart below, Asians constitute the greatest number of non-white employees in this workforce as they compose 6.6% out of a total of 13.2% non-whites in the workforce, whereas they compose 20.2% of the operatives, representing the second largest group of operatives after whites in the workforce (See Table 3).

Changing Skills Requirements in High-Technology Firms

Nationally, there is a trend towards upskilling production workers in the electronics industry as the organization of firms change. The American Electronics Association (AEA) in Santa Clara, California, released a set of skills standards for high-tech industries to be used by community college instructors and training experts, in order to better meet the changing needs of industries. Increasingly, jobs in the electronics industry are moving away from narrow task categories and towards broad skills. Workers must work to develop, manufacture, deliver and improve electronics-related products and process that meet or exceed customer needs. Skills requirements for production operators are becoming greater and more diverse and a lack of these skills hinder firms' attempts to increase productivity, upgrade technology, and to implement a team approach (American Electronics Association, 1994).

More specific to the interviewed firms, Medical Manufacturers had a job description that required assemblers to perform a variety of tasks including critical hand-assembly operations, reading and interpreting blueprints, and performing quality checks. Human and interaction skills are also a priority as assemblers must work with individuals of diverse cultures, possess proficiency in written and oral communication, and have the
### TABLE 3
high-tech manufacturing employment in Boston SMSA -- 1990

**Number of Employees**

<table>
<thead>
<tr>
<th></th>
<th>TOTAL</th>
<th>MGR.</th>
<th>PROF.</th>
<th>TECHS.</th>
<th>SALES</th>
<th>CLERK</th>
<th>CRAFT</th>
<th>OPER.</th>
<th>LABOR</th>
<th>SERV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL</td>
<td>40,870</td>
<td>7,119</td>
<td>12,809</td>
<td>4,874</td>
<td>1,524</td>
<td>5,235</td>
<td>2,091</td>
<td>6,015</td>
<td>930</td>
<td>273</td>
</tr>
<tr>
<td>WHITES</td>
<td>35,478</td>
<td>6,729</td>
<td>11,667</td>
<td>4,257</td>
<td>1,389</td>
<td>4,831</td>
<td>1,855</td>
<td>3,870</td>
<td>652</td>
<td>228</td>
</tr>
<tr>
<td>NON-WHITES</td>
<td>5,392</td>
<td>390</td>
<td>1,142</td>
<td>617</td>
<td>135</td>
<td>404</td>
<td>236</td>
<td>2,145</td>
<td>278</td>
<td>45</td>
</tr>
<tr>
<td>AFRIC.-AM.</td>
<td>1,445</td>
<td>160</td>
<td>276</td>
<td>188</td>
<td>80</td>
<td>204</td>
<td>63</td>
<td>352</td>
<td>99</td>
<td>23</td>
</tr>
<tr>
<td>HISPANIC</td>
<td>1,193</td>
<td>69</td>
<td>131</td>
<td>117</td>
<td>27</td>
<td>93</td>
<td>94</td>
<td>571</td>
<td>71</td>
<td>20</td>
</tr>
<tr>
<td>ASIANS</td>
<td>2,686</td>
<td>153</td>
<td>715</td>
<td>303</td>
<td>27</td>
<td>96</td>
<td>76</td>
<td>1,215</td>
<td>99</td>
<td>2</td>
</tr>
<tr>
<td>NATIVE-AM.</td>
<td>68</td>
<td>8</td>
<td>20</td>
<td>9</td>
<td>1</td>
<td>11</td>
<td>3</td>
<td>7</td>
<td>9</td>
<td>0</td>
</tr>
</tbody>
</table>

**Percentage of Employees by Job Category**

<table>
<thead>
<tr>
<th></th>
<th>TOTAL</th>
<th>MGR.</th>
<th>PROF.</th>
<th>TECHS.</th>
<th>SALES</th>
<th>CLERK</th>
<th>CRAFT</th>
<th>OPER.</th>
<th>LABOR</th>
<th>SERV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>WHITES</td>
<td>86.8</td>
<td>94.5</td>
<td>91.1</td>
<td>87.3</td>
<td>91.1</td>
<td>92.3</td>
<td>88.7</td>
<td>64.3</td>
<td>70.1</td>
<td>83.5</td>
</tr>
<tr>
<td>NON-WHITES</td>
<td>13.2</td>
<td>5.5</td>
<td>8.9</td>
<td>12.7</td>
<td>8.9</td>
<td>7.7</td>
<td>11.3</td>
<td>35.7</td>
<td>29.9</td>
<td>16.5</td>
</tr>
<tr>
<td>AFRIC.-AM.</td>
<td>3.5</td>
<td>2.2</td>
<td>2.2</td>
<td>3.9</td>
<td>5.2</td>
<td>3.9</td>
<td>3.0</td>
<td>5.9</td>
<td>10.6</td>
<td>8.4</td>
</tr>
<tr>
<td>HISPANIC</td>
<td>2.9</td>
<td>1.0</td>
<td>1.0</td>
<td>2.4</td>
<td>1.8</td>
<td>1.8</td>
<td>4.5</td>
<td>9.5</td>
<td>7.6</td>
<td>7.3</td>
</tr>
<tr>
<td>ASIANS</td>
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<td>2.1</td>
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<td>6.2</td>
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Source: Lenny Siegel of the Pacific Studies Center from 1990 data provided by the U.S. Equal Opportunity Commission for high-tech firms in the Boston SMSA.

Definition of Terms: Mgr. = Officials & Managers; Prof. = Professionals; Techs. = Technicians; Sales. = Sales Workers; Clerk = Office & Clerical Workers; Craft = Blue-Collar/Skilled Production; Operatives = Semi-Skilled/Blue-Collar; Labor = Laborers/Unskilled Blue-Collar; Serv. = Service Workers
flexibility to change job assignments. Technical skills requirements are that the operator reports quality problems, be proficient in the metric system, fill in statistical process control sheets, and suggest solutions for quality problems.

**Assumptions Before Going Out on the Field**

I went out on the field assuming that firms were using Cambodian immigrants labor strategically, given a thesis by Ramon Borges-Mendez (1993). He found that in Lowell's modernizing, high-technology corporations, Latino immigrants were used as a marginal source of labor and constituted no more than 3% of the total labor force in examined firms. Latinos were employed in low-skilled, low-wage positions, and received no more than $6.50 an hour. In the small to midsized modernizing firms of Holyoke and Lowell, Latinos were moderately used as a source of unskilled and semiskilled labor, and therefore the labor-market outcomes for Latino labor in these firms were relatively better than for Latinos in Lowell corporations. Latinos in these small to midsized firms received relatively better wages, which ranged from $6.50 to $15.00 an hour. In my research of six modernizing firms -- including five corporations and one small firm -- along the Route 128 corridor, I found that Cambodians were employed in the primary labor market and were given training. In fact all six firms employed practices that fit Borges-Mendez's model of the small to midsized modernizing firms of Holyoke and Lowell, rather than his model of the corporations of Lowell.

I found no strong preference by employers for Cambodian immigrants, as was found by Lynn McCormick's study, where she shows with Public Use Micro Sample (PUMS) data that Latino and Polish immigrants were the workers-of-choice in Chicago's small, modernizing, metal-working firms (1993). Due to the cost pressures on Chicago manufacturers during the 1970s and 1980s, immigrants were hired into firms at a lower-wage than native workers for mostly unskilled production work. But in the late 1980s, immigrants were being trained to meet the upskilled requirements of the new production
processes. Similar to McCormick's research, I found in my research that all six firms are training their workforce, which includes Cambodian immigrants. Although many managers said that they noticed Cambodian immigrants -- and more generally all immigrant workers -- are more diligent towards their work than native workers, managers said that the difference is slight. Also, because the regional economy is just beginning to recover from a recent recession, all workers, whether native or immigrant, are eager to work.

Another researcher, of Asian-American production workers in Silicon Valley's electronic industries, which practice Taylorist productions processes, found that employers view Asian workers as being more acquiescent and possessing a stronger work-ethic than native workers (Park, 1992). Thus employers prefer them over other racial groups because they believe that Asians are easily exploitable. Due to this study, I assumed that managers of Route 128 firms perceive Cambodian workers to be passive and prefer native workers over them because native workers are more "outspoken." This characteristic is important in the context of work reform. But I found no outstanding preference by managers for native workers.

Just as there is a multiplicity of individuals in any society, managers had different perceptions of Cambodian immigrant workers that ranged across the spectrum. Some managers had not encountered problems receiving input from Cambodian workers because they spoke sufficient English to get by in their new work roles. Whereas some managers said that they had encountered problems receiving input from Cambodian workers due to their lack of fluency in the English language, it had not been a major problem. In addition to the benefits Cambodians derived from the training given by all firms examined, most spoke sufficient English to handle the new job requirements because they had acculturated to American society. But a sure outcome of my interviews with managers was that future applicants, who did not speak sufficient English or possess the required skills, would encounter problems getting hired.
Changing Work Organizations and their Effects on Cambodian Immigrant Labor

I present findings from the field on the changes in work organization and explain how these changes affect Cambodian immigrants. I present managers’ perceptions on Cambodian immigrant labor in the context of the increased requirements for English-language skills, math skills, computer programming skills and soft skills. But first I outline the changes in work organization in order to contextualize the new skills requirements of the six firms examined.

Capital Equipment

The capital equipment used by the six companies differed since I interviewed an array of high-technology firms that manufactured different products. Most companies had invested in capital equipment since changing over to a production system based on continuous improvement. Most companies had invested in CNC machinery, which allows workers more discretion than they had before. For example, Integrated Circuits had bought capital equipment that significantly changed the skills requirements of the operator from one based on manual dexterity to one of monitoring capital equipment and repairing it when it broke down. Additionally, the worker would be responsible for programming statistics into the computer. Now testing machines are capable of gathering statistics on tested products and the operator must immediately decide what to do depending on the statistics of a run:

Before they just pushed the stuff in and pushed the stuff out and didn’t know which was the right amount for one grade. Now they know what is expected for that grade, and they know if there is a deviation and will notify someone when there is. The manual skills have decreased, but the soft skills have increased, and now the operators make more decisions than they did before, whereas before they would wait for the supervisor to come down and say that there is a yield problem, now the operator will call the manager directly and say that there is a yield problem (Production Controls Supervisor, 3/25/94).
Upskilling of Workers

A sign of a changeover towards a leaner system is the merging of the quality control departments into the production line. Of the six firms examined, all had integrated quality control measures throughout the production line and relied upon quality control circles to continuously improve processes. Aligned with the merging of the quality control department into the production line, firms had begun to streamline their organization by cutting down on its middle-management and supervisor positions and were delegating these responsibilities to operators. For example, Medical Manufacturers had saved seven million in manufacturing over a two year period by cutting down on its non-value-added positions.

Additionally, upskilling occurred as workers became responsible for a variety of tasks, including programming of machines, statistical quality control, and the repair and maintenance of machines. For example, at Printed Circuit Boards, teams are asked to give input on procedures and to evaluate chemistry used in producing printed circuit boards but are not required to staff or to schedule. Supervisors' roles are to run the area instead of organizing teams as they used to. In order to foster workers' input, groups meet weekly in what result as coffeetalks to discuss ways of improving the processes. Whereas at Integrated Circuits, operators set up machines themselves and plugged in the equipments and cables, making sure that all of the standards are correct. If the machines go down they can unclear the jams.

Other factors guide the improvement of quality standards, such as the certifications for ISO-9000 (International Standards Organization), which manufacturers must receive in order to export to the European community. All of the firms interviewed were either ISO-9000 certified or were planning to apply for certification. Workers are responsible for reading instruction sheets and recording their activities, as there is more documentation involved in ISO-9000 in order to insure quality standards.
Training

All firms had begun training their workforce in commensurate with a switch over to a lean production system; a couple firms had contracted out to a consulting firm to assess the skills of their workforce and subsequently offered English-language classes, math classes, and computer programming classes for those who needed them. Most firms reimbursed employees for community college classes that helped employees build skills for their work situation. Of those firms that gave English-language classes to their immigrant workforce, some classes were given in order to upskill the workforce for the documentation necessary under ISO-9000. For example, one firm Printed Circuit Boards Inc., had an ESL instructor help immigrant workers document and read instructions for ISO-9000 procedures.

The most progressive company interviewed, Compu-Tech, offered an array of classes that helped people move from production positions to administrative assistant positions. In attempting to build workers' soft skills to foster trust among employees, Integrated Circuits invested in team-building exercises, where they took their employees to Thompson Island off the coast of Massachusetts. These team-building exercises required that workers fall back onto each other and that co-workers catch them, thus fostering trust among workers.

Firms saw their training programs as a one-time investment and did not plan to invest in further training with their future workforce. At Medical Manufacturers, a two-year program, offering math and English-language classes, includes 100 production workers. After they are done with the program in December, it will have cost Medical Manufacturers two million dollars. Although the company has paid for only half of the program, with employees putting in half of their own time, a human resource manager said that they do not plan on investing in a program like this in the future:
Partnership for Learning, Unlimited Success (PLUS), began approximately two years ago and it is a program that runs for four hours a week, with two hours being sacrificed by employees and the other two hours being paid by Medical Manufacturers. Because we don't want to start the program again since it is costly, we are looking for these skills in future employees. Also, we would like to start giving English language and math skills tests to applicants (Human Resource Manager, 3/4/94).

Evidence from the Field on Soft Skills: Input Levels, English-Language Skills, Quality-Mindedness, Motivation, and Worker Interactions

After interviewing managers from six firms, I found that Cambodians possessed sufficient English-language skills to carry out their new work roles due to the training that they received. Other characteristics specific and significant to the Cambodian workforce under the context of work reform, and included under the umbrella of "soft skills," are their input levels, quality-mindedness, motivation, and interaction with co-workers. All of these skills are crucial under continuous improvement activities. Although some managers noted differences between the Cambodian and native workforce in their input levels and quality-mindedness, managers thought that the differences were insignificant. Training, which all firms have invested in, helped to reduce any shortcomings of the Cambodian workforce; because firms were just recovering from a regional recession, employers had not hired new employees and the average tenure of their workforce was seven years. And because operators possessed valuable production knowledge due to their length of tenure, and thus were not easily expendable, firms invested in training them.

A process supervisor of Compu-Tech said that if immigrant workers were lacking in the skills required under work reform, they had equipped operators with tools to insure their success in continuous improvement activities. A group came in two years ago and assessed the skills of production workers and offered English-language, math, and business-writing classes to Compu-Tech's current workforce:

The Cambridge Education Consortium came in two years ago and assessed the skills of the workforce and offered English, math, and
business-writing classes to the production workers who needed them. These classes are paid for by the company's time and will continue to help current employees meet their goals. But future applicants who don't have these skills will be hurt, as we will be looking for these skills in future employees and will not offer these classes after the current workforce has been trained (Process Supervisor, 4/8/94).

A production controls supervisor at Integrated Circuits took an active interest in Asian cultures, had befriended many Cambodian workers, and even attended some of their weddings. His perspective of the community was valuable because he had been with the company for ten years and had witnessed the firms' changeover towards a leaner production system. This supervisor said that Cambodians may be more eager and less resistant to learning computer skills because they do not have an ego problem, whereas a native workers may have a problem because they expect themselves to possess these skills already. Whereas for Cambodian immigrants, everything is a new experience for them -- like learning English -- and they constantly expect to learn new things:

There is tremendous training on all levels and Cambodians are not better prepared or worse prepared than those that have a high school diploma. Neither come with computer skills and we train the workforce within the company. Maybe Cambodians don't have an ego problem about learning computer skills because they don't expect themselves to have known these skills previously. There is extensive one-to-one training on computer skills and always a translator is available (Production Controls Supervisor, 3/25/94).

The same supervisor at Integrated Circuits said that if Cambodians workers ran into problems, they could turn to their Cambodian co-workers to look for translation and assistance:

There is extensive training on all levels and there is somebody to translate for the workers who don't speak sufficient English. This system of workers helping each other out works very well because the work is done
in teams to begin with and there is increased interaction among workers (Production Controls Supervisor, 3/25/94).

The same manager at Integrated Circuits said that there wasn't a great problem with Cambodians interacting with native workers because many Cambodians had become acculturated to American society since first immigrating. Although, the Cambodian workforce at Integrated Circuits had not integrated completely into the mainstream workforce, -- for example, in the lunchroom, Cambodian and white workers sat separately to eat their meals -- Cambodian and white workers worked well together in the production lines.

Also, a human resource manager at Medical Manufacturers noted that Cambodians spoke more English than they let on. The company had started a training program, which included English-language and math classes, where 60% of the 100 people recommended for the program were Cambodian. The instructor was surprised at how well Cambodians spoke English since most usually spoke Khmer on the shopfloor with fellow Cambodian workers. This manager also noted that Cambodians gave different levels of input than native workers and that Cambodians tend to be more quiet. But he did say that the lower input levels from Cambodians workers did not pose a significant problem for the continuous improvement activities.

A production manager of final tests at Integrated Circuits, voiced a slightly different opinion than the human resource manager of Medical Manufacturers. This manager supervised twenty Cambodians and said that he had to rely on showing rather than explaining when training them because some did not speak sufficient English. He also said Integrated would be looking for English and math skills in new hires, and that they are currently asking for high school diplomas. He also illustrated a problem he encountered with two Cambodians who do not speak English well. But he went onto say that their expertise was important enough to override their lack of English-language skills:
There are some barriers for immigrants in giving input, but this is not a big dilemma. I have encountered two Cambodian immigrants who had trouble giving input but they are very capable people and knowledgeable computer operators. The limitation is that they can't communicate their knowledge to other individuals so that other individuals can be brought up to the same level as them. They are excellent workers but it is very difficult to get them involved in "quality improvement" activities. Leaders have difficulty getting information out of them and this limits their involvement in TQM activities. Their inability to communicate to their co-workers don't make these two less valuable, though, because they fill a valuable niche due to their knowledge and expertise of one or more operations. These people are two extremes and with others you just have to be more patient and wait for them to contribute (Production Manager of Final Tests 3/25/94).

The same manager went onto comment that he did notice subtle differences between Cambodian -- or Asian -- immigrants and native workers. He thought that Asian workers are more quality-oriented and that American workers are more independent and hence Americans tend to give more input and take more initiative to act on their own. But when asked whether he would choose a more quality-oriented worker or a more independent one, he said that he would choose the more quality-oriented one, leading one to believe that the Cambodian worker may be at an advantage over the native worker in the eyes of this manager.

A manager at Personal-Alert Systems said that there is no problem of interaction among workers of different races. There are many ethnic groups working at this firm, and all operators work well together under the context of work reform:

There are seven language groups in the plant and we have provided translation assistance in order to train immigrant workers in starting TQM. We have been very successful because we have simplified processes to make it very easy for workers. We have also cross-trained the workforce and have instituted teams in order to allow for flexibility. Currently, there are Koreans, Cambodians, Haitians, and Jamaicans and we see no problem of having workers of different culture working together (Corporate Materials Manager, 3/28/94).
This manager went onto say that the immigrant workers, including seven Cambodian workers, have a more diligent attitude towards their work because they are coming from different life circumstances. Because they come from a culture, which strives for more perfection than the American culture, immigrants may be more quality-minded than native workers:

I see no distinction between immigrant workers and native workers in terms of input, but perhaps immigrants have more of a sense of ownership or accountability in their attitude towards work because their work is the center of their livelihood, whereas native workers have other things that enter their lives. Immigrants take more pride and ownership in what they do maybe because they feel more lucky or gratified to be employed and not take it for granted. It is easier to push an immigrant operator to be more of a perfectionist than it is to drive a native operator because they hadn't been schooled in an education system or a social setting where 90% was sufficient and was still an "A," but rather were pushed for a 100% (Corporate Materials Manager, 3/28/94).

**The Changing Structure of the Internal Labor Market**

In many of the firms interviewed, the role of the supervisor's position had changed dramatically. Because much of the responsibilities of the "first-line" supervisors were delegated to operators, many of these positions had been eliminated. Because these first-line supervisor positions had been eliminated, Cambodians would find it difficult to move up the ranks because the number of opportunities had decreased. At the same time, higher-level supervisor positions had been changed so that the job requirements were that a person have the background of a finance major or possess a MBA. At Compu-Tech, a human resource manager said that a program providing training for higher-level supervisors had ended three to four years ago. They would be asking for these skills of future applicants:

As job descriptions were changing, people needed additional skills. For supervisor positions, finance skills and higher level math skills are
required. We worked with Northeastern to come up with programs for supervisors to be trained. Some passed the program and some didn't and those who passed stayed, while those who failed had to look for other positions within Compu-Tech. The program occurred three to four years ago and was called Supervisor Technical Educational Program (STEP) and the classes were directed at building the skills of a finance major and included classes such as: budgets, analysis, statistics, and writing skills (Human Resource Manager, 4/8/94).

Some of the firms interviewed had changed their compensation structure to include a team approach to manufacturing, with bonuses given if the individual had performed well in a team. For example, at Compu-Tech, there was a $1,000 bonus if the person worked well in a team. But all companies compensated based on individual performance. Additionally, many companies had increased their wages after switching to a lean production system. For example, at Medical Manufacturers, an assembler at entry-level currently gets paid $10.69 an hour and can be paid up to $12.50 an hour. In the old production system, an assembler starting at entry-level would be paid at $8.90 an hour and would peak at $10.69 an hour.

Oxygenics was trying to retain their current workforce and had even offered ESL classes to their immigrant workforce, but they would be asking for English-language and math skills of future applicants:

The people we hire currently are required to take math and English-language tests; this testing began in June of 1993. In 1992 we required that people understand basic English. There are no exceptions to failed tests and so immigrants may be hurt under these new qualifications. Relative to native workers, immigrants who don't speak English may be faring relatively worse because there are more qualified candidates, both native and immigrant, who are eager to work in the current job market (Human Resource Manager, 3/23/94).

As Oxygenics changes its organization of work, future job applicants not possessing the required skills will be at a disadvantage. Although workers currently employed in the six firms are doing well given the training received, many unemployed
Cambodians face a labor market that is increasingly difficult to enter. Because of the tight labor market in the 1984 to 1988 boom period, Cambodians were able to access jobs as production workers. But as the regional economy declined between 1988 and 1992, firms stopped hiring and switched over towards a production system that would make them more competitive. At the same time, they trained their workforce to meet the increased skills requirements of the new processes and kept them on since many workers were with the firm for an average of seven years, and thus possessed valuable production knowledge. Now as business starts to pick up along the corridor new applicants, including Cambodian immigrants, without the English-language and math skills find it difficult to gain employment in these firms. The following chapter will be on recommendations to address the skills shortage of the Cambodian community.
Many Cambodian immigrants are not doing well in the Route 128 labor market. A community leader estimates that 80 to 85 percent of the employed Cambodian population work in the electronics field, whereas 30 to 40 percent of the community are unemployed and do not speak English well enough to meet the new requirements of firms practicing continuous improvement processes (Liek, 1994). Many Cambodians do not speak English after being in America for years because they can live in a neighborhood in the city of Lowell and get by with speaking only Khmer. Although Cambodian immigrants were hired in electronic firms as assemblers during the boom period because of their dexterity and because of the tight labor market, many unemployed Cambodians cannot gain employment now because they lack the required skills.

Additionally, ethnic networks that were employed previously are harder to access for unskilled Cambodians. Because of the increased requirements, employees are hesitant to refer their friends freely. Because employee-referral programs operate on a cash awards basis, employees will not be awarded if referred friends are not employed. Specifically at Integrated Circuits, a Cambodian group leader was hesitant to refer friends freely and checked to make sure that the friend possessed both manufacturing experience and English-language skills before referring them (Prins, 1994).

Cambodians, who are laid-off due to the downsizing of Raytheon, USCI, and BASF, -- which practiced a Taylorist approach to production -- are disadvantaged because they are not equipped with the skills needed under work reform. And because registering for community classes costs money, which many unemployed Cambodians cannot afford, there are only a few means of acquiring the necessary skills.

A viable option for some Cambodians is to enroll in the Workers’ Assistance program, operating out of the Merrimack Valley Skills Center in Lowell. This program,
funded by the Industrial Service Program, has trained a total of 250 workers in the two years it has been running. Out of these 250 individuals, Cambodians constitute 70 percent of the participants. In this program workers receive ESL training for twenty hours a week for a span of up to six months while enrolled in a training program and also enroll in a basic-education program for an average of 26 weeks. During this training period, they receive unemployment insurance (UI). The program has been very successful and has had a 100% placement rate (Rourke, 1994).

The advantage of the Workers' Assistance program is that the skills needed by firms are taught. For example, the math classes include basic algebra and multiplication. Also, soft skills are covered including English-language and life-skills classes. The program also provides training in many vocational fields including electronics. But only about 100 individuals can enroll in the program every year, so the program cannot meet the needs of all unemployed Cambodians.

For example, the most needy in the community will never be able to access this program, since the Workers' Assistance program screens applicants and "creams-the-crop" to insure that participants will complete the program. Many individuals will be left out, including Cambodian women who face a greater disadvantage than Cambodian men because they possess less skills. Both in Cambodia and in the states, women received less formal education than men because they were thought of as caretakers, and thus it was thought unnecessary to educate women since they would not use it.

In most firms examined, Cambodians will be reimbursed for classes taken at community colleges. But many Cambodians do not take advantage of programs offered by firms since many are busy and have no time to take classes, or are not motivated enough. Many Cambodians are satisfied with their current wages and do not foresee that changing job requirements may push them out of their job all together (Liek, 1994).

Although many employed Cambodian immigrants are stressed for time, community-based organizations, like the CMAA, must educate and inform workers to
take advantage of the reimbursement programs offered by their employers. Employed Cambodians must be notified of firms' trends towards upskilling, and be pushed to take advantage of the reimbursement programs while still employed.

Because jobs in the electronics industry are considered, by Cambodian individuals, to be good jobs compared to jobs in other industries, efforts towards expanding employment opportunities for Cambodians in this sector must be made. Currently, 50% of the unemployed Cambodian population are having trouble with English and math skills and thus more training must be offered to the unemployed labor force. And because employers are screening employees for English-writing skills by verifying that they can complete a job application, and that they have sufficient English-language skills to complete a job interview, more training must be offered to Cambodian immigrants in order to equip them with the necessary skills.

Federal and state grants must be actively pursued in order to create a tripartite structure among the Cambodian Mutual Assistance Association (CMAA), local community colleges, and firms in order to provide a training program both sensitive to the needs of Cambodian immigrants and firms. After talking with the employment-training director of the CMAA, I found that a tripartite structure had been created previously among CMAA, Middlesex Community College, and local hospitals. This structure provided training for Cambodian immigrants in the health-care professions, with funding provided by JTPA moneys. Given that firms view Cambodian workers as a productive workforce, and evidence is available of Cambodians' success in firms' training programs, managers should be encouraged to engage in a program that trains Cambodian individuals and also be encouraged to employ them after they have completed the program.

Another example of a cooperative process has been a program created by the American Electronics Association (AEA) and Middlesex Community College, where the AEA pursued funding from the Department of Labor in order to develop, with Middlesex Community College, a training program tailored to the needs of the electronics industry.
This program is currently being developed and the dean of Middlesex Community College is optimistic that the program will be successful.


**Miscellaneous**


1990 Federal Census Demographics for the City of Lowell.
APPENDIX A
INTERVIEWS RELATING TO THE CAMBODIAN COMMUNITY

Abislaiman, Ralph, Director. International Institute of Lawrence. Lawrence, Massachusetts. Phone Interview, 26 January 1994.


Lee, Thomas, President of the Center for Quality Management and a Professor of Electrical Engineering and Computer Science at MIT. Cambridge, Massachusetts. Phone Interview, 4 March 1994.


Rourke, James, Occupational Coordinator. Merrimack Valley Skills Center. Lowell, Massachusetts. Phone Interview, 5 May 1994.


Oxygenics. Human Resource Manager on 23 March 1994

Medical Manufacturers Inc. Human Resource Manager on 4 March 1994
