

EMPLOYMENT IN HIGH TECHNOLOGY FIRMS:

Evaluating Job Creation

for the Cambridgeport Industrial District

by

Nancy Andrea Sackman

B.A., University of California, Santa Cruz  
(1975)

SUBMITTED TO THE DEPARTMENT OF  
URBAN STUDIES AND PLANNING  
IN PARTIAL FULLFILLMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF

MASTER OF CITY PLANNING

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 1982

© Nancy Andrea Sackman 1982

The author hereby grants to MIT permission to reproduce and  
to distribute copies of this thesis document in whole or in part.

Signature of Author\_\_\_\_\_

Department of Urban Studies and Planning  
May 24, 1982

Certified by\_\_\_\_\_

Philip Herr  
Thesis Supervisor

Accepted by\_\_\_\_\_

Langley C. Keyes  
Chairman, Department Committee

**Rotch**

MASSACHUSETTS INSTITUTE  
OF TECHNOLOGY

AUG 3 1982

LIBRARIES

EMPLOYMENT IN HIGH TECHNOLOGY FIRMS:

Evaluating Job Creation  
for the Cambridgeport Industrial District

by

Nancy Andrea Sackman

Submitted to the Department of Urban Studies and Planning  
on May 24, 1982 in partial fulfillment of the  
requirements for the Degree of Master of City Planning

ABSTRACT

This thesis analyzes the employment structure of a selected sample of high technology manufacturing companies. In particular, it assesses the quality and quantity of non-technical jobs created by computer manufacturing and scientific instruments firms with reference to community employment objectives. The characteristics of the individual firms are also analyzed to distinguish among different types of firms in this sector and the types of jobs they tend to produce.

The client for this research is the Riverside-Cambridgeport Community Corporation (RCCC), a local community development organization that is developing an industrial development plan for the Cambridgeport Industrial District (CID), a 155 acres site adjacent to the Cambridgeport neighborhood at the south-eastern edge of the city of Cambridge. This study is one piece of RCCC's industrial planning work in evaluating the employment-related costs and benefits of prospective employers in the CID.

Thesis Supervisor: Philip Herr

Title: Associate Professor of Urban Studies and Planning

#### ACKNOWLEDGEMENTS

The research that was conducted for this report was supported in part by the Massachusetts Community Economic Development Assistance Corporation and the Riverside Cambridgeport Community Corporation.

I wish to thank Phil Herr for his insight, patience, and for all the long hours he spent with me filtering through the myriad of details involved in primary data collection and analysis. Thanks also to Jean Myerson at RCCC for her guidance in mapping out the project and providing feedback with respect to RCCC's needs. Bennet Harrison provided valuable help in developing the questionnaire and in understanding the patterns that were emerging on firm and employment structure.

I would also like to thank the numerous industry sources and company managers who consented to interviews and whose valuable information on the industries in question and their particular companies provided the basis for this study.

TABLE OF CONTENTS

CHAPTER I: INTRODUCTION..... 7

CHAPTER II: METHODOLOGY.....13

CHAPTER III: ANALYSIS OF EMPLOYMENT STRUCTURE.....23

    A. Adequate Numbers of Jobs.....23

    B. Turnover Rate.....40

    C. Job Stability.....44

    D. Mobility, Training, Skills.....50

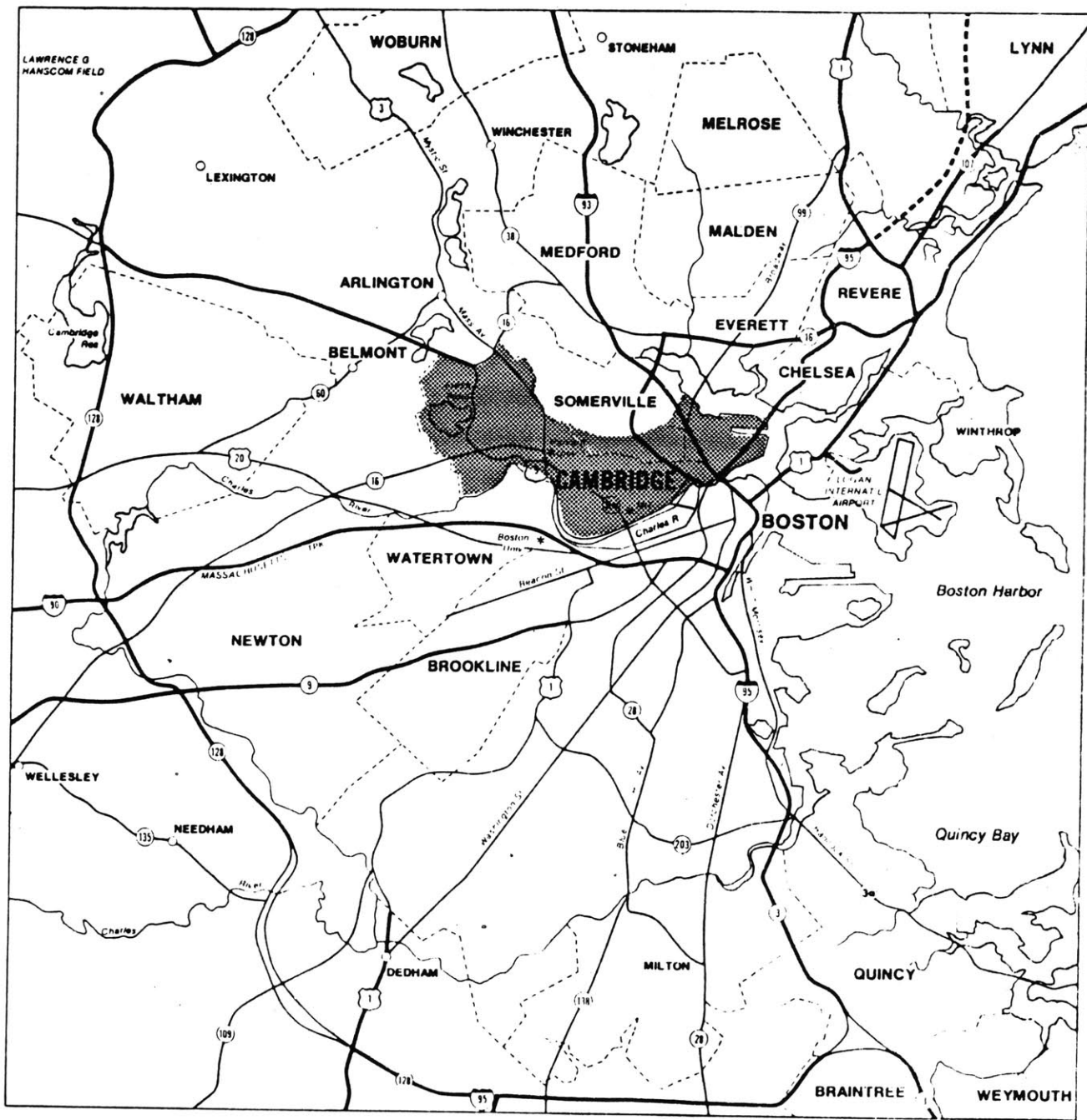
    E. Wage, Wage Advancement, Benefits.....60

CHAPTER IV: SUMMARY AND CONCLUSIONS.....69

APPENDIX.....79

BIBLIOGRAPHY..... 86

### AREA MAP



# LOCATION OF CAMBRIDGEPORT INDUSTRIAL DISTRICT



Neighborhoods

# CAMBRIDGE

Community Development Department 1976

CHAPTER I

INTRODUCTION

The future development of the Cambridgeport Industrial District (CID) is currently the center of debate in the city of Cambridge. With over 50 acres of vacant or underused land and approximately 30 or more acres that may change uses in the future, the District can have significant effects on the adjacent Riverside and Cambridgeport neighborhoods, as well as on the city as a whole. An estimated 2000 to 3000 jobs could be created through new development in the CID.<sup>1</sup> The new employment generated in the area could create significant job opportunities for local residents, or a mix of poor quality, low wage jobs and highly paid professional jobs inaccessible to a large portion of the neighborhood population. In the former case, community income would be increased, whereas in the latter, employment opportunities may not bring significant income to residents with low or unstable incomes. Future development may encourage the influx of new residents and a rise in property values. The resulting pressure on housing in the neighborhoods would most likely accelerate displacement of low and moderate income residents. Ultimately, then, the effects of development in the CID will be felt by the Riverside and Cambridgeport communities.

These concerns over possible impacts of future development are being addressed by the Riverside Cambridgeport Community Corporation (RCCC), a locally based community development corporation.<sup>2</sup> Its mandate to promote neighborhood stabilization is implemented through housing and economic development programs to deal with rising housing costs, falling incomes of neighborhood residents, and local population shifts. The RCCC Economic Development Program has focused on the employment and income needs of its clients, particularly low and moderate income and minority residents.<sup>3</sup> The organization

has operated programs of employment recruitment and referral, and provision of technical assistance to local businesses and capital to selected relocation or expansion ventures. Most recently, it has engaged in development planning for the CID. This project is guided by a set of goals developed by a committee of local businesses and residents concerned with the compatibility of new development with existing land uses. The goals pertaining to employment are to encourage employment opportunities in the following ways: <sup>4</sup>

1. Maintain a diversified economic base, which promotes economic stability and supports a variety of job opportunities.
2. Increase the number of job opportunities for Riverside and Cambridgeport residents and for the remainder of the Cambridge population.
3. Emphasize jobs which offer entry level opportunities and provide job security, training, and advancement potential, especially light industrial jobs.

This thesis is one piece of RCCC's industrial development program for the CID that links the organization's employment agenda with land development planning. The purpose of this report is to aid RCCC in determining what types of employment are offered by firms in technical manufacturing industries and whether these jobs meet local employment objectives. The position of RCCC and other community voices that light manufacturing will generate jobs with appropriate characteristics provides the basis for examining technical manufacturing firms (these firms are described in Chapter II). The purpose of the analysis is to identify characteristics of firms that indicate the type of employment most likely to be generated by this sector and to identify whether in fact, individual firms provide high quality employment for neighborhood residents. With this information, RCCC can assess the employment related costs and benefits of prospective employers.

The Cambridgeport Industrial District, a 155 acre site on the eastern edge of Cambridgeport, in the city of Cambridge, is one of the largest and



oldest industrial areas in the city. Regional economic trends away from manufacturing towards services and trade have led to the closing of many traditional manufacturing businesses, particularly in nondurable and consumer goods.<sup>5</sup> Despite this shift, there is a large and diverse industrial base that remains in the CID. Further, the manufacturing industries that have grown rapidly in the state and are projected to continue their growth have relocated into and expanded in the district. Over half of the five thousand people who work in Riverside and Cambridgeport are employed in manufacturing industries.<sup>6</sup>

Although there are indications of a viable industrial community, how the underused portions of the CID will be developed is uncertain. The expanding market for office development in the Boston area and the city of Cambridge suggest that development in the CID may move in that direction. A major question for the Riverside and Cambridgeport communities is what type of employment opportunities are offered by office and manufacturing industries for low and moderate income residents.

In order to answer that question, it is important to consider the quality as well as the number of jobs created, particularly if adequate and stable incomes for residents need to be generated. A number of labor market economists maintain that the quality of jobs is a function of the characteristics of the firm to which they are attached. Labor markets are organized into two institutionally and technologically separate segments, termed the core and periphery segments. As described by Bennett Harrison and Andrew Sum,

"[t]he core is dominated by a primary labor market in which employers possess a high degree of market power, have at least a part of their sales guaranteed by government contracts, and are usually able to generate sufficient profits to be able to pay nonpoverty wages. Their economic power permits them to pass on some part of any new costs in the form of higher prices. Their profitability permits

them to invest in both physical...capital and [the training of their work force] which in turn increases the productivity of labor, [so that they can offer relatively high wages]." 7

The ability of primary employers to provide stable, or full-time year-round, employment is an important characteristic of this segment of the economy. The more stable nature of these jobs is attributable to the relatively high wage levels that "induce workers to value these jobs, while the fixed costs of [physical capital and training] encourages employers to value [stability in their work force]." 8 Thus the jobs in the primary labor market tend to be stable and relatively high paying.

Within the primary labor market are two types of employment. In independent primary jobs, such as professional, managerial, and crafts positions, workers tend to have more security in and control over their jobs and the work is more closely related to formal education than in the second tier. Subordinate primary jobs are generally well paying blue collar occupations that provide job security, but require less formal education or skill. 9

The periphery segment of the economy consists of a secondary labor market in which employers possess little market power and have low investment in capital equipment. These factors restrict their ability to offer high wages and other benefits, which in turn discourage stable job attachment by the labor force. Because of the low fixed costs of physical capital and specific training for employees in this segment, there is little incentive for employers to maintain stable employment. In addition, unstable product demand, due in part to the lack of market power, restricts the ability of employers or need to provide full-time year-round employment. 10

Certain segments of primary employers' operations may be organized into secondary employment. This is particularly the case in certain geographic regions or in stages of the manufacturing process in which work is highly

standardized and labor-intensive.

The different sets of jobs created by commercial and light industrial development in the CID can then be assessed in light of differences in job quality. According to state labor market information, a greater portion of jobs created by office and commercial uses tend to be either part-time or low-wage compared to manufacturing employment in the primary labor market. Based on state averages, about 20 percent is part-time and over 50 percent is likely to be in clerical, sales and service occupations where average salaries tend to be low,<sup>11</sup> whereas primary manufacturing employment tends to provide a larger proportion of full-time jobs and higher average wage.<sup>12</sup> In addition, these manufacturing industries are known to structure pay and skill advancement through well-defined career ladders, that provide security and predictable future increases in income.<sup>13</sup>

This evidence has led RCCC and others in the community to conclude that subordinate primary manufacturing jobs have the greatest potential for generating secure employment with adequate income, and, as indicated earlier, it is for this reason that this study focuses on technical manufacturing firms. Chapter II outlines the methodology used for the study, including the choice of specific industries, individual firms, and the particular indicators used to measure job quality. Chapter III comprises the analysis of the results of interviews with thirteen firms, including a profile of employment conditions and an analysis of the indicators that associate firm and job characteristics. Chapter IV summarizes the findings, offers conclusions about the qualities of employment in the sample, and the associations between characteristics of the firms and the types of jobs they create.

FOOTNOTES

<sup>1</sup> Richard Whitman, The Impacts of Office, Retail, and Industrial Development of Neighborhood Change. MCP Thesis, MIT, 1981, page 8. This study analyzed the effects of different development scenarios in the CID on employment, housing, and traffic.

<sup>2</sup> Founded in 1971, RCCC is a non-profit organization located in the Riverside and Cambridgeport neighborhoods, comprised of local membership and run by an elected Board of Directors.

<sup>3</sup> RCCC, "The RCCC Economic Development Program," mimeo, 1980, p.1.

<sup>4</sup> The full set of CID development goals are as follows: 1) Protect the existing neighborhood; 2) Maximize the development of affordable housing, to reduce pressure on the housing market, to provide ownership opportunities for low and moderate income residents, and consistent with the scale and densities of the neighborhood; 3) Encourage employment opportunities; 4) Encourage expansion of existing businesses, retain existing jobs, and capture new jobs by assuring availability of expansion space; and 5) Improve traffic and transportation flows. (RCCC, "Response to the CID Rezoning Proposal," September 1980 mimeo, p.1.)

<sup>5</sup> RCCC, An Analysis of the Business Sector in Riverside and Cambridgeport (Cambridge: RCCC 1981).

<sup>6</sup> Ibid.

<sup>7</sup> Bennett Harrison and Andrew Sum, "The Theory of Dual or Segmented Labor Markets." Journal of Economic Issues, p. 689.

<sup>8</sup> Ibid, p. 689

<sup>9</sup> David Gordon, The Working Poor: Towards A State Agenda (Washington, DC: Council of State Planning Agencies, 1979), p. 36

<sup>10</sup> Harrison and Sum, op.cit., p. 690.

<sup>11</sup> Whitman, op. cit, p. 55.

<sup>12</sup> Ibid, p. 55. Secondary manufacturing such as the garment and textile industries, do not provide this type of employment.

<sup>13</sup> Harrison and Sum, op. cit., p. 690.

CHAPTER II  
METHODOLOGY

Overview

The research method for this study was developed to identify the characteristics of jobs in technical manufacturing firms, and to evaluate the extent to which firms generate these jobs over time. The goal of the reasearch was to develop, given constraints of limited time and budget, a set of questions or measurements that a community organization could use to evaluate employment-related business performance.

Measures of job quality and firm characteristics were developed based on models of labor market segments in the economy presented in Chapter I. A number of structured interviews, based on these measures, were conducted with one or more company managers in a small sample of technical manufacturing establishments in the Boston area. Industry data drawn from state and national employment statistics, available industry studies, company annual reports, and SEC 10K reports were used to supplement interview findings.

Comparison With Other Research Methods

Since the purpose of the study was to learn about variations in employment practices and discover a means of predicting these practices in individual firms, research relied mainly on primary data collection.

The use of large data bases for employment research would yield statistically reliable results. Yet publicly available, reasonably priced data on individual firms is difficult to obtain. For instance, the Dun & Bradstreet identifier files, a valuable source of information on individual firms, would not give data on employment quality. Data bases on employees, such as the Social Security longitudinal files, can be used to assess employment quality

through workers' employment histories, but may not be financially accessible to small groups, and would need to be supplemented by information on individual establishment characteristics.

Another approach would be to use a large statistically significant sample, and conduct research through surveys or a larger set of interviews. This method would smooth out what appear to be large variations in a small sample or to offer greater contrasts. The limits of time and resources ruled out this method. Although interviews with **employees** and other sources familiar with the firms in question would better get at tricky questions of mobility, wage advancement and skill, this approach requires time and access to informants.

The approach chosen, although less comprehensive, offers a more detailed view into individual firms in the industries that interest RCCC, and it provides an opportunity to assess more variables than are measured in accessible statewide data. This has provided a number of keys to the employment potential of individual firms that RCCC might consider than could be gathered from publicly available sources. Because RCCC is interested in profiles of individual firms, large data bases may not be helpful, since they do not afford a view of single establishments.

#### Choice of Industries

To test the premise that technical manufacturing firms<sup>1</sup> would provide primary sector employment, selected industries within the high technology sector were chosen for the study sample. A large portion of the production-oriented high technology sector is of interest for the CID, and information on high technology manufacturing industries is drawn upon throughout the analysis in Chapter III. However, two industries were selected for study: computer manufacturing (SIC code 3573) and scientific instruments (SIC

codes 381, 382, 383).<sup>2</sup> The focus on two major industries rather than all high technology manufacturing permits greater detail in gathering industry data. The reasons for choosing these particular industries are outlined below.

1. Growth: The industries were chosen on the basis of their past growth performance and continued strength. Industry research strongly indicates that, despite the decline of traditional manufacturing industries in Massachusetts, particularly in urban areas, technology-based manufacturing industries are expected to continue their growth.<sup>3</sup> Some of the fastest growing manufacturing industries are scientific instruments (SIC 38) and computer manufacturing (SIC 3573). State projections of employment growth to 1985, done in 1976, are shown in Table 2.1. Compared to a projected growth rate of 15 percent for manufacturing as a whole over this period, these industries are expected to grow much more rapidly, from 22 percent to 109 percent. Actual employment in 1980 exceeded projected growth in the computer and scientific instruments industries (note that 1980 employment for scientific instruments includes only one of the two SIC codes).

Table 2.1

Employment Growth in Selected Industries in Massachusetts, 1976-1985

<u>SIC Code</u>	<u>Industry Title</u>	<u>Employment 1976</u>	<u>Projected 1985</u>	<u>% Change 1976-1985</u>	<u>1980 Actual Employment</u>
3573	Electronic Computing Equipment	20,000	43,740	109	47,700
366	Electrical Machinery	90,100	166,050	29	113,260
381, 382	Scientific Instruments	13,560	16,590	22	19,200*
383, 382	Optical/Medical Instruments	14,730	22,080	50	18,960
Total Manufacturing		609,840	701,570	15	673,100

\*382 only

Source: Massachusetts Division of Employment Security Employment Requirements by Occupation, by Industry 1976-1985. (Boston: Massachusetts DES, 1979) and Massachusetts Employment Review, November 1981.

2. Labor Force: The labor force needs of these industries include both a large proportion of skilled technical personnel and semi-skilled production workers (Table 2.2). This occupational mix matches well with the labor supply of Cambridge. The city has a high concentration of technical professionals and two major universities that supply the professional labor needs of the Massachusetts high technology industries. It also contains a large population of blue collar workers facing pressure as manufacturing employment in other industries declines. There are also a major number of new entrants to the labor force with minimal education.

3. Job Quality: As presented in Chapter 1, most manufacturing industries tend to provide higher quality jobs, based on state averages for full-time work and wages. State wage data for the sample industries shows that in November 1981 the broad class of production workers had a higher average wage



in the nonelectrical machinery and instrument industries (SIC code 35 and 38) than for manufacturing as a whole in the Boston SMSA (an average \$8.14 and hour in the two industries, compared to \$7.74 an hour total manufacturing).<sup>4</sup>

Table 2.2

Occupational Composition of Computer Manufacturing and Instruments Industries in Massachusetts, 1980

<u>3 digit SIC code</u>	<u>Industry Title</u>	<u>Industry Employment</u>	<u>Professional /Technical (percent)</u>	<u>Production (percent)</u>	<u>Other (percent)</u>
357	Office & Computing Machines	45,870	37	30	33
381*	Scientific Instruments	2,770	27	NA	NA
382**	Measuring & Controlling Devices	16,670	27	45	28
383	Optical Instruments	6,060	34	36	30

\*1974 DES survey

\*\*1977 DES survey

Source: Massachusetts Division of Employment Security, Occupational Profile of Selected Manufacturing Industries in Massachusetts, 1974, 1977, 1980 (Boston: Massachusetts DES).

Sample Companies

Individual companies for the sample were chosen on the basis of industry (SIC code), size, age, production orientation (firms with few or no production workers were generally excluded) in order to arrive at a cross-section of firms by age and size. The sample includes sizes and ages of companies that would be similar to the types of establishments likely to relocate to or expand in the CID: establishment (single plant) ages ranged from one to 15 years old, and sizes were no larger than 600 employees (Table 2.3).

Companies were first identified through two industrial directories, Hall's Directory of New England Manufacturers and the Massachusetts Industrial

Directory, under the appropriate SIC codes. Further research and informal phone surveys were required to determine firm age and production orientation (size was listed in the directories). Other sources were consulted as well to supplement the original list: Dun & Bradstreet Million Dollar Directory, industry sources, the Boston business telephone book. Extensive phone contact with firms, during which many dropped out and others were added, yielded the present sample of thirteen companies shown in Table 2.3. The names of the firms are changed to preserve their anonymity.

Table 2.3

Distribution of Sample Establishments by Size and Age

<u># of Employees</u>	<u>Establishment Age</u>			
	<u>Under 4</u>	<u>5-8</u>	<u>9-12</u>	<u>13+</u>
1-49	Test Tech CAD Systems			
50-99	Minicomp		Filteroptics	
100-199		Entrycomp <sup>1</sup>	NCG	Compscan Emspec <sup>1</sup>
200-299	Datanet <sup>1</sup>			
300-499				Ionalysis
500+		Compusystems <sup>2</sup>	Analyzer	

<sup>1</sup>Subsidiary  
<sup>2</sup>Branch Plant

Representativeness of the Sample

The sample does not approximate the distribution of the instruments and computer manufacturing industries statewide, either by the number of establishments in each size class or by the occupational breakdowns. Table 2.4 compares the distribution of the sample and the total number of establishments in Massachusetts by number of employees. The data is an approximation, since statewide distributions were only available for 1977, and by 2 digit SIC code. In the case of nonelectrical machinery (SIC code 35), computer manufacturing is only one subsector (the others are office and industrial machinery). The table shows that the sample

has a larger representation of establishments with 50 to 249 employees, and a smaller representation of smaller firms (under 49 employees).

Table 2.4

Distribution of Establishments by Employee Size  
for the Sample (1982) and Massachusetts (1977)

<u># Employees</u>	<u>Instruments (SIC 38)</u>		<u>Nonelectrical Machinery (SIC 35)</u>	
	<u>Sample</u>	<u>State</u>	<u>Sample (SIC 3573)</u>	<u>State</u>
1-49	28%	75%	17%	86%
50-99	14	8	17	6
100-249	28	7	50	4
250-499	14	5	0	2
500-999	14	3	17	1
1000 +	0	2	0	1
Total # of Establishments	7	444	6	1530

Occupational distribution differs by the proportion of production workers in the sample and for the state industries as a whole. Comparing Tables 3.4 and 3.5, 83 percent of the sample establishments have less than the 30 percent production workers in SIC code 357 statewide in 1980. For SIC code 38, 87 percent of the sample companies contain less than 46 percent production workers (the proportion statewide in 1980).

The sample then probably yields most representative data on companies of from 50 to 249 employees that have larger proportions of technical personnel (the smaller proportion of production workers is a consequence of the proportion of professional and technical occupations in the sample (see Table 3.4 ). The study does not examine any very large establishments with higher proportions of production workers, thus it cannot draw conclusions about these except where the literature supplements sample data.

The atypical nature of the sample is not a serious problem for the purposes of this study, since it compares large and small firms within

the sample and draws upon industry literature where there are gaps. There is no attempt made to average out factors across size classes and make quantitative comparisons between the sample and other industries, for example, which would require a more representative sample. The limitations of the findings for drawing conclusions, are pointed out where necessary, throughout the analysis in Chapter III.

### Development of Variables & Indicators

Based on the needs of the community for secure employment, stable incomes, and based on the characteristics of jobs that would provide these types of employment, certain job qualities (termed variables in this study) were selected as criteria for measuring a firm's employment performance. In order to evaluate the presence of these variables, in the firms and to make a systematic comparison across firms, certain measures, or indicators, were established. The variables and indicators are as follows:

<u>Variables</u>	<u>Indicators</u>
Stability	1. Proportion of full time, year round workers 2. Annual turnover rate 3. Average tenure** 4. <u>Frequency and extent of layoffs</u>
Mobility, Training	1. Hiring practices For entry-level workers 2. Job ladders: extent, average tenure 3. Number promoted per year* 4. Formal, informal, outside training 5. Transferable skills; number of employees that left and joined similar companies*
Wage, Wage Advancement, Benefits	1. Entry level 2. Average wage for existing assemblers, technicians** 3. Covered benefits
Adequate Numbers of Nontechnical Jobs	1. Annual employment growth** 2. Occupational mix, changes, over time,** projected changes

Note: items marked with \* were dropped from the interviews. Items with \*\* were not consistently obtainable and were gathered where possible.

To study how the primary and periphery segments of the economy influence the type of employment structure in the sample firms, a set of firm characteristics (termed variables) were selected to describe the firms. To measure these variables, a set of indicators were defined, as follows:

<u>Variables</u>	<u>Indicators</u>
Product/ Production process	1. Standardization of the product and process 2. Extent of automation 3. Skill requirements of labor force 4. Proportion of professional/technical to production staff
Age and Size	1. Age, size
Growth	1. Sales volume growth
Market Position	1. Market share, product markets 2. Type of competition in product market

A set of working hypotheses was developed about the relationship between the firm and job variables. For example, it was hypothesized that smaller firms, because they have less market share than large firms and thus have more unstable product demand, would offer less stable employment in terms of layoffs and lower wages. These hypotheses, derived from the labor market theories presented in Chapter I, would be tested against interview results. The major hypotheses are introduced in each section of the analysis in Chapter III.

FOOTNOTES

<sup>1</sup> Technical manufacturing industries are within the "high technology" sector. This sector is defined by the Massachusetts Department of Manpower Development as 20 industries that have a larger proportion of technical professionals and technicians than durable manufacturing as a whole. (Massachusetts DMD, Defining High Technology Industries in Massachusetts, 1979), p 7.

<sup>2</sup> Industries are classified in national and state industrial statistics by standard industrial classification (SIC) codes. This system is used in this report.

<sup>3</sup> Lynne Browne and John Hekman, "New England's Economy in the 1980's", New England Economic Review, January, February 1981, p. 15.

<sup>4</sup> Massachusetts Division of Employment Security, Massachusetts Employment Review November 1981, p.10.

### CHAPTER III

#### ANALYSIS OF EMPLOYMENT STRUCTURE

This chapter presents an analysis of the employment patterns exhibited by the sample firms in this study, along with industry-wide information to enrich the findings from the sample. The chapter is organized by the types of characteristics identified in Chapter II as important qualities of employment. These qualities are that firms generate adequate levels of employment accessible to RCCC's constituents, that employment is stable, and that it offers structured advancement opportunities in skill and pay.

It should be stressed that the sample represents an already differentiated segment of the industry, (notes in Chapter II), rather than a cross-section of all manufacturing or high technology industries. In addition, the sample includes businesses that have survived, that are small (only one establishment has more than 500 employees), and that are in a certain age bracket (under 15 years). Thus the findings are representative of the patterns and variations within this subset, and not the wider variations likely to exist between this subset and manufacturing generally, or between manufacturing and all industries.

##### A. Adequate Numbers of Jobs: Gain in Production Employment

This section evaluates the absolute levels of employment generated by technical manufacturing firms and the growth of jobs accessible to RCCC's target population. An analysis of total employment growth is not the major focus of this study but, along with job quality considerations, RCCC needs to evaluate the number of jobs created to better target its resources in business development. This section is divided into three

sections for ease of discussion: total employment growth and factors that affect growth, shifts in occupational mix, and the effects of productivity gains on employment.

1. Total Employment Growth

The technology-based sector has experienced rapid growth in Massachusetts, and individual firms reflect that growth.<sup>1</sup> Overall, firm age and size are useful indicators of growth. In each of the twelve sample companies that started business with a handful of engineers, employment grew anywhere from ten to 65 times in the first eight to thirteen years. Table 3.1 shows the growth in selected sample firms from 1972 to 1982. Growth rates, starting from a low employment base, were high and tended to slow considerably in later years.

Table 3.1

Employment Growth in Selected Sample Firms

<u>Year</u>	<u>Firms</u>				
	<u>Minicomp</u>	<u>Entrycomp</u>	<u>Analyzer</u>	<u>Scancomp</u>	<u>Ionalysis</u>
1972	0	0	5	15*	15
1979	0	170*	325	110*	500
1980	3	160*	435	145*	450
1981	23	90	492	165	346
1982	71	107	500	190	332
			<u>Indexed (1982 = 100)</u>		
1972	-	-	1	8	4
1979	-	159	65	58	151
1980	4	149	87	76	135
1981	32	84	98	87	104
1982	100	100	100	100	100

\* Estimates

However, pinpointing more precisely the timing of that growth is not possible on the basis of sample data. In this sample, large amounts of growth occurred at different ages. Two firms did not grow substantially until their tenth to thirteenth year. For example, Emspec, after adding



only ten jobs in six years, expanded during its thirteenth to fifteenth years to a current base of 109 employees. Analyzer grew most rapidly during its sixth to eighth year, adding 200 jobs to a base of 200.

At the aggregate level, firm size and age are powerful indicators of employment gains and the likelihood of expansions or contractions. In his research on job creation, David Birch<sup>2</sup> found that, from 1969 to 1976, small, young establishments<sup>3</sup> were the largest contributors to gross new private sector employment nationwide, creating at least two-thirds of new jobs. As a group, business establishments tend to expand less rapidly after their first four years.

Birch's work points out the "churning" underneath this aggregate growth rate, however. Individual establishments expand, contract, or die within each size and age class. Birch found that firm size and age did indicate the likelihood of failure, contraction, or growth. Data for the study period show that there was a high probability of failure, compared to growth or contraction, especially among small firms (58 percent death rate during the study period) and that across firms of all sizes and ages there was no greater than a 40 percent probability of expansion (Table 3.2). However, the group of small (20 employees) establishments that survived the study period are more likely to expand than contract, whereas larger surviving businesses (100+ employees) had a higher probability of contraction than expansion (Table 3.3). Birch also concluded that fluctuations in size are not associated with age, that is, firms are not less likely to experience changes as they grow older. This is corroborated in the sample, where four firms ages seven up to twelve declined in employment from 10 percent to 35 percent.

Firm size, then, can indicate probabilities of failure or employment change. It is useful to know that, in general, small firms are more likely

Table 3.2

**Components of Change by Age and Size for Establishments  
in the United States, 1969-1976**

<i>Size</i>	<i>Age</i>	<i>Expand</i>	<i>Shrink</i>	<i>Die</i>
0-20	0-4	27.6%	7.6%	64.8%
	5-9	32.7	10.4	56.9
	10+	33.4	12.5	54.1
	TOTALS	31.6	10.7	57.8
21-50	0-4	25.2	24.4	50.4
	5-9	29.9	32.1	38.0
	10+	31.8	39.0	29.2
	TOTALS	30.1	34.8	35.1
51-100	0-4	23.4	29.1	47.4
	5-9	26.9	35.1	37.9
	10+	28.7	43.6	27.7
	TOTALS	27.5	39.7	32.8
101-500	0-4	21.7	31.9	46.3
	5-9	24.5	37.9	37.6
	10+	28.7	45.6	25.7
	TOTALS	26.9	42.2	30.9
500+	0-4	23.9	39.6	36.6
	5-9	21.0	38.7	40.3
	10+	35.1	46.7	18.2
	TOTALS	32.2	44.9	22.9
TOTALS	0-4	27.4	8.6	63.9
	5-9	32.4	12.0	55.6
	10+	33.1	15.4	51.5
	TOTALS	31.4	12.8	55.8

Source: David Birch, The Job Generation Process  
(Cambridge: MIT, 1979)

Table 3.3

**Experience of Surviving Establishments  
in the United States, 1969-1976**

<i>Size</i>	<i>Age</i>	<i>% Expanding</i>	<i>% Contracting</i>
0-20	0-4	78%	22%
	5-9	76	24
	10+	73	27
	TOTALS	75	25
21-50	0-4	51	49
	5-9	48	52
	10+	45	55
	TOTALS	46	54
51-100	0-4	45	35
	5-9	43	57
	10+	40	60
	TOTALS	41	59
101-500	0-4	40	60
	5-9	39	61
	10+	39	61
	TOTALS	39	61
500+	0-4	38	62
	5-9	35	65
	10+	43	57
	TOTALS	42	58
TOTALS	0-4	76	24
	5-9	73	27
	10+	68	32
	TOTALS	71	29

Source: David Birch, op. cit., 1979.

to fail, and if they survive are most likely to expand. Yet, as shown by the sample data it is difficult to make predictions about specific cases on the basis of size alone. At the level of the individual firm, it is also critical to understand the economic environment in which it operates.

The growth and decline in employment experienced by technical manufacturing firms, and shown in Birch's work for the business sector as a whole, reflect the general fluctuations in the economy, product markets, government expenditure policies, and firm specific strategies. To understand and to be able to predict the fluctuations of individual firms in these industries, examination of these factors is warranted.

The high technology sector in Massachusetts is characterized by uneven growth and employment declines, despite employment gains in the late 1970s. Since the end of World War II, irregular growth and decline have been recorded in segments of the industry, in different geographical areas, and for different individual firms<sup>4</sup>. These fluctuations reflect cycles both in economic activity and in defense expenditures. Sensitivity to business cycles differs among the various industries and is reflected in their growth. High technology firms that produce consumer goods, such as photographic equipment or binoculars, are sensitive to direct consumer demand, and in the more standardized products, to foreign competition.<sup>5</sup> Although the sample did not contain firms in the consumer market, industry statistics show that these subsectors have recently experienced declines while others have grown.<sup>6</sup> The sample firms that produce industrial process controls (Fileroptics, Ionalysis, Emspec) and computers depend on the level of capital investment in plant and equipment over the entire economy, thus are sensitive to macro cycles of capital investment. The growth of other firms in the sample reflected the growth in the semiconductor industry (NCG), computer

manufacturing industry (Scancomp), health care industry (Analyzer, TestTech, Chemtech), laboratory instruments industry (Ionalysis, Test Tech), large corporations and financial institutions (Minicomp, Compusystems, Datanet).

All the study companies have had, or will have, a portion of sales guaranteed by government contracts, for R&D, general supplies, or defense related products. This relationship means they both are somewhat vulnerable to government policy fluctuations depending on the proportion of sales and have more stable product demand (reflected in more stable employment) as well. Two older companies that depended heavily on defense contracts during the Vietnam War experienced employment declines in the 1960's when defense spending priorities shifted away from their products.

Although product markets affect employment growth or decline, firm specific business strategies may also have planned or unplanned impacts as well, which makes prediction of employment more complex. For instance, at the same time that Ionalysis undertook added expenses of new construction and expansion of its foreign markets, a general weakening in the economy was reflected in the decline in demand for its product. In addition, a major competitor captured part of the firm's market share. These events led to a 35% reduction in its work force over a three year period. From the interview and other reports of these events, it appears that the outcome (contraction of the firm) had to do with management decisions about marketing and facilities as well as fluctuations in the product markets.

This example also illustrates how the type of competition a firm faces will influence the way in which the firm externalizes production costs or reduced revenues, which ultimately affects its employment levels. Ionalysis, unable to pass on all added costs in its competitive market, reduced employment levels. If a firm can pass on higher costs to customers it can

retain employees, in the face of higher costs, whereas if the market is sufficiently price competitive and it cannot pass costs on, the likelihood of externalizing costs through reductions in variable costs (labor) is great. Although there was insufficient sample evidence to test the association between competition and employment levels, there is anecdotal evidence from a few cases where both types of competition affect growth. The case of Ionalysis illustrates the impacts of a competitive market. Analyzer, a medical instruments firm, was able to pass costs on in the form of higher prices over the 1980 to 1981 period, during which time its employment levels remained stable.

## 2. Changes in the Occupational Composition of Firms

Before going on to analyze the growth of production employment in the sample firms, it is necessary to describe the jobs on which this study focuses. Because RCCC's employment goals are to provide jobs geared to the skills and background of its target population, the growth and availability of non-technical employment is of major concern to RCCC. Research focused on production occupations, defined as those engaged in the direct manufacture and assembly of goods.<sup>7</sup> These occupations include skilled crafts workers, semi-skilled operatives, and unskilled laborers. Most information was gathered on assemblers (semi-skilled and unskilled operatives), the largest operative occupation and representative of production work that requires limited work experience. Depending on the industry and the degree of standardization of the workplace and product, assemblers' tasks range from skilled hand work to the routine assembly of components.

The growth of production employment in a firm can be traced by the change in occupational mix that generally results as the firms grows in size. The proportion of research and development (professional/technical) occupations decreases as a share

of total employment. This shift is generally linked to the growth in product volume and degree of standardization of the product: as product volume increases, manufacture of the same product does not require an increase in R&D staff. Further, as a product assumes a standard form and the need for continual revisions lessens, there is less need for technical personnel. In general, then, an increasing share of production employment can be expected as a firm grows and as it standardizes its product.

The growth histories of the sample firms bear out this proportional decline of R&D staff. Although respondents could give no numerical data on historical changes, they verbally confirmed that professional staff declined relative to production staff.<sup>8</sup> Proportionally large additions to total employment in the firms were in production occupations. For example, in its eighth year, with 200 employees, Analyzer added 100 production workers over the course of a year. After three years of prototype development, Entrycomp doubled in size by the addition of 35 production workers. Comparing across firms in the sample, the different occupational mixes corroborate to a large degree the association of firm size with gain in production jobs. Because of the sample's limited range in size and type of firm, however, there were few large proportional differences between larger and smaller firms. Table 3.4 illustrates the occupational breakdowns of the sample firms by employee size. The four firms of at least 190 employees older than four years contain 30 percent to 50 percent production staff. Most of the smaller firms, 66 percent of the firms over four years old, had low proportions of production workers, about 11 percent to 17 percent.

The small share of production employment is generally associated with a less standardized production process and lower production volume than

Table 3.4

Percentage Distribution of Professional, Technical, and Production Employment by Firm Size and Age

<u>Firm Age</u>	<u>Firm Size</u>	<u>Total # Employees</u>	<u>Managers/ Officers</u>	<u>Occupations (percent)</u>					
				<u>Professional</u>	<u>Technical</u>	<u>Production</u>	<u>Clerical</u>	<u>Sales</u>	<u>Service</u>
<u>0-20</u>									
<4	Test Tech	5	*	80	20	0	0	*	-
<4	Cad systems	12	12	50	17	0	8	*	-
13+	Chemtech	15	13	36	13	20		*	NA
<u>21-99</u>									
<4	Minicom	71	12	39	6	6	7	28	NA
9-12	Filteroptics	60	14	10	14	44	14	*	3
<u>100-249</u>									
<4	Datanet	45	16	26	22	12	22	2	NA
5-8	Entrycomp	107	28	32	12	12	8	8	NA
9-12	NCG	152	5	32	38	16	9	NA	NA
13+	Emspec	109	NA	>24	9	11	NA	NA	NA
13+	Scancomp	190	11	7	22	39	13	3	NA
<u>250-499</u>									
13+	Ionalysis	332	16	18	11	29	16	6	4
<u>500+</u>									
5-8	Compusystems	600	12	28	25	17	9	6	NA
9-12	Analyzer	500	9	10	5	50	9	4	2

\*Included in professionals

Note: Occupational breakdowns are for establishments, not for parent companies or entire firm (the breakdown for Compusystems as a whole would show a much higher proportion of production employment, for example).

that of larger companies. Respondants attributed the larger share of technical staff to the complex technology of their products, and some linked it to limited production volume. In a few cases, where the companies do a fair amount of customized work, production operations are carried out primarily by more skilled technical staff rather than semi-skilled workers. As production volume increases and the firms expand, however, there will be some level of increase in production labor in the majority of firms that presently have low proportions of production employment. From the interviews, it is unclear how large a shift toward production will occur in the sample firms.

The proportion of production workers in individual firms does not necessarily reflect the occupational mix of the industry as a whole. As shown in Table 3.5, the computer and instruments industries contain a much greater proportion of production workers than 85 percent of the sample and a lower percent for 15 percent of the sample. (Production workers in Massachusetts comprised 30 percent of total employment in SIC 357 and 46 percent in SIC 38 in 1980). Although state-wide production employment has declined as a share of total industry employment from 1974 to 1980, production employment has continued to grow over the years. For example, in SIC 38, it grew 5.6 percent from 1977 to 1980.<sup>9</sup> In the sample firms, some degree of production growth is projected to continue. This is particularly the case for the current start-up firms and the heavily technical operations that will have needs for production labor if production volume increases and product lines stabilize.

A complication in estimating the gain in production jobs is that the increase is not necessarily a smooth progression. Three firms intend to expand production labor in the next five or so years, but their short term



Table 3.5

Occupational Composition of  
Office Machines and Computers (SIC 357) and Scientific Instruments  
(SIC 38) in Massachusetts 1974-1980

	<u>SIC 357</u>		<u>SIC 38</u>			<u>SIC 382</u>
	(percent)		(percent)			(percent)
	<u>1977</u> <sup>1</sup>	<u>1980</u>	<u>1974</u>	<u>1977</u>	<u>1980</u>	<u>1977</u>
Managers/Officers	12	10	7	8	8	7
Professionals		24	15	16	17	18
Technical	17	13	8	10	10	9
Production	48	30	51	49	46	45
Clerical	19	20	16	15	15	18
Sales	3	1	1	1	2	1
Service	1	1	2	2	2	2

Note:

1) In the first quarter of 1977 over 90 percent of all employment in SIC 357 was in computer manufacturing (3573). Thus it is used as an approximation of the computer industry breakdown.

2) For SIC 38, figures at the three digit SIC code level were not available except for SIC 382 in 1977. SIC 38 includes the industries under study - 381, 382, 383 - and ones not treated - 384, 385, 386 387.

3) This data based on responses to DES Surveys, and Massachusetts high technology companies have a poor response rate. The data then should be interpreted with caution.

Sources: <sup>1</sup> Kuhn, Computer Manufacturing in New England, 1981.  
Massachusetts Division of Employment Security, Occupational Profile of Selected Manufacturing Industries in Massachusetts, 1977, 1980.

plans are to expand R&D staff. For instance, Entrycomp is following a trend among computer firms to expand software development and stabilize its hardware production component. Therefore it intends to increase professional employment while maintaining current levels of production employment.

The shifts in occupations resulting from shifts in the market may yield new sources of employment in the industry in marketing and field service. These occupations are growing as firms expand their markets and compete on the basis of reliability of the product. Nationally, employment in the computer service occupations, which includes repair, marketing and programming, is projected to grow at twice the rate as assembler positions.<sup>10</sup> Many of the sample firms stressed the increasing emphasis on marketing and repair functions. Therefore, a firm's plans for these components of their operations and the type of employment they provide will be important to RCCC's employment goals.

### 3. Labor Productivity and Effects on Production Employment

Labor productivity, or output per employee, affects short and long-term employment levels. In the production operations, redesign of the production process, simplification of the product, and automation of some lines increases productivity which can increase employment in some cases and slow its absolute growth in the long term. In field service operations, more sophisticated diagnostic equipment and the use of modules in computer hardware has, according to one company manager, simplified the repair process and reduced the need for large numbers of technicians.

The nature of the competition and whether price is an important factor, will influence the ways in which productivity affects employment. Productivity in these industries has increased through the redesign and simplification of products, as well as redesign and automation of some segments of the

production process. The redesign of products has also lowered product prices. In some product markets where demand is price elastic, that is, where lower prices would stimulate increased consumption of the good, lower product prices expand the market which increases production and with it, employment. According to three respondents in the instruments industry, and two in computer products, rising productivity enabled them to reduce prices on expensive products, capture a larger market, and increase production, particularly for those companies that compete with other producers for markets. Even when a company is a sole source of a product, in effect having monopoly power, such as Entrycomp, demand for the product might be relatively price elastic as well. In the case of Entrycomp, lower product prices have led to larger markets, higher production volume, and expansion in employment.

However, productivity gains may not produce lower prices, an expanded market, and increased employment in cases where competition is monopolistic--one firm sells the product--or oligopolistic--there are standard prices industry-wide for the product, set by price leaders, and an individual firm in this market would not significantly reduce its prices. Product demand may be relatively price inelastic, so that neither does a higher price reduce consumption, nor does lower price increase consumption. Thus if the market and production volume have not expanded as a result of productivity measures, employment may not expand.

The majority of firms in the sample are in production stages where the large scale introduction of automated lines seems to be limited and thus demand for labor is still relatively strong. Their relatively complex technologies require use of hand assembly because of the risk of mechanical error and the difficulty of automating the more complex lines.

The short production runs and customized products characteristic of these firms also limit the need for or efficiency of large amounts of capital equipment. This is because automation can reduce the flexibility needed for these types of operations and can be expensive if production volume is relatively low or not continuous. Many respondents claimed that a highly automated system was not cost efficient in their firms for the above reasons.

Field service operations seems to be following the trend where increased production expands the need for labor but that productivity gains may also reduce the need for labor in the long term. Presently, firms with complex products and those who are expanding their service operations, still depend on human labor to deliver services. One example of this is Analyzer, which according to its annual report, derives a growing portion of revenues from field services such as training programs, repair, and preventative maintenance. A substantial proportion of its personnel are engaged in marketing and field service (20 percent of total staff). In the long run, simplified products and diagnostic equipment may tend to reduce these operations but the timing is far from clear. The long term effects of productivity gains will be a slowdown in employment growth but the timetable is unclear. Industry-wide, Kuhn reports that while employment in the computer industry grew rapidly between 1969 and 1976, productivity gains presumably slowed the growth.<sup>11</sup> However, employment in the industry is still growing strongly. For individual firms in the sample, the objective of introducing mechanized operations is evident, in their goals of expanding of output with the same labor force, expressed by many company managers. However, it is far from clear to what extent this affects employment gains in the next several years. Newer businesses with less standardized products and older

firms that may have standardized production to a greater degree and are expanding in production volume or product lines still require human labor in production and field service operations.

The conclusion can be drawn that in individual firms, some level of automation will be introduced as the firm grows and increases production volume. This will be tempered by the need for more labor intensive methods on some lines, and the continuing need for labor to operate the more automated lines. Useful indicators of this process are the nature of the product and the level of standardization of the process. Firm age along with size often, but not always, may help predict the level of standardization. It is difficult to predict to what extent gains in productivity in firms will or will not add to the jobs available to RCCC's constituents, on the basis of interview data or the general industry literature. Nevertheless, the general effects over time of productivity gains in firms can be broadly estimated based on the competitive factors presented above. The impacts are an important issue for RCCC to raise in its evaluation of prospective employers.

#### Summary

Predictions of employment growth and gain in production jobs are difficult to make on the basis of interview data and given the unclear implications of rising productivity in the industry. Trends identified in David Birch's research show that the small business sector generates more employment than older and larger establishments. For individual firms, however, employment growth patterns vary in absolute numbers and in timing. Nevertheless, all sample firms grew 10 to 65 times in their first five to thirteen years, indicating that employment growth in these types of firms is strong. The implication for RCCC is that

expectations for growth must be phased over a several year period to account for variations in growth or decline.

Production jobs are still the largest category of occupation in the industry statewide and thus a significant source of jobs. In individual firms, the gain in production jobs is clearly associated with the stage in the production process and product demand, as for instance, younger, smaller firms that are in the more innovative stages of their product development have the potential to grow in production employment as product volume grows and product prices decrease. Somewhat older firms, such as Scancomp and Analyzer, are growing or grew significantly in their seventh and twelfth years, as production volume and number of product lines increased. The majority of firms in the sample predicted employment growth in production but indicated that growth would be moderated by introduction of automation and simplified production processes to reduce the need for labor. The extent of the slowdown in employment growth over the next several years is unclear, however, which makes it difficult to judge their long term employment potential.

Uneven growth in a firm is a function of economic forces and the ability of the firm to pass on or absorb added costs and reduced revenues. To predict fluctuations in employment, the product market and extent of market power are important factors. With few or no competitors, small firms may withstand fluctuations as large firms do -- by passing on costs. Reduction in the already small markets of small firms however, may cause contractions in employment levels, regardless of competitive position.

For RCCC the absolute numbers of production jobs as well as the growth rate may also be a valid measure of adequate employment level. To measure additional job opportunities for the community, the number of

vacancies is an important figure to consider. A relatively slow growing firm may have more openings available to local residents through turnover than a rapidly growing firm whose jobs are inaccessible to local residents. Turnover in firms that offer good quality jobs is discussed in the next section.

### B. Turnover Rate

The rate of turnover in a firm (employment terminations as a proportion of total employment) may be an indicator of the instability of the jobs, poor work environment, or alternatively an indicator of an active labor market in the presence of quality jobs. Vacancies that result from turnover in the CID can provide a steady flow of opportunities for neighborhood residents, but might, signal presence of poor quality jobs. This section examines the meaning of turnover rates with respect to job quality and quantity in the sample firms. Evidence gathered from the interviews, although limited, suggests that turnover rate by itself is not an indicator of job quality but must be interpreted in light of labor demand and supply factors in the job markets, and the ways in which employers organize the labor process in terms of wages, advancement opportunities, work schedules, and working conditions.

The Massachusetts high technology industry is known for its high turnover rate, particularly in areas of industry concentration, such as Routes 128 and 495. The factors associated with the turnover rate can be very different depending on the level of occupation. In the professional and technical occupations, high turnover has been linked to the high demand for skilled labor.<sup>12</sup> In addition, the widespread practice of pirating trained labor rather than investing in internal training has encouraged high turnover. Together, these factors suggest an active labor market for experienced technical personnel.

Turnover rates in the skilled production occupations can be a function of similar factors as for technical personnel, namely high demand relative to supply and the practice of pirating skilled labor. Although this study



did not focus on crafts or field service occupations, it appears that the demand for skilled labor in these operations also indicates an active labor market and high quality employment opportunities.

For semi-skilled operatives, different labor market conditions may prevail. There is strong demand for these personnel, but there is little shortage of supply.<sup>13</sup> This is suggested by the results of a survey on human resource needs prepared for the Massachusetts High Technology Council in 1980, which found that, among 60 responding member companies, six percent of total production jobs were unfilled whereas up to thirteen percent of engineering technician jobs were vacant.<sup>14</sup> The Massachusetts Department of Manpower Development conducted a survey of a variety of businesses that employed assemblers and found that, among 17 respondents, 88 percent did not consider assemblers to be in short supply.<sup>15</sup> Finally, all managers in the sample who hired operatives had little trouble filling positions. This suggests that scarce supply is not a factor in encouraging turnover among assemblers.

In the sample firms, turnover rates for production workers ranged from less than 15 percent to 30 percent, at a 20 percent median rate. Table 3.6 groups the turnover rates reported by the sample companies into lower and higher figures. The rates are not strictly comparable because managers included slightly different items in their estimates.<sup>16</sup> Nevertheless the broad categories reveal the various factors that increase or reduce turnover rates.

The interviews suggested that turnover rates are associated with job quality (wages, personnel practices, work schedule, advancement opportunities) and the employer's choice of labor force. Wages and benefits offered by the firm are a key factor in turnover.

Table 3.6

Annual Turnover Rates for Operatives

<u>Turnover Rate</u>	<u>Number of Firms</u> (Total = 10)
to 15%	4
to 25%	4
26+%	2

Lower turnover in Compusystem may be attributable to relatively higher wages (see section E. Wages). According to the manager at Analyzer, when wages and benefits were upgraded, the firm's turnover decreased. The DMD survey of assemblers found that low wages were strongly associated with problems employers had with high turnover.<sup>17</sup> Firm specific hiring and personnel practices were two key factors mentioned by respondents. For example, lower turnover in Minicomp was not associated with higher wages relative to those paid by other firms, but may have been a result of the personal connections production workers had to professional staff. In addition, according to the manager, the company fostered employee loyalty through less rigid work rules and employment policies. Four other small firms (less than 300 employees) mentioned their flexible personnel practices as an element in stabilizing employment. The practice of retaining labor during economic downturns and personalized employment practices to stabilize turnover has been noted in research on small business.<sup>18</sup>

Low turnover is not necessarily an indicator of high job quality in terms of wages and advancement. In the case of Filteroptics, low turnover was in the presence of low skill jobs with little advancement opportunity. Rather, personnel practices to foster a "good atmosphere," the use of part-time work schedules, and the choice of an older female

work force were strategies to reduce turnover in the assembler positions. A majority of suburban companies adopted the strategy of employing older, predominantly female assemblers, claiming this work force was more stable.

Nevertheless, respondents acknowledged that job structure (not simply the characteristics of the work force) was an important factor affecting the rate of turnover. Limitations in wage and internal advancement were cited by Scancmp, Emspec and NCG as contributing to employee turnover. Company policies mentioned above (avoidance of layoffs, more flexible work rules and use of benefits) were used to offset the problems of wages and internal advancement. According to the findings of the DMD survey, the routine nature of the job as it is structured in a majority of firms combined with relatively low wages for the occupation as a whole, contribute to absenteeism and turnover.<sup>19</sup>

The two firms who quoted higher turnover rates did not have "worse" conditions of employment relative to the other firms, as communicated through interviews. The manager at NCG attributed turnover to the constraints of a small company in offering higher wages and benefits. The other firm, Analyzer, had just upgraded its wages and benefits. These two cases support the possibility that higher turnover among operatives can be associated with either limited job opportunities or relatively better wages.

Because the turnover rates in the sample seem to be associated both with competitive and low wages, and because working conditions cannot be assessed through an interview format, the turnover rate in prospective firms should be assessed individually, on the basis of wages and the availability of job opportunities outside the firm that would contribute to active labor market conditions.

### C. Job Stability

The stability of the job is a function of the stability of the firm, as measured by its ability to provide full-time, year-round employment and the manner in which the firm externalizes fluctuations in product demand through layoffs. Long term stability is a function of future business growth or failure, potential relocation, and the impact of productivity measures on employment levels.

#### Provision of Full-Time Year-Round Employment

From the sample survey, it was found that there is relatively little part-time work in these firms, generally concentrated in the clerical, professional, and a few production occupations. Twelve of the thirteen firms contained over 90 percent full-time, year-round jobs. Part-time work in production was for the most part in the least skilled jobs. For example, Filteroptics created part-time shifts for the lowest rung operatives. Part-time work in low wage jobs in the industry may be more common than the sample indicates.<sup>20</sup>

The majority of the firms in the survey preferred to maintain full-time work schedules, and in fact made more or less heavy use of overtime, rather than adding new full or part-time workers. This is a common strategy in many manufacturing industries<sup>21</sup> and increases workers' annual earnings, but may in part reduce the numbers of jobs available in production employment.

For the local community's purposes, the lack of part-time work may or may not be beneficial, depending on the needs of the target population. Use of overtime is beneficial to employed workers, as annual earnings are increased, but it also restricts the number of new jobs created for local residents.

Firms may use temporary workers in periods of high product demand. The question here for community concerns is whether temporary work constitutes a major portion of the production jobs, thus reducing the stability of the jobs. Although the data does not allow a comparison of this strategy by size of firm, the prevalence of temporary work may be higher in smaller than in larger firms. The latter have greater market power and thus face more stable demand, which reduces the fluctuations in work force. Six of the sample firms used temporary workers and the largest firm maintained a list of on-call production and clerical workers. Because no firm is currently using temporary workers the proportions were not assessed, but they are presumably small relative to permanent staff, according to respondents. Nonetheless, the use of permanent and temporary work schedules by prospective companies should be examined to determine job stability.

### Layoffs

Reductions in the work force indicate the employer's strategy for externalizing the costs of a fluctuating market, among other possible reasons. Layoffs were expected to be more common in small than large firms because of less stable product demand faced by the small firm. The higher incidence of layoffs in small firms which is common in most industries, is borne out by the study sample. Four companies of 40-500 employees experienced layoffs during periods of general downturns in the economy (1974, 1980 to 1982). Firm size seems to be a useful indicator of the likelihood of layoffs, but some caveats are in order. First, only one establishment belonging to a firm of over 1,000 employees was included in the sample, thus comparative statements between small and large firms cannot be made on the basis of the interviews.

Second, as David Birch's work indicates, there is a relatively high probability of reductions in the work force of establishments of over 500 employees (Table 3.2 shows that in the 1969-1976 period there was a 45 percent likelihood of contraction compared to expansion or death for these establishments.)

Literature on the small business sector has documented the tendency of small firms to hoard labor during downturns as way to stabilize employment over the long term, and to avoid the expense of rehiring labor and start up production costs during upswings.<sup>22</sup> This practice is corroborated by interviews, wherein five companies of less than 500 employees redirected employees' work during slow periods. However, large firms adopt these practices as well. The largest sample firm was able to retrain and move employees into higher demand positions in other plants. Such extensive efforts are limited in smaller firms, as evidenced by the layoffs cited above. Table 3.7 shows the occurrence of layoffs in the sample by firm size and age.

Table 3.7

Reductions in Workforce in Sample Firms

<u>Firm</u>	<u>Firm Age</u>	<u>Firm Size at time of layoff</u>	<u>Percent Reduction</u>	<u>Year</u>
Emspec	6	NA	NA	1974
Entrycomp	7	150	30+	1980*
NCG	9	100+	10	1981
Ionalysis	11	500	35	1980-1982

In the sample, small product markets and competitive markets made firms more vulnerable to downturns in demand. The firms that contracted had overestimated their product demand, or experienced reduced demand because competitors had captured some of their market. Thirdly,

the industries they supplied, experiencing downturns, curtailed orders for their product. It cannot be concluded that the other firms that have not had layoffs are more stable, or will not have them in the future, because their performance during downturns is unknown. In addition, major layoffs in large high technology corporations in Massachusetts that have occurred over the past few years suggest that large as well as small firms externalize costs through reductions in the labor force.

The broad conclusion can be made that security in employment depends on a number of factors in the economic environment and on company specific strategies. To predict employment security from the single indicator of layoffs is risky, although the indicator can give some idea of the firm's vulnerability to market shifts and its strategies to cope with them, by maintaining or reducing its labor force.

#### Stability of the Firm (Firm Turnover)

Although not treated in this study of employment, "firm turnover" (the likelihood of failure or location out of an area) is an important determinant of long term employment security. The impacts of market fluctuations and changes in the production process on employment levels were analyzed previously. In this discussion, two points are briefly noted that bear on potential relocation of an establishment. First, as a firm moves towards standardized and high volume production processes, levels of employment may change and segments of the process can be separated and moved from the original facility.<sup>23</sup>

Secondly, absentee ownership of a firm may influence its locational behavior. Although the study did not research the relationship of administrative status and firm turnover, interviews revealed that ownership structure changed as the firms sought outside capital to fund their growth.

The majority of high technology firms and the sample firms fund their growth from retained earnings rather than borrow at high interest rates. The rapid growth rates typical of this sector make it difficult to finance solely from internal sources because when sales are brisk, there is a need for working capital in the periods between payments from customers. In addition, the capital needed for expansion is spent long before the profits from this expansion are available. According to one industry observer, at growth rates of over 20 percent per year, firms must seek outside sources of capital to supplement retained earnings.<sup>24</sup> The revenues of about 90 percent of the sample firms over four years of age have been growing at a rate of about 20 percent to 40 percent annually.

Table 3.8 shows the current administrative status of the sample firms.

Table 3.8

Administrative Status in Sample Firms

<u>Establishment</u>	<u>Privately Held Corporations*</u>	<u>Public Corporations**</u>
Single Plant	6	1
Corporate Hdq***		1
Branch/Hdq.		
Instate		1
Subsidiary/Instate		1
Subsidiary/Hdq.		
out of state		2
Merger/Instate	1	

\*Stocks not publicly traded   \*\* Stock is publicly traded

\*\*\*Headquarters

All past or proposed changes in administrative status reflect the methods used by the firms to obtain needed capital. In the cases at hand, equity capital can be obtained through public sale of stock (becoming a public corporation) or by selling to a larger parent company. Sixty-six percent of the private corporations (stock is not sold on public markets) plan to go public eventually, to raise equity capital. This is a common method



for established firms to raise needed capital. Two sample firms were acquired in 1980 by large out-of-state parent companies with larger retained earnings and better access to capital markets. However, literature on the computer manufacturing industry has found that acquisitions are also motivated by the original backers' desire for liquidity as well as the firm's need for capital. Because there is a high risk in selling to a parent company of the original company losing control of the business or going out of business altogether, acquisitions are usually the path of last resort for most growing computer firms.<sup>25</sup>

There is little experience to draw upon regarding the effects of buyouts by absentee owners in high technology companies. Based on the pattern in older industries, the shift to absentee ownership may increase the chances of movement out of a local area. Since 77 percent of the sample firms are located near where their founders live, and many company managers noted informal policies to remain in the area, absentee ownership may change this locational commitment. Although it would be almost impossible to predict the future changes in ownership in a growing high technology firm, since available capital sources shift with regional and national economic trends, the question of the current and potential future financial position and funding sources of prospective firms should be raised and monitored.

D. Job Mobility, Training, Skill

This section covers the hiring policies for new employees, the extent of training in the firm, the skill attached to the jobs and the development of skills, and the opportunities for advancement either within or across firms in the industry. Field research, as previously noted, focused on assemblers and to a lesser extent, on technicians. Career mobility, defined as the opportunity to advance in pay and skill, was hypothesized to be a function of the size and age of the firm, and is connected to the stage of production process and growth rate.

Hire-in Requirements

A major question is whether high technology employment as presently structured is accessible to RCCC's constituents. Hiring practices differ among firms, generally as a function of their production process, growth rate, size, and company training policies. About 70 percent of the sample companies adopt the strategy of hiring operators with at least six months work experience rather than train inexperienced workers internally. Table 3.9 lists the requirements for new entry level assemblers, both in the sample firms and in a sample from the survey conducted by the Massachusetts Department of Manpower Development. As can be seen from the table, only thirty-one percent of the study sample hired inexperienced workers. The DMD however shows a larger number of firms that do hire

inexperienced workers.<sup>26</sup> Thus hiring practices vary among firms in these industries.

That formal education is not an important requirement is evident from the small number of firms (27 percent of the sample firms, 18 percent in the DMD survey) that required a high school diploma. In practice, both sets of firms hired assemblers with more than the minimum amount of education. The DMD survey found however, that a diploma or equivalent was required by fifty percent of the respondents for experienced level assemblers (not shown in Table 3.9).

Table 3.9

Requirements for Entry Level Assemblers

<u>Minimum Education</u>	<u>Sample</u>		<u>DMD Survey*</u>	
	<u>No. Firms</u>	<u>Percent</u>	<u>No. Firms.</u>	<u>Percent</u>
No minimum education	2	18	7	41
Read, write	6	55	2	12
Less than high school	--	--	4	23
High school diploma/GED	3	27	3	16
CETA training	--	--	1	6
	<u>11</u>	<u>100</u>	<u>17</u>	<u>100</u>
 <u>Prior Work Experience</u>				
None	4	31	17	85
6 months -- 1 year	4	31	NA	NA
Over 1 year	3	23	NA	--
Technical Level	2	15	NA	--
	<u>13</u>	<u>100</u>	<u>20</u>	<u>100</u>

(\*Massachusetts Department of Manpower Development, A Report on Seven Growth Occupations in Massachusetts (Boston: MDMD,1981)

The practice of hiring already experienced workers appears to be indicated by the age, stage of production process and growth of the firm.

This assertion is supported by the hiring policies of the younger, smaller and more fast growing firms: assemblers (or technicians in place of assemblers) are required to have at least six months to a year's experience. One firm of 100 employees noted there was no time to train assemblers. The older and larger firms (150 to 400 employees over ten years old) had somewhat less demanding requirements. In these firms, the major objective was to simplify the product and the manufacturing technology. Thus, as one respondent reported, the jobs were becoming simpler than the assemblers' skill levels. Inexperienced workers were hired in two small firms (15 to 60 employees) and the two largest firms. These cases are discussed in the next section on training.

The requirement of prior work experience may also function as a screening device, as well as a guarantee of trained labor. A few respondents noted the use of a prior work record to establish the stability of the employee, although, many of the qualities sought by employers for assemblers could be learned on the job, as well as from prior experience: manual dexterity, coordination, speed, ability to follow directions, and acceptable job behavior (for example, punctuality).

The requirement of a portion of the sample firms for prior experience in allied industries, especially common in the smaller, more technically staffed firms, is important to note. If skills from other industries than high technology are not transferable, then lack of internal training in the firm may prove problematic for local hiring goals. Whether a firm could accommodate inexperienced workers through adopting training policies should be examined in the review of prospective firms.

## Training

As mentioned above, many sample firms hire already trained production staff, to obtain skilled workers or perhaps as proof of work-readiness. Kuhn<sup>27</sup> concludes that for technical professionals, high technology companies externalize the costs of training by relying on other companies for sources of labor. This observation seems to hold true for the sample interviewed, in the production occupations of the smaller, faster growing firms.

Nevertheless, though many firms required prior work experience, once employees were hired they received informal on-the-job training, the prevalent training method for production jobs. The extent of training may depend on firm size, and the division of labor within the firm. Whereas the largest firm, Compusystems, had in the past run formal training programs, small firms depend on informal learning. The largest firms also retrain workers for other types of jobs. The extent to which smaller firms train their employees for other types or higher level jobs could not be obtained from the interviews. Researchers who examined the association between formal training and firm size have found a difference between large and smaller firms. In a study of 600 firms in two size classes (over 10,000 employees and 500-999 employees), they found that large firms spent more money per employee on training than small firms (about \$72 annually per employee compared to \$19 per employee in smaller firms).<sup>28</sup> Smaller firms focus on management training, recruitment of already trained personnel, and informal on-the-job training for less skilled staff.

The interviews did clearly show that the certain of the younger firms with complex production processes, such as Entrycomp, provided extensive training to already experienced personnel in a variety of jobs in order to maintain the flexibility of their work force. On the other end of the spectrum, Filteroptics and Analyzer trained inexperienced personnel for entry level positions. The standardized manufacturing process in the former and the larger division of the labor process in the latter firms allowed the firms to train for low skilled entry level jobs.

Internal training for technical professional positions is primarily related to firm specific needs. In the sample firms, there is no internal training provided to enter technical and professional jobs. (Career ladders are discussed in the following section.)

#### Internal Labor Market

High technology firms as a group are reputed to offer excellent structured opportunities for advancement. On the whole, interviews confirmed that advancement in pay and skill through work experience was the common practice.

Firm size and production process are useful indicators of the extent of and bridges between "job ladders." Structured promotional ladders, and internal promotion policies were common in the firms larger than 60 employees or older than four years of age.<sup>29</sup> Young start up firms did not use formal job ladders. Two firms of 100-200 employees that had a low proportion of production workers (under 20 percent) had no job descriptions, although they made use of career ladders. Small firms in the sample have relatively short job ladders, since respondents noted the loss of workers to large companies that "have better opportunities and benefits." This corroborates research on small firms that suggest

they act as "feeder firms," training workers who then move to large companies.<sup>30</sup> Compscan and NCG, employing 75 and 27 production workers, respectively, pointed to the constraints in upward mobility in a small company, since there were few higher level jobs relative to lower level production jobs.

The degree of standardization of the product and the division of labor indicate the degree of mobility within a firm as they do the skill levels of production jobs. The newer and smaller firms offer the opportunity to learn new skills as job duties are less circumscribed. Job ladders may not exist in these small firms but pay and skill may still increase with work experience. Yet many fast growth firms do not train internally, and entry level opportunities for inexperienced workers may be rare. In contrast, larger firms, or small firms that adopt relatively standardized processes, offer more entry level training, but the jobs are circumscribed and there may be fewer opportunities for upward mobility. Whether there are opportunities to learn new skills and advance along a career path within these entry level jobs could not be clearly ascertained through interviews.

The high degree of standardization in production within two small firms was reflected in a stratified job structure. In these two firms, assemblers remained in the more routine jobs and there were few promotional lines to higher skilled jobs. On the other hand, in smaller firms that have less rigid stratification of tasks, evidence from one firm suggests that a more flexible negotiation between workers and management over promotions is a more common practice than in either highly standardized operations or in large firms with rigid job description systems.

In all of the sample companies, structured wage adjustments within job levels (Assembler I, for example) gave workers predictable increases in pay. This part of a career ladder--regular pay increases as a result of work experience--then is a good indicator of the quality of jobs in these companies. With respect to promotion through a structured career ladder, in 80 percent of the firms over four years old, there were official career ladders from entry level to higher paying, more skilled production jobs. In all of these companies, movement on the ladder was somewhat stratified in practice. According to company managers, there were some cases of promotions, but in general, lower wage assemblers tended to stay in those positions, whereas higher paid entry level electro-mechanical assemblers, for example, did advance to higher jobs. A number of managers attributed the lack of advancement in entry level assembly as a function of the labor force. As one respondent stated, "only twenty percent of the assemblers want to be promoted." However, the reasons for this stratification could not be obtained from the interviews. It appears to be associated with choice of labor force and the skills in each type of assembly work. The companies hire different types of labor forces (basic assemblers are predominantly women and second household income earners, whereas mechanical assembly contains more male workers) and the skills in mechanical assembly, three respondents mentioned, are more applicable to higher level jobs. Whether this situation is a function of the circumscribed tasks within the job, mentioned above as a common occurrence as the production process becomes more standardized, or a function of the preferences of the labor force, the important question is whether skills imparted in the job enable workers to advance in a predictable manner. The interviews captured



the formal structure of job ladders but not the mechanics of promotion in the sample firms.

The internal job ladders for production workers that are a function of the workers' on-the-job experience end at the higher skilled crafts and technical positions. This conclusion is suggested by hiring requirements for somewhat extensive work experience in the machine trades for crafts positions and for a two-year technical degree in the technical and computer operator positions. All sample firms, however, do maintain tuition reimbursement programs so that production workers can move into technical jobs through outside training. Although in practice, some production workers do pursue outside education, in general the use of this program by production workers is uncommon. Although beyond the scope of this study, some barriers to the use of the reimbursement program were suggested by anecdotal evidence. Production workers may not have the necessary front end funds to pay for technical school. In a few firms, the small number of technical jobs and lack of job openings may reduce the incentive to pursue a two-year course. Three other firms mentioned they give little active encouragement to production workers to make use of the program.

Smoother job ladders to technical levels seem to be a function of firm-specific technology and size. For instance, because the tasks performed by technicians are complex, Filteroptics organizes a group of production workers as apprentices to technicians. Since the tasks of technicians require extensive internal training, the company tries to retain these employees. Although outside education is required for production workers to move into these jobs, the apprenticeship may have served as a transition. In a seven person staff, six workers followed

this path over six years. Larger firms may be better able to afford formal training that supplements outside technical education. This is suggested by the formal training offered by Compusystems that supplements required outside education. The program runs only when the company is in need of technicians, rather than as a continuous service to its employees, however.

Advancement within the professional levels requires substantial investment in education, generally a college degree. In her study of the computer manufacturing industry, Kuhn found that extensive work experience usually did not substitute for a formal degree, at least in the career path of computer programmers.<sup>31</sup> Shifts in manufacturing technology to simpler processes and products, through mechanization and simplification of components, place downward pressure on mobility between the technical and professional levels. As explained by one respondent in a computer manufacturing firm, the need for higher skilled technicians is decreasing as the firm redesigns operations to require less skill in manufacturing and programming, and as new diagnostic equipment simplifies repair operations. As a result, one firm has reduced its training programs for technicians.

The transferable nature of the skills is a critical indicator of mobility for RCCC and the local community. Internal job ladders, and hence mobility, within small firms, may be limited, yet the training value of the jobs may nevertheless be high if skills imparted enhance local workers' ability to bid for jobs outside the firm. All respondents indicated the transfer value of the skills learned in the majority of production jobs throughout the high technology industry. The transferability of the skills is reflected in the frequent movement of

employees among firms in allied industries, noted by all respondents. The practices of the firms to hire already trained employees also points to the value of the skills.

While this inter-firm mobility is evident, the interviews did not yield systematic evidence whether workers moved "vertically" or "horizontally" along a skill/pay ladder. As mentioned previously, particularly in the lower level assembler jobs, this movement could be symptomatic of poor job quality as well as transferable skills.

Kuhn<sup>32</sup> identifies three forces that tend to limit upward mobility in the long term in the computer manufacturing industry, applicable to certain segments of the instrument industry as well.<sup>33</sup> While opportunities are now better in the computer industry than in most industries, fast growing firms pirate experienced labor rather than train internally, slowing the promotion process. Secondly, based on the pattern the industry seems to be following similar to other maturing industries, as firm growth and the demand for additional labor slows, internal training could increase in the short run, but jobs may become circumscribed and the labor process more standardized. Thirdly, as production, technical, and professional work are replaced with mechanical aids and simplified work processes, the opportunity to learn new skills in these jobs will decline, reducing the ability to progress along a skill and pay ladder.

E. Wage, Wage Advancement, Benefits

Wage levels and the opportunity for advancement in wage have been identified as critical qualities of employment for RCCC's constituency. This section examines wages for the industry as a whole and for the individual firms in the sample to determine what types of wage structures and advancement opportunities exist and how they could be predicted by characteristics of the firm.

Statewide, in November, 1981, wages for production workers in the computer manufacturing and instruments industry are close to the state average for all manufacturing industries (Table 3.10).

Table 3.10

Average Hourly Wages, Hours, and Weekly Earnings  
of Production Workers in Massachusetts (November 1981)

<u>SIC Code</u>	<u>Industry</u>	<u>Massachusetts</u>		
		<u>Hourly Wage (\$)</u>	<u>Average Hours</u>	<u>Weekly Earnings (\$)</u>
35	Non-electrical machinery	7.78	42.5	330.65
357	Computing and office equipment	6.70	42.9	287.43
38	Instruments	7.66	41.3	322.79
382	Measuring and controlling devices	6.54	41.0	273.37
	Total Manufacturing	7.15	40.0	286.00
		<u>Boston SMSA</u>		
35	Non-electrical machinery	7.98	45.0	359.10
38	Instruments	8.31	41.1	341.54
	Total Manufacturing	7.74	40.1	310.37

Source: Massachusetts Division of Employment Security, Massachusetts Employment Review, November 1981.

In the Boston metropolitan area (or SMSA), average wages and weekly earnings for production workers are higher in the instruments and non-electrical machinery industries than for total manufacturing employment.<sup>34</sup>

The wages in Table 3.10 permit a general comparison of wages among industries, rather than strictly for production workers in the sense used in this study (semi-skilled and unskilled operations). This is because the category of "production workers" in the state wage data is defined as employees engaged in all aspects of production, including professionals engaged in product development, supervisors, clerical, and shipping occupations.<sup>35</sup> Therefore, it is unclear whether the wage levels indicate the presence of well paid production workers or the salaries of skilled technical and professional employees in production work.

In the sample firms, wage data was collected on assembler and technical positions. Wage indicators proved difficult to obtain in consistent form; therefore the data serve as general guides rather than exact figures. The most significant limitation is that the numbers were estimated by nine out of eleven respondents, which could possibly result in wages being overestimated. On the other hand, some of the companies simply quoted the starting and midpoint wages on their salary schedules. This may cause wage advances to be underestimated, since not all employees begin at the starting wage and since most wages for current employees may be somewhere between the mid and end points. Thirdly, because companies hire entry employees at different job levels, "entry" wages cannot be compared across all firms. Wages of existing employees in the different companies reflect different lengths of service, anywhere from one to four years.

Table 3.11 illustrates the wage levels in the sample firms for new entry level employees and for existing employees at about the same level (note that experienced assemblers' wages are not included here).

Table 3.11

Hourly Wage Levels for Entry Level Assemblers  
(March/April 1982)

Wages of New Employees (total = 10)	\$3.50- <u>4.29</u>	\$4.30- <u>4.50</u>	\$4.50- <u>4.99</u>	\$5.00- <u>5.99</u>	\$6.00+
Work experience:*					
None	2	2			
1/2 - 1 year	1	4			1
over 1 year		1			1
<hr/>					
Wages of Existing Employees (total = 8)					
Work experience:*					
None				3	
1/2 - 1 year			1	2	
over 1 year			1		1

\*Required work experience at time of hiring

Median Beginning Wage = \$4.50

Median Existing Wage = \$5.50

Although the data must be interpreted with caution, some broad observations and comparisons can be made regarding wage levels and advancement. The sample firms' entry wages are comparable to statewide average wages recorded for job openings in November 1981 for benchwork in scientific and electrical equipment (includes operatives in the study industries).<sup>36</sup> The wages were listed as \$3.97 an hour in the state as a whole and \$4.50 an hour in the Boston SMSA. However, the hourly wages for new entrants are below 150% of minimum wage, or \$5.02 an hour, a figure often used by community organizations as a target wage level for their job creation goals. Hourly wages for existing employees (\$5.50 an hour) are 10-20% above this level.

Secondly, Table 3.11 shows that earnings of assemblers increase in these firms. Six companies that offered entry wages of \$3.50 to \$4.50 paid existing assemblers between \$5.00 and \$6.00 an hour. What the data does not show are the wages of all employees who were promoted to higher job

levels (Assembler III, for example), so presumably a number of existing employees receive higher wages than is listed. With respect to the formal structure of pay advances over 70 percent of the companies use regular wage review processes, based on tenure and work experience. Promotions to higher job levels ("vertical" promotion) are a function of work experience, skill, employee motivation, and supervisor's evaluations. The extent to which employees of each firm actually advance along the formal ladder is not possible to assess on the basis of interview data.

The wage levels of experienced production and technical staff do show there is advancement in pay through promotions. Wages for experienced assemblers (requiring two to four years of experience) range from \$5.75 to \$6.85 in the four responding firms, with a median wage of \$5.80. Entry level technicians are paid \$6 to \$8, which increases up to \$9 to \$10 after two to four years. Employee earnings reflect, in part, firm size and also the level of complexity of the production process. The four small start up firms hired skilled workers at higher wages. But smaller firms with more standardized processes paid lower wages (about \$3.50) and hired unskilled workers. The interviews suggest that the skill levels of the jobs were not the only determinant of wage levels but that firm size was a factor. The larger firms in the sample paid similar wages to unskilled entrants as the smaller firms that hired workers with six months to over a year's experience. This is, in effect, a higher wage, given the differentials in hiring policies. Since the sample included only one very large firm, generalizing from the sample about higher wages in large firms is not possible. However, industry research on the small business sector as a whole has found that pay differentials exist between large and small firms.<sup>37</sup>

Wage levels in these firms are also a function of industry wide wage structures and regional labor markets. The practice of many sample companies to conduct wage surveys across competing firms maintains general industry wide wages. In addition, the two firms that offered comparatively lower wages (\$3.50 an hour for new entrants in one company and \$4.50 an hour for existing employees in another) were located in labor markets that have lower prevailing wages than in the Boston SMSA. In November 1981, this labor market had an average wage for benchwork of \$3.89 an hour, compared to \$4.50 an hour in the Boston SMSA.<sup>38</sup>

The comprehensiveness of the fringe benefit package seems to depend on the size of firm and its ownership. This was shown in the benefits packages offered by the sample firms. All firms had health, life, disability insurance, vacation and sick leave, and tuition reimbursement, but the company share of costs generally were greater in larger firms and subsidiaries. There are exceptions, specific to the firm, however: smaller sample firms offer comprehensive coverage on specific items such as tuition reimbursement. Two larger firms (300-500 employees) offered less coverage than firms of less than 300 employees on specific items. Industry observers have noted that certain items in the benefit package are used by smaller firms to promote employee loyalty and stability. For example, the sample contained small firms that offer flexible use of disability payments, stock option plans, and full tuition reimbursement.

In summary, it is difficult to compare wages across the sample firms since the smaller firms generally hired new workers into higher than entry level jobs. Among firms that hired in at similar job levels, the size of the firm and regional location appears to influence wage levels and benefits.



FOOTNOTES

<sup>1</sup>Employment in the instruments industry in Massachusetts increased 11.8 percent from 1977 to 1980, while manufacturing employment grew 8.3 percent over the same time period. Two subsectors of this industry, Measuring and Controlling Devices and Medical Instruments, grew over 20 percent at that time. Employment in the office and computing machinery industry about 90 percent of which is in computer manufacturing, more than doubled between 1976 and 1980. In just one year, 1979 to 1980, employment grew by 7.8 percent. (Massachusetts Division of Employment Security, Occupational Profiles of Selected Manufacturing Industries in Massachusetts. (Boston: DES, 1981) pp. 134, 183. In individual mini-computer firms in the state, the rate of employment growth between 1975 and 1979 ranged from 689 percent for the smallest company (1,310 employees) to 72 percent for the largest (18,000 employees). Total employment in the eight Massachusetts mini-computer firms doubled during this period. Mass. DES, Employment and the Massachusetts Mini-Computer Industry (Boston: DES, 1979) p. 49.

<sup>2</sup>David Birch, The Job Generation Process (Cambridge: MIT Program on Neighborhood & Regional Change, 1979). All of the data quoted in this discussion are taken from this report.

<sup>3</sup>Establishments are single plants, whereas firms include all plants owned by one company.

<sup>4</sup>Pannell and Doeringer report that high technology employment rose by about one-third in the 1970s, of which a major portion was professional and technical personnel. Irregular growth and decline has been recorded for electrical equipment, watches and clocks, radio, TV, and photographic equipment in the 1950's through the 1970's. Because of variations in the location of industry and in the prosperity of individual firms, growth was also geographically uneven.

<sup>5</sup>U.S. Department of Commerce, U.S. Industrial Outlook 1982, p. 270.

<sup>6</sup>In Massachusetts, the photographic equipment industry (SIC code 386), showing the effects of foreign competition and the high cost of goods to consumers, declined 12 percent in employment between 1979 and 1980. Massachusetts Division of Employment Security, Occupational Profiles of Selected Manufacturing Industries (Boston, MA: MDES, 1980), p. 183.

<sup>7</sup>Manufacturing occupations are classified by the Massachusetts Division of Employment Security as follows: Managers and Officers, Professionals, Technical, Production and Maintenance, Clerical, Sales, Service. This system was adopted for this study for ease of comparison with industry data and across firms.

<sup>8</sup>The literature cites case examples of this shift in occupational composition. For example, Teradyne, a manufacturer of computerized test equipment, reports a shift from over 70 percent to about half professional

staff over a three year period of rapid growth. At Data General, a much larger company, the staff is 25 percent professional. (Sarah Kuhn, Computer Manufacturing in New England (Cambridge: Joint Center for Urban Studies, 1981), p. 90.

<sup>9</sup>Massachusetts DES, Occupational Profiles, 1980 (Boston: MDES, 1980), pp. 146, 186.

<sup>10</sup>U.S. Department of Commerce, op. cit., p. 227.

<sup>11</sup>Sarah Kuhn, op. cit., p. 99.

<sup>12</sup>Coopers and Lybrand, Results of Survey on Human Resources Needs (Boston, MA: Mass. High Technology Council, Inc., 1981), p. 9. This survey suggested that the turnover rate for professional and technical workers was a possible indicator of high demand relative to supply. The turnover rate for professional and technical occupations in the 60 responding firms ranged from one percent to 43 percent, at weighted averages of 12 percent for professionals to 14 percent for technical personnel.

<sup>13</sup>Assemblers are considered a high demand occupation, because of the large proportions and growth across many industries, according to the Massachusetts Division of Employment Security (Annual Planning Information Report, 1982).

<sup>14</sup>Coopers and Lybrand, op. cit., p. 9.

<sup>15</sup>Massachusetts Department of Manpower Development, A Report on Seven Growth Occupations in Massachusetts, (Boston: MDMD, 1981), p. 60.

<sup>16</sup>The rate may include quits, leaves, retirements, movement within a single plant or a firm, and layoffs of less than 10 percent. The majority of respondents could not separate out the figures. In addition, some of the rates may not be accurate because they were estimated by managers without use of quantitative data.

<sup>17</sup>Massachusetts Department of Manpower Development, op. cit., p. 63.

<sup>18</sup>Pannell and Doeringer, op. cit., p. 17.

<sup>19</sup>Massachusetts Department of Manpower Development, op. cit., p. 63.

<sup>20</sup>The DMD survey suggests that part-time work schedules could be used as a solution to high absenteeism and turnover in low-skill assembly jobs. Part-time work thus might be a strategy some employers do or will adopt.

<sup>21</sup>David Gordon, op. cit., p. 51. Gordon maintains that the high fixed costs of providing primary employment in primary sector manufacturing industries (fringe benefits, insurance) shift the calculus of employment toward hiring current employees for longer hours.

<sup>22</sup>Cited in Pannell and Doeringer, op. cit., p. 20.

<sup>23</sup>In the sample, two firms had established subsidiaries overseas that produce components which are assembled at the original facilities. The locational patterns of different stages of the production process in technical manufacturing are treated in Hekman "The Future of High Technology Industry in New England: A Case Study of Computers" (January/February 1980) and "Can New England Hold Onto its High Technology Industry?" (March/April 1980) New England Economic Review; and Sarah Kuhn, op. cit., pp. 60-85.

<sup>24</sup>Sarah Kuhn, op. cit., p. 49.

<sup>25</sup>Ibid, p. 51. See Kuhn (1981) pp. 48-54 for further discussion of capital sources and ownership changes.

<sup>26</sup>That 85 percent of the DMD sample hired inexperienced workers may be a consequence of the different types of firms included in each sample. In the DMD study, a cross section of industries (not identified in the study) that hired assemblers was chosen, whereas in this study, a smaller grouping of sizes and ages of firms and industries was selected. A number of local firms already located in the CID do hire inexperienced production workers. This implies that it is possible for a number of firms to hire at this level and train internally.

<sup>27</sup>Sarah Kuhn, op. cit., p. 123.

<sup>28</sup>Pannell and Doeringer, op. cit., p. 18.

<sup>29</sup>Documentation of job ladders and tenure through quantitative measures proved difficult to obtain in an interview format. Findings relied on anecdotal evidence.

<sup>30</sup>Pannell and Doeringer, op. cit., p. 19.

<sup>31</sup>Kuhn, op. cit., p. 121.

<sup>32</sup>Kuhn, op. cit., p. 121

<sup>33</sup>U.S. Industrial Outlook 1982 reports that labor efficiencies introduced in instrumentation manufacture from the use of high density integrated circuit boards have simplified the production process and are associated with a national decline in production work force. U.S. Department of Commerce, U.S. Industrial Outlook 1982 (Washington, DC: U.S. Government Printing Office), p. 270.

<sup>34</sup>Wage data for the Boston SMSA was available only at the two digit SIC code level. Because SIC 35, non-electrical machinery, includes metal working, special industry, and office machinery as well as computing equipment, the wages reflect the pay scale of all these industries.

<sup>35</sup>Massachusetts DES, Massachusetts Employment Review, November, 1981, p. 2.

<sup>36</sup>Massachusetts Division of Employment Security, Annual Planning Information Report 1982, p. 117.

<sup>37</sup>Kieschnick reports that little data exists linking payroll per employee to firm size. From various research studies, evidence suggests that generally employees in larger firms receive higher compensation; in urban areas small firms pay 12-20 percent less in wages per employee than larger firms; wage differentials are highest among unskilled workers; and, fringe benefits are higher in large companies. (Michael Kieschnick, op. cit., pp.18-19)

<sup>38</sup>Massachusetts DES, op. cit., p. 117.

CHAPTER IV

SUMMARY AND CONCLUSIONS

The analysis of employment focused first on the ways in which individual firms within certain subsectors of technical manufacturing organize the jobs of their production workers. Secondly, it examined how factors related to the firm -- particularly the firm's position in the core or periphery of the economy, its size and age, product life cycle, manufacturing processes, and market position -- affected job structure. By examining the association between the organization of work and firm structure, the study intended to define indicators of job quality and raise issues for RCCC to examine in its analysis of job quantity and quality in prospective firms.

Adequate Numbers of Jobs: Gain in Production Employment

1. Firm Size and Age

Small, young firms yield employment growth, but there is a high level of uncertainty associated with their survival. They have a high death rate (over 50% during the 1969-1976 period), but small firms are more likely to expand than larger firms, if they survive. Based on evidence from the sample, technical manufacturing firms are more likely to create production jobs after the start-up phase, generally as a consequence of increase in production volume. The timing of this expansion in non-technical jobs is not easily predicted. As seen in the sample, growth (and decline) can occur in the early or later years of a firm's life, as smooth annual increments or as one large expansion. Therefore, RCCC can expect small firms to expand, but since the likelihood of survival or the timing of growth in individual small firms can vary, RCCC must be in a position to work with

some degree of uncertainty. RCCC's expectations of employment growth in a firm will have to be phased over a number of years, taking into account the irregular growth and potential employment declines that may occur.

## 2. Product and Process Life Cycle

Technical manufacturing firms tend to expand production employment as a product stabilizes, that is, as it assumes a marketable form, and as the market expands which generally stimulates an increase in production volume. Sample firms in the computer manufacturing and instruments industries generally adopt a product/process life cycle strategy, in which the product and manufacturing process move from highly sophisticated, complex technology to a more simplified form and labor process. The timing of this cycle in individual firms depends on the size of the product market and the firm's strategy with respect to its use of a skilled or semi-skilled labor force. The amount of growth in production jobs then depends on the firm's timing of movement through this cycle. As shown by the range of total employment levels and the share of production jobs in the sample, individual firms may differ slightly in their organization of the labor process. The size of firm, however, does generally tend to indicate the position of the firm in this cycle, as evidenced by the greater division of labor and simplification of the manufacturing process in the two larger sample firms.

Three factors tend to increase or decrease potential employment: productivity, subcontracting, and simplification of tasks. Gain in labor productivity may generate new employment. This outcome generally occurs where the reduction in costs from redesign of the product results in lower product prices and product demand is sensitive to price levels. The market may thus expand and with it, production and employment. In the long run, literature on the industry suggests that the introduction of

automation tends to curb the growth of employment in the computer manufacturing and instruments industries. The extent to which automation replaces labor in individual firms is far from clear, but the potential impacts on employment levels is well documented. RCCC then needs to examine the ways in which productivity measures in a firm will enhance or reduce jobs for its constituency.

The practice of subcontracting in a firm will tend to hold down the number of production jobs within that firm. A majority of production work in the sample firms is in the final assembly and testing of equipment. In these firms, the manufacture of components is subcontracted out to specialized suppliers that produce in high volume and employ large numbers of production workers. As a firm moves to simplify its products and manufacturing process, it may also bring in portions of subsassembly production, but the timing and extent of this strategy are uncertain, based on the sample data. To determine potential employment levels, RCCC should examine the firm's strategy regarding contracted work.

Simplification of the labor process, combined with certain productivity measures, may lead to more circumscribed and less skilled jobs in the firm. This process has two contrasting implications. The number of jobs accessible to inexperienced workers may be increased because a firm may require little or no prior work experience for more standardized work. Yet the opportunity for workers to learn new skills and advance in wages may be reduced as the tasks are made more routine. This change in the work process will occur at different times or to different degrees among firms, depending on their size, timing of growth, and manufacturing process.

### 3. Product Market and Market Position

The performance of the computer manufacturing and instruments industries is strong and is projected to grow, but the share of growth in total employment and in production jobs will differ among individual firms. Since the performance of individual firms cannot be reliably predicted by overall industry performance, the specific product markets of the firm and the competitive structure of these markets should be examined to gauge growth potential in production jobs. The markets on which the firm depends, such as semiconductors, industrial plant and equipment, the housing industry, or government contracts will fluctuate, and with them, the firm's ability or need to expand production employment. Whether the firm is in a monopolistic competitive position because it is marketing a new product, whether competition is oligopolistic, in that more or less standard prices prevail, or highly price competitive, whether the firm is creating a new market or capturing a share of an established one, will influence its plans to expand employment, its strategy with regards to production standardization, and the level of skill in the jobs of the firm.

Shifts in the market have also led to the increasing focus on marketing and field service operations in individual firms as marketing, product reliability, and rapid service gain importance in industry - wide competitive strategies. RCCC should consider the possible shifts in occupational mix in firms it examines, and whether any growing occupations can feasibly be captured for local employment.

#### Turnover Rate

Because the turnover rate has to do with levels of employment in a firm and job quality, this indicator should be considered from both



perspectives. Because RCCC is concerned with the absolute numbers of accessible jobs as well as rates of employment growth, it should consider the turnover rate as a possible job generator in a firm that does not experience large rates of growth. However, turnover can alternatively indicate poor quality of work environment, and unstable conditions of employment. If turnover is high in a firm of interest, then it raises questions about the firm's wages, personnel practices, and advancement opportunities. Nevertheless, low turnover should also be examined in this light, since it was found to be associated with low wage work in the sample. However, the study found that the turnover rate was not a strong indicator of poor job quality, although it was found to be so by the Department of Manpower Development study. Therefore, the turnover rate should be examined in conjunction with other job quality factors to determine if this indicates poor quality of jobs or an active labor market for production workers.

### Job Quality

#### 1. Firm Size and Age

The provision of full-time, year-round jobs is common in all sample firms, regardless of firm size or age. This is a strong indicator of primary sector employment and the presence of stable jobs in terms of consistency of work schedule. In the sample, the use of part-time work schedules appears to be a firm-specific strategy to curb turnover in routine assembly jobs. Another strategy involving work schedules is the heavy use of overtime in some sample firms. RCCC may want to consider whether this decreases available jobs for the community or is a benefit because it increases the earnings of employed workers.

Smaller firms may be more prone to layoffs as they are more

vulnerable to fluctuations in market demand as well as management decisions that can bring planned or unplanned added costs. Yet, since smaller firms also tend to hoard labor as far as possible during downturns, as documented in the literature, the timing or extent of contractions in an individual firm would be difficult to predict. Because larger firms also externalize costs through laying off workers -- as in the case of a 500 employee firm in the sample and recently, major high technology corporations in Massachusetts -- firm size is not the sole indicator of potentially unstable employment. Although potential layoffs in a prospective firm cannot be predicted by the sample data on the basis of firm size, the personnel practices and product market of the firm are the most useful indicators to gauge relative safety from layoffs.

The size of the firm is a strong indicator of job mobility, training, and wage levels (combined with the stage of the production process, discussed below). Small firms may not offer the opportunities of larger firms because of relatively short job ladders. But as they grow, the opportunities for upward mobility and increase in pay also expand. An important characteristic of small and young firms is the less rigid division of labor, that may permit workers to learn new skills and with them advance in job level and pay. This arrangement would be useful to the community if residents can be trained in these firms and then can move into more skilled positions at higher pay elsewhere, if not within the firm itself. In the sample, the larger firms on the whole offer more entry level training than the smaller firms that employ complex production processes. The latter firms externalize training costs and hire more experienced production personnel, particularly if they are growing rapidly. This situation creates a barrier for the inexperienced worker. In the study cases where the production is

more standardized small firms train for entry level positions. Anecdotal evidence from sources other than the sample suggest the some small firms do train internally, even at different stages of standardization.

There then appears to be some degree of variation among small firms with respect to training policies, although the general pattern discussed above is evident in the sample (small, fast growth firms externalize training costs, while slower growing or larger firms, whose jobs are more circumscribed, offer more entry level opportunities but overall the jobs may be less skilled). Therefore, in examining a smaller firm, RCCC should consider the training and mobility opportunities that can be structured within the firm at its present size and as it grows, and whether entry level training and mobility have to be traded off in a particular firm.

Wages seem to be lower in the smaller sample firms, considering that in large and small firms similar wage scales exist for new entrants although more work experience is required in many of the smaller firms. But wage levels are also a function of prevailing wages in the local labor market and so will reflect conditions external to the firm. Structured increases in pay seem to be common among most firms in this industry, based on interviews and industry research. But wage differentials exist, as evidenced by the turnover rate in some sample firms. Because wages differ to some degree among firms, wage structures must be examined in light of competitive wages in the market and advancement opportunities if initial wages are low. In addition, there may be trade-offs between qualities in a firm. For example, a smaller firm may offer advantages to the community, such as entry level training opportunities that may have to be traded off against higher pay scales.

## 2. Product and Process Life Cycle

Training and mobility opportunities vary with the type of production process; as such, RCCC should examine firms in stages of the production process where upward mobility is fostered along with training opportunities. However, as noted above, there are some trade-offs between the type of labor process and accessibility of jobs to inexperienced workers. In these firms where products and the labor process are relatively complex, there are flexible work roles, giving workers opportunities to learn new skills. Yet generally smaller firms do not offer entry level training. Where the labor process has been standardized, work is more circumscribed and entry jobs routine, inexperienced workers are hired and trained. Although the interviews yielded little information on the actual mechanics of mobility, it appears that in some cases entry level workers move into more skilled work. In other cases, assembler jobs are stratified: there is little opportunity to learn skills required to move into new jobs.

For RCCC, the training that can be offered by the firm in entry level jobs and throughout the job ladder will determine whether employment is accessible to its constituency and whether there is movement in pay and skill. The manufacturing technology a firm adopts is a useful indicator of these opportunities and as such should be closely examined.

The movement of workers from production to technical jobs - in the sample firms requires an outside degree rather than production work experience. Thus, RCCC should consider the extent to which the transition to technical occupations can be facilitated through work experience or training, in order to capture some portion of the growing occupations at the technical level.

### 3. Product Market and Market Position

The product markets of the individual firms affect job stability and wage levels as well as employment levels. The markets faced by the firms in the sample are stable or growing, and are reflected in the ability of all these firms to provide full-time, year-round employment. However, beyond this common trait, a number of firms respond to fluctuations in the market by laying off workers. Firms with smaller or highly competitive markets may be more vulnerable to unstable product demand and thus exhibit more unpredictable patterns of employment stability. This is supported by the experiences of four firms in the sample during drops in demand. Potential layoffs in other firms cannot be predicted on the basis of interview results, since there is little quantitative evidence to document the market they face. RCCC will probably work with a degree of uncertainty as it evaluates market stability, but can be helped by examining the competitive structure and company personnel policies that may offset fluctuations.

Differential wage levels among the sample firms are associated with market position, generally indicated by firm size. Although a comparison of the relative sizes of markets in the sample cannot be made, the literature suggests that smaller firms, facing more unstable demand, are less likely than large firms to offer higher wages to workers. As a firm grows, its markets may also grow, thus RCCC should consider the changing stability of a firm's market, and so potential increases in wage levels, over a several year time frame.

As the study corroborates RCCC's working premise that technology - based manufacturing firms tend to create primary sector employment, RCCC should continue to pursue this direction. Nevertheless, the variation revealed by the interviews suggests that analysis of individual firms is

warranted. The issues raised here that associate firm size, production process, and market position to quality and absolute numbers of jobs can be used to sort out the choices that RCCC will make in selecting prospective employers.

APPENDIX

INTERVIEW DATA SHEET

Date: \_\_\_\_\_

Note: All information will be held confidential

Establishment \_\_\_\_\_

Address \_\_\_\_\_

Industry (SIC code) \_\_\_\_\_

Respondant's Name \_\_\_\_\_ Title \_\_\_\_\_

Length of time with company \_\_\_\_\_ Phone # \_\_\_\_\_

I. MISCELLANEOUS

A. Total Square Footage of Establishment \_\_\_\_\_

B. % breakdown by function: Office \_\_\_\_\_ R/D \_\_\_\_\_ Production \_\_\_\_\_

Other \_\_\_\_\_ Comments \_\_\_\_\_

II. JOBS

A. NUMBERS/OCCUPATIONS

1. Number employees at this location now \_\_\_\_\_

2. Major years of growth or decrease \_\_\_\_\_

Numbers or % \_\_\_\_\_

3. Occupational Breakdown:	number or %				
	1982	1981	1979	*	1st yr

TOTALNUMBER \_\_\_\_\_

a. Officers/Managers \_\_\_\_\_

b. Professionals \_\_\_\_\_

c. Technical \_\_\_\_\_

d. Production/Mtn. (list by Craft/Operative or job titles ex. Assemblers)  
Craft \_\_\_\_\_

Operative \_\_\_\_\_

e. Service \_\_\_\_\_

f. Clerical \_\_\_\_\_

g. Sales \_\_\_\_\_

\* list important years as well

4. Briefly note the general trend in number and types of employees over the life of the firm \_\_\_\_\_

5. Skills involved in job categories  
Technical(different levels) \_\_\_\_\_

Production(diff. levels) \_\_\_\_\_

6.a. Entry level jobs in production , technical (titles, #) \_\_\_\_\_

b. education/skills/other requirements \_\_\_\_\_

c. %Production \_\_\_\_\_ d. % of total employment \_\_\_\_\_

e. Grown/decline (%) \_\_\_\_\_

7.a. Job titles growing (hiring) most? Why? \_\_\_\_\_

b. Growing least/declining? Why? \_\_\_\_\_

8. Long term prospects for employment here \_\_\_\_\_

B. SCHEDULE

9.a. Number/% full time (35+ hrs/wk) year round workers \_\_\_\_\_

b. Does it differ between job titles \_\_\_\_\_

c. Different other years? \_\_\_\_\_

10.a. Number/% seasonal \_\_\_\_\_ Job categories \_\_\_\_\_

b. #/% part time(<35 hrs/wk) \_\_\_\_\_ Categories \_\_\_\_\_

c. Can people ask for/negotiate part time work? \_\_\_\_\_

11.a. Average rate at which jobs turn over \_\_\_\_\_

b. Vary among categories? Over time? \_\_\_\_\_



- 12.a. Average # yrs people stay in production jobs \_\_\_\_\_
- b. Does this vary among production jobs? \_\_\_\_\_
- c. Average % leave and % move up in co. \_\_\_\_\_
- d. Different other yrs \_\_\_\_\_

- 13.a. # or % workers in entry production jobs, moved up 1+ grade (new job title and wage increase) in last year \_\_\_\_\_
- b. over last few yrs \_\_\_\_\_

14. Typical career path for 2-3 entry job titles:

1.a. Job Title (start/present): \_\_\_\_\_

Typical wage increase: \_\_\_\_\_

Average Years: \_\_\_\_\_ Education/Training: \_\_\_\_\_

b. Job Title: \_\_\_\_\_

Wage increase: \_\_\_\_\_

Years: \_\_\_\_\_ Training: \_\_\_\_\_

c. Job Title: \_\_\_\_\_

Wage increase: \_\_\_\_\_

Years: \_\_\_\_\_ Training: \_\_\_\_\_

15. Do workers receive this training/ed inhouse \_\_\_\_\_

16. Positions mostly filled from outside/transfers \_\_\_\_\_

\_\_\_\_\_ Why (more ed, license, can't fill internally)

C. TRAINING

17. How are employees trained: informal, OJT, inhouse progs, tuition reimb, apprenticeships, co. sponsors or participates in prog \_\_\_\_\_

18. Which job categ/titles \_\_\_\_\_

Purpose \_\_\_\_\_ How extensive \_\_\_\_\_

Different in past yrs \_\_\_\_\_

19. Skills learned in jobs transferable or unique to co. \_\_\_\_\_

estimate of workers left and gone to other co's? \_\_\_\_\_

Job categ \_\_\_\_\_

20. Approx % of sales \$ that goes to wages, salaries, & fringes \_\_\_\_\_

21. List benefits(or enclosed benefits manual) \_\_\_\_\_

b. Employees not covered \_\_\_\_\_

22. Other benefits: day care, job sharing? \_\_\_\_\_

23. Average wage:

a. Production workers \_\_\_\_\_

Assemblers (at different grades) Start wage: \_\_\_\_\_  
Present wage: \_\_\_\_\_

Technicians (at different grades) Start wage: \_\_\_\_\_  
Present wage: \_\_\_\_\_

24. #/% women \_\_\_\_\_ Jobs/ \_\_\_\_\_

Blacks \_\_\_\_\_ Jobs \_\_\_\_\_

Hispanic \_\_\_\_\_ Jobs \_\_\_\_\_

Other \_\_\_\_\_ Jobs \_\_\_\_\_

25. Age Range of production/technical workers \_\_\_\_\_

26. Any problems obtaining employees around here \_\_\_\_\_

27. Are you satisfied with labor/management relations \_\_\_\_\_

\_\_\_\_\_  
COMMENTS/ADDITIONS:

Respondant \_\_\_\_\_ Title \_\_\_\_\_

Length of time with company \_\_\_\_\_ Industry, SIC code \_\_\_\_\_

FIRM CHARACTERISTICS

A. AGE

1. Date firm founded \_\_\_\_\_ Location \_\_\_\_\_

2. Date this establishment founded \_\_\_\_\_ Location \_\_\_\_\_

B. PRODUCTION PROCESS

3. Product(s) \_\_\_\_\_

4. Length of time making products here \_\_\_\_\_

5. Any change in product? \_\_\_\_\_

6. Any Change in the production process \_\_\_\_\_

7. Level of standardization, automation, and complexity of production process \_\_\_\_\_

8. Is emphasis on prototype devt or volume production? \_\_\_\_\_

9. What is subcontracted and done inhouse \_\_\_\_\_

10. Future plans (product, process, volume change) \_\_\_\_\_

11. Do you or would you continue to manufacture here? Elsewhere? Why? \_\_\_\_\_

12. Future labor force needs \_\_\_\_\_

13. Why did your firm decide to do business here? \_\_\_\_\_

Past locations & dates, reasons for moves \_\_\_\_\_

C. OWNERSHIP

14. Legal/Corp History:

a. Independent/single plant, headquarters, branch, subsidiary \_\_\_\_\_

b. Owner \_\_\_\_\_ Location \_\_\_\_\_

c. Owned by larger nat/intern company \_\_\_\_\_  
Acquisition date \_\_\_\_\_

d. Previous merger/reorg \_\_\_\_\_

e. Does co. own other plant(s)/Locations \_\_\_\_\_

15. Adv/disadv of being part of x co system \_\_\_\_\_

D. GROWTH

16. Sales volume 1982 \_\_\_\_\_ 1981 \_\_\_\_\_ 1980 \_\_\_\_\_ 1979 \_\_\_\_\_ Major  
Years \_\_\_\_\_ First year \_\_\_\_\_

17. Co. future performance \_\_\_\_\_

18.a. Significant expansions, additions to equipment? When, why? \_\_\_\_\_

b. Financed how \_\_\_\_\_

c. Any govt involvement \_\_\_\_\_

19.a. Contractions: what, when, why \_\_\_\_\_

b. Govt role \_\_\_\_\_

c. Work force impacts \_\_\_\_\_

20. (Multiplant firms): expansions at another plant making same product.

Why \_\_\_\_\_

E. MARKET POWER

21. Company position in industry (just developing a market, or product, or an established market) \_\_\_\_\_

22. Customers \_\_\_\_\_

23.a. Market share \_\_\_\_\_

b. Growing/stable/declining \_\_\_\_\_

24.a. What is the nature of competition (over price/performance; with regional, nat'l, internat'l firms) \_\_\_\_\_

25. Impressions on factors contributing to present position \_\_\_\_\_

COMMENTS/ADDITIONS

BIBLIOGRAPHY

Birch, David. The Job Generation Process. Cambridge, MA: MIT Program on Neighborhood and Regional Change, 1979.

Browne, Lynne, and John S. Hekman. "New England's Economy in the 1980s." New England Economic Review. Jan/Feb 1981, Boston, MA: Federal Reserve Bank.

Cambridge Community Development Department Cambridgeport Industrial District Study: Technical Memoranda Reports 1-13. Cambridge, MA: CCDD, Feb. 1980-1981.

Coopers and Lybrand. Results of Survey on Human Resource Needs. Boston, MA: Massachusetts High Technology Council, Jan. 1981

Doeringer, Peter B. and Patricia Pannell. "Manpower Strategies for New England's High Technology Sector." Conference on Manpower Policy Issues, Harvard University Graduate School of Business Administration. Boston, Ma. Commission on Higher Education and the Economy of New England, May 15, 1981.

Dun and Bradstreet. Million Dollar Directory Vols. I-III. New York: Dun and Bradstreet, 1981.

The First National Bank of Boston, Economics Department. The 1982 Outlook for Capital Spending Among New England Manufacturing Firms. Boston, MA: First National Bank, March 18, 1982.

Directory of New England Manufacturers 1981-1982. Boston, MA: George D. Hall and Co.

Harrison, Bennett, and Andrew Sum. Labor Market Data Needs from the Perspective of "Dual" or "Segmented" Labor Market Research. (Washington, DC: National Commission on Employment and Unemployment Statistics).

Harrison, Bennett and Andrew Sum. "The Theory of 'Dual' or Segmented Labor Markets" Journal of Economic Issues. Vol. XIII, No. 3, Sept. 1979.

Hekman, John S. "Can New England Hold Onto its High Technology Industry?" New England Economic Review. March/April 1980. Boston, MA: Federal Reserve Bank, 1980.

Hekman, John S. "The Future of High Technology Industry in New England: A Case Study of Computers." New England Economic Review, Jan/Feb, 1980. Boston, MA: Federal Reserve Bank, 1980.

Hill, Christopher T., and K. Hagaraja Rao. "Technology and Local Development: A Preliminary Assessment -- Discussion Memorandum #1." Mimeo, Massachusetts Institute of Technology, Center for Policy Alternatives, January 20, 1982.

Kieschnick, Michael. Venture Capital and Urban Development Washington, DC: The Council of State Planning Agencies, 1979.

Kuhn, Sarah. Computer Manufacturing in New England: Structure, Location, and Labor in a Growing Industry. Boston, MA: Joint Center for Urban Studies, MIT and Harvard, March 31, 1981.

Massachusetts Department of Manpower Development, Policy and Evaluation Division. Defining "High Technology" Industries in Massachusetts. Boston, MA: Massachusetts Department of Manpower Development, September, 1979.

Massachusetts Department of Manpower Development, Policy and Evaluation Division. High Technology Employment Developments Within Selected Labor Market Areas in Massachusetts. Boston, MA: Massachusetts Department of Manpower Development, March, 1980.

Massachusetts Department of Manpower Development, Policy and Evaluation Division. A Report on Seven Growth Occupations in Massachusetts: Findings from a Statewide Employer Survey. Boston, MA: Massachusetts Department of Manpower Development, April, 1981.

Massachusetts Division of Employment Security, Job Market Research. Annual Planning Information Report, Fiscal Year, 1981 - Massachusetts. Boston, MA: Massachusetts Division of Employment Security, 1981.

Massachusetts Division of Employment Security, Job Market Research. Annual Planning Information Report, Fiscal Year 1982 - Massachusetts, Boston, MA: Massachusetts Division of Employment Security, 1982.

Massachusetts Division of Employment Security, Job Market Research. Employment and the Massachusetts Minicomputer Industry. Boston, MA: Massachusetts Division of Employment Security, Fall, 1979.

Massachusetts Division of Employment Security, Job Market Research. Employment Requirements by Occupation, by Industry, 1976-1985. (Boston, MA: Massachusetts Division of Employment Security, December, 1979.

Massachusetts Division of Employment Security, Job Market Research. High Technology Employment in Massachusetts and Selected States. Boston, MA: Massachusetts Division of Employment Security, March, 1981.

Massachusetts Division of Employment Security, Job Market Research. "Massachusetts Employment Review". Job Market Research Bulletin, November, 1981. Boston, MA: Massachusetts Division of Employment Security.

Massachusetts Division of Employment Security, Job Market Research. Occupational Profiles of Selected Manufacturing Industries in Massachusetts, 1977, 1980. Boston, MA: Massachusetts Division of Employment Security, January 1979, January 1980.

Massachusetts Division of Employment Security, Job Market Research. Scientific Instruments Industry in Massachusetts, 1979. Boston, MA: Massachusetts Division of Employment Security, 1979.

Massachusetts State Industrial Directory, 1981. New York: MacCrae's Blue Book, Inc.

Riverside Cambridgeport Community Corporation. An Analysis of the Business Sector in Riverside and Cambridgeport. Cambridge, MA: RCCC 1981.

Riverside Cambridgeport Community Corporation. "The Economic Development Program," mimeo. Cambridge, MA: RCCC 1980.

Riverside Cambridgeport Community Corporation. "Response to the Cambridgeport Industrial District Rezoning Proposal," mimeo, Cambridge, MA: RCCC 1980.

U.S. Department of Commerce, Industry and Trade Administration. U.S. Industrial Outlook, 1982. Washington, DC: U.S. Government Printing Office, January, 1982.

Whitman, Richard. "Market Study for the Cambridgeport Industrial District", unpublished mimeo. Riverside Cambridgeport Community Corporation Cambridge, MA: RCCC, November 1981.

Whitman, Richard. The Impact of Office, Retail, and Industrial Development on Neighborhood Change: Evaluating Development Alternatives for the Cambridgeport Industrial District. M.C.P. Thesis. Massachusetts Institute of Technology, June, 1981.