ALTERNATIVES FOR THE TRAINING OF SKILLED INDUSTRIAL LABOR IN SAO PAULO, BRAZIL

Dissertation for the Degree of Ph. D.

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ABSTRACT

ALTERNATIVES FOR THE TRAINING OF
SKILLED INDUSTRIAL LABOR IN
SÃO PAULO, BRAZIL

By

Michael Francis Lukomski

Over the past several decades the State of São Paulo in Brazil has been industrializing at a rapid pace. Large quantities of skilled industrial labor have been developed and several sources of industrial training can be identified. The most visible is the quasi-private Serviço Nacional de Aprendizagem Industrial (SENAI) which was established in 1942. Industrial training is also provided by private training schools as well as in the formal school system. Given the existing data, a comprehensive historical view of the total system of industrial skill development has not been possible.

This study was undertaken with three basic objectives: to establish the origin of the present skilled industrial workers; to identify the types and sources of the training they received; to evaluate the effects of differences in both origin and training on their present work situations and the time taken to reach the skilled occupational level.

The first step in the realization of the study was the construction of a general model which related factors important in the development of skilled industrial workers. The model contained six blocks of variables: (1) present work situation; (2) present work situation control; (3) initial conditions; (4) formal education; (5) work experience; and (6) training. The model was used for two purposes. First, it was used to organize information in a useful manner and served as a general framework for the description of the entire system of industrial skill development. Second, it provided the basis for the development of several linear regression models which were used to estimate the effects of various factors on (1) hourly wage rates, (2) number and difficulty of operations performed on the job, and (3) time taken to reach the skilled occupational level.

Data was obtained using the "reverse tracer" technique. A sample of 540 skilled lathe setter-operators from the "ABC" area of Greater São Paulo was selected and interviewed. Detailed information was collected on their present work situations, origins, and past learning experiences (formal education, work experience, and training).

Those who have become skilled industrial workers were not drawn randomly from the total population. Most had parents who were well educated and had fathers who worked in industrial occupations. Almost all had at least a complete primary education and many went beyond the primary level. Over two-thirds had at least one "rapid" industrial training course. Of those who did not, half had been enrolled in SENAI apprenticeship programs, and about 13 percent had received industrial training in the formal school system. Only 11 percent of the total sample reached the skilled occupational level without some form of special industrial training.

Most of the rapid industrial training courses were sponsored by private industrial schools and not SENAI. The respective percentages were 54 percent and 31 percent. Of those in the sample who had at least one course, 66 percent had at least one private school course, while only 33 percent had at least one SENAI course. Private school industrial training has existed at least since 1942, the year SENAI was established.

In terms of what is done on the job, the pay received, and time taken to reach the skilled occupational level, private school training was not shown to be inferior to SENAI training. Variation in wage rates was explained by differences in work experience and by the conditions under which work takes place (size of firm, sector, machine type, etc.). Differences in initial conditions (origin), formal education, and training were not significant in explaining the variation. Both levels of formal education and past work experiences were found to influence the time taken to reach the skilled occupational level. Initial conditions and training were, again, not significant.

ALTERNATIVES FOR THE TRAINING OF SKILLED INDUSTRIAL LABOR IN SÃO PAULO, BRAZIL

By

Michael Francis Lukomski

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CHAPTER I

INTRODUCTION

1.1 The Purpose of the Study

Over the past several decades Brazil, particularly the State of São Paulo, has been industrializing at a rapid pace. Growth rates during the past eight years have been especially high, ranking the Brazilian economy as one of the fastest growing in the world. Brazil's ability to sustain high rates of industrial growth over a long period has been closely related to the large quantity of skilled industrial labor which has been developed. Industrial growth and the development of skilled industrial manpower have apparently taken place at compatible rates.

It has long been appreciated in Brazil that skilled industrial labor is important in the process of industrialization, and that the development of skilled industrial labor requires training. Several major sources of industrial training can be identified. The most visible is the quasi-private Serviço Nacional de Aprendizagem Industrial (SENAI), an institution with a series of industrial apprenticeship and training programs, which was established in 1942. It was the first of its kind in

South America, and has served as a model for other South American countries' national manpower development systems such as SENA (Servico Nacional de Aprendizaje) in Colombia and INCE (Instituto Nacional de Cooperación Educativa) in Venezuela.

Industrial training also is provided in the formal educational system. Basic industrial training is available at the middle school level, and there are technical industrial programs in some high schools. Private industrial schools offer training in a wide range of industrial occupational areas. Some firms offer special training courses for their employees, and several large firms maintain their own training centers in lieu of paying taxes for the support of SENAI. Such training centers are, however, supervised by SENAI. Various religious and trade organizations also sponsor industrial training courses.

All these different sources have provided the training for Brazil's skilled industrial workers. However, data on what types of individuals received training, the percentages trained through each of the different sources, and the effects of different types of training have not been available. It is known that large quantities of skilled industrial labor have been developed recently and rapidly; however, given the existing data, a comprehensive historical view of the total system of industrial skill development in Brazil has not been possible. Without such an over-all frame of reference, it has not been possible to evaluate the contribution of any individual program.

Presently, parts of the Brazilian training system are being copied in other countries. Furthermore, laws have been passed recently in Brazil which will have profound effects on the industrial training system. In 1971, a national law (Lei 5.692) was passed recognizing the existing system of non-formal education as a legal supplement (Ensino Supletivo) to the regular, formal school system. Through a system of special courses and examinations, organizations such as SENAI will be able to offer diplomas which are legal equivalents to the regular diplomas of the formal school system. This legislation and decisions by other countries to copy parts of Brazil's model are being made with incomplete information. Many scarce resources are involved, so that any losses due to "wrong" decisions are great. More complete data on the development of skilled industrial labor in Brazil are needed.

The general purpose of this study is to provide such data. First, a general model or conceptual frame will be developed to organize logically information on industrial skill development in Brazil. It will also serve as a basis for the development of several other models designed to be used in the evaluation of different forms of industrial training. Second, based on the organization suggested by the conceptual frame, the separate parts of the skill development system will be described in the context of the complete system of industrial skill development. Finally, the effects of different types of industrial training will be evaluated.

1.2 Background Notes

1.2.1 Introduction

The purpose of this section is to provide general historical and institutional information on Brazilian industrial growth and the development of skilled industrial labor. Many types of data commonly available in advanced countries simply do not exist in Brazil. In recent years, Brazil's data collection systems have improved greatly, but there is still a lack of reliable, long-term, time series data in almost all areas. Also, cross-section data collected in different years is not always comparable due to variations in coverage and definitions. Even today, in some areas there are no comprehensive data available. This is particularly true concerning the operations and output of private industrial training schools.

1.2.2 Growth, Industry, Skilled Labor, and São Paulo

Real Gross Domestic Product in Brazil has increased over 500 percent since 1947. The average annual rate of increase has been over 6.8 percent (see table 1). Since 1965, the average annual rate of increase has been over

TABLE 1.--Domestic Product at Constant Prices--Total and Per Capita, 1947-1972.

Year	Total Gross Domestic Product			Gross Domestic Product-Per Capita		
	At 1949 prices (CR$million)	Index (1965=100)	Annual variation (%)	At 1949 prices CR$1.00	Index (1965=100)	Annual variation (%)
1947	200.7	34.0	---	4.1	56.2	---
1948	215.6	36.6	7.4	4.3	58.9	4.7
1949	229.9	39.0	6.6	4.5	61.6	4.3
1950	244.8	41.5	6.5	4.7	64.4	4.0
1951	259.3	44.0	6.0	4.8	65.8	2.8
1952	281.9	47.8	8.7	5.1	69.9	5.6
1953	289.0	49.0	2.5	5.1	69.9	-0.5
1954	318.2	54.0	10.1	5.4	74.0	7.0
1955	340.0	57.7	6.9	5.6	69.9	3.7
1956	350.8	59.5	3.2	5.7	78.1	0.2
1957	379.1	64.3	8.1	5.9	80.8	4.9
1958	408.3	69.3	7.7	6.2	84.9	4.6
1959	431.1	73.1	5.6	6.4	87.7	2.4
1960	472.9	80.2	9.7	6.8	93.2	6.6
1961	521.6	88.5	10.3	7.3	100.0	7.2
1962	549.0	93.1	5.3	7.4	101.4	2.3
1963	557.5	94.6	1.5	7.3	100.0	-1.3
1964	573.8	97.3	2.9	7.3	101.4	0.0

TABLE 1.--Continued.

Year	Total Gross Domestic Product: At 1949 prices (CR$million)	Total Gross Domestic Product: Index (1965=100)	Total Gross Domestic Product: Annual variation (%)	Gross Domestic Product-Per Capita: At 1949 prices CR$1.00	Gross Domestic Product-Per Capita: Index (1965=100)	Gross Domestic Product-Per Capita: Annual variation (%)
1965	589.5	100.0	2.7	7.3	100.0	-0.1
1966	619.6	105.1	5.1	7.5	102.7	2.2
1967	649.2	110.1	4.8	7.6	104.1	1.8
1968	709.7	119.4	8.4	8.1	111.0	6.3
1969	773.6	130.1	9.0	8.6	117.8	5.9
1970	847.2	142.5	9.5	9.1	124.7	6.4
1971*	942.9	158.6	11.3	9.9	134.2	8.2
1972*	1,040.0	175.1	10.4	---	---	---

*Estimated.

Source: A economia brasileira e suas perspectivas, PRÉ-APEÇÃO 73 (Rio de Janeiro: APEC Editôra, 1973), p. 75.

8.3 percent. Per capita real Gross Domestic Product since 1947 has grown at an average annual rate of over 3.7 percent, and since 1965, over 5.1 percent. Presently Brazil is one of the fastest growing and most rapidly industrializing countries in the world.

The leading growth sector in Brazil has been the industrial sector. Since 1947, real industrial production has increased by over 800 percent (see table 2). The average annual rate of growth in industrial production since 1947 has been over 8.8 percent, and since 1965, over 11.2 percent.

The State of São Paulo is by far the leading industrial center in Brazil. In 1949, 49 percent of all Brazilian industrial manufacturing originated there. Ten years later in 1959, São Paulo's share increased to over 55 percent.[1] The Department of Statistics (Departamento de Estatística) for the State of São Paulo estimates that in 1967, São Paulo accounted for over 57 percent of all Brazilian manufacturing production.[2] It is generally assumed, though data are not available, that this trend is continuing. São Paulo's share of a rapidly increasing industrial product is also increasing.

The 1970 census (Censo Demográfico-Brasil) reported the total population of Brazil in 1970 as more than 93 million.[3] Approximately 66 million (71 percent) were ten years old or older. Of these 66 million, only 30 million (46 percent) were economically active, and of those

TABLE

17, 1873

TABLE 2.--Real Product Index by Sectors, 1947-1972.

Year	Agriculture	Industry	Commerce	Transp. and Communic.	Services	Total Product
1947	43.4	26.0	41.2	25.4	34.6	34.0
1948	46.4	29.0	42.5	29.6	36.8	36.6
1949	48.5	31.9	45.1	32.1	38.9	39.0
1950	49.2	35.6	48.3	35.2	41.6	41.5
1951	49.5	37.8	53.0	39.0	45.6	44.0
1952	54.0	39.7	55.0	41.8	50.7	49.0
1953	54.1	43.2	53.8	46.0	50.6	54.0
1954	58.4	46.9	59.8	49.9	57.2	57.7
1955	62.9	51.9	62.2	51.8	59.2	59.5
1956	61.4	55.4	63.2	54.4	61.9	59.5
1957	67.1	58.6	69.3	58.7	67.5	64.3
1958	68.5	68.1	74.1	62.3	71.1	69.2
1959	72.1	76.2	81.1	68.2	72.0	73.1
1960	75.7	83.5	85.9	80.1	81.3	80.2
1961	81.4	92.4	91.9	82.7	91.1	88.5
1962	85.8	99.6	97.2	89.7	94.1	93.1
1963	86.7	99.8	97.3	96.7	96.7	94.6
1964	87.9	104.9	98.4	98.2	98.7	97.3
1965	100.00	100.0	100.00	100.00	100.00	100.00
1966	96.8	111.7	107.7	106.6	103.5	105.1

TABLE 2.--Continued.

Year	Agriculture	Industry	Commerce	Transp. and Communic.	Services	Total Product
1967	102.3	115.0	112.4	114.9	109.9	110.1
1968	103.7	132.8	125.5	125.1	117.0	120.4
1969	109.9	147.1	136.6	139.7	---	131.2
1970	116.1	163.5	148.8	160.5	---	143.7
1971*	129.3	181.8	168.1	174.0	---	159.9
1972*	135.8	209.1	---	---	---	176.5

*Estimated.

Source: _A economia brasileira e suas perspectivas, PRÉ-APECÃO 73_ (Rio de Janeiro: APEC Editôra, 1973), p. 74.

economically active, 5.3 million (17.6 percent) were working in the industrial sector.[4] The National Department of Labor (Departamento Nacional de Mão-de-Obra) estimates that in 1970 over 51 percent of all Brazilian industrial employees were working in the State of São Paulo.[5] The data clearly indicate that São Paulo is the dominant and most dynamic industrial center in Brazil. SENAI estimates that in 1972 there were more than 1.5 million individuals employed in São Paulo's industrial sector (see table 3).

TABLE 3.--Industrial Workers in the State of São Paulo, 1972.

	Number	Percentage
Unskilled	175,541	11.56
Semi-skilled	794,530	52.33
Skilled	266,913	17.58
Foreman, etc.	23,466	1.55
Technicians	18,820	1.24
Engineers	7,502	.49
Other	237,633	15.65
Total	1,518,405	100.00

Source: Serviço Nacional de Aprendizagem Industrial (SENAI), Departamento Regional de São Paulo, "Levantamento Industrial 1972." Unpublished Internal Document.

Over 17.5 percent were classified as skilled industrial workers. According to the SENAI definition:

> A skilled industrial worker is a worker capable of performing all the operations required in a skilled industrial occupation. His work is varied and not subject to automation. A relatively long training period (3,000-4,000 hours) is required to develop the necessary skills. Two types of training are possible (1) for a 'new' worker apprenticeship training, or (2) for a semi-skilled worker rapid training courses. Knowledge of the technical aspects of the occupation is required.[6]

Time series data on the specific number of skilled industrial workers in the State of São Paulo are not available. A good proxy, however, is available. SENAI has kept records on the number of "qualified" (qualificados) industrial workers in the state since 1946. The qualified category contains, in addition to skilled industrial workers, foremen, technicians, and engineers. In 1972, 20.9 percent of São Paulo's industrial workers were classified as qualified. Within the qualified category, 84.3 percent were skilled industrial workers. The development of the industrial labor force in São Paulo since 1946 is illustrated in table 4.

Since 1946, the number of industrial employees in the State of São Paulo has increased by over 274 percent. The number of qualified industrial workers has increased by at least 280 percent, and perhaps by as much as 350 percent.[7] The rapid development of the industrial sector in São Paulo has been "matched" by an impressive increase in the quantity of skilled industrial labor. There is

TABLE 4.--Industrial Workers in the State of Sao Paulo, 1946-1972.

Year	All Industrial Workers (000)	Qualified Industrial Workers (000)	Year	All Industrial Workers (000)	Qualified Industrial Workers (000)
1946	552.5	109.8	1959	945.6	194.5
1947	597.2	118.0	1960	969.1	194.3
1948	610.1	121.1	1961	1,016.4	203.6
1949	619.2	131.4	1962	1,068.4	213.1
1950	672.9	196.7	1963	1,172.6	231.7
1951	735.9	212.6	1964	1,193.6	232.9
1952	769.2	218.7	1965	1,187.7	227.9
1953	802.6	229.1	1966	1,209.6	232.9
1954	840.8	239.2	1967	1,211.5	236.3
1955	856.5	209.0	1968	1,256.4	245.8
1955*	856.5	168.3	1969	1,331.8	266.9
1956	888.9	178.0	1970	1,391.6	280.9
1957	904.6	182.2	1971	1,449.4	293.9
1958	922.3	186.1	1972	1,518.4	310.7

*In 1955 the definition of qualified was changed and a new series was initiated. Sufficient information was not available to make the pre-1955 and post-1955 series comparable.

Source: Serviço Nacional de Aprendizagem Industrial (SENAI), Departamento Regional de São Paulo, Relatório 1946--Relatório 1972 (São Paulo: SENAI/SP, 1946-1972).

little doubt that the failure to develop skilled labor at these high rates would have resulted in significantly lower rates of industrial expansion. In the following sections, some of the major sources of industrial training are identified and briefly discussed.

1.2.3 The Formal School System

There are four basic levels in the Brazilian formal school system:[8]

1. Primary School (primário)--4 years
2. Middle School (ginásio)--3 or 4 years
3. High School (colégio)--3 or 4 years
4. University (superior)--3 or 6 years

In 1970, approximately one-third of all Brazilian children between the ages of 7 (the legal age for starting primary school) and 14 were not enrolled in any formal school program.[9] For those who do begin the first year of primary school, the prospects for completing the required four-year program are not very good (see table 5). Less than 27 percent of those who begin primary school graduate. Of those who do graduate from primary school, less than 36 percent begin a middle school program. This pattern is repeated at all levels. Only 4 percent of those who start in the formal school system graduate from middle school. Less than .5 percent graduate from a university.

To help overcome this problem the government has instituted special equivalency examinations at both the

TABLE 5.--Hypothetical Experience of 10,000 Students who Began Primary School.

Step	Enrollment	Percentage Loss from Preceding Step	Percentage Loss Accumulated
Beginning primary school	10,000	---	---
Completing primary school	2,673	73.27	73.27
Beginning middle school[a]	952	64.39	90.48
Completing middle school	400	57.99	96.00
Completing senior high[b]	188	53.00	98.12
Beginning university[c]	76	59.58	99.24
Completing university	34	55.27	99.66

[a] ginásio

[b] colégio

[c] superior

Source: John M. Hunter, Economic Aspects of Higher Education in Brazil, Monograph No. 5, Latin American Studies Center, Michigan State University, p. 24.

middle and high school levels, giving adults who have dropped out of the formal school system an opportunity to further their educations. Both television and radio are used to aid individuals with their self-study programs. The United States Agency for International Development (AID) reports that very little data on the number of individuals preparing for the exams or on the number who have passed the exams are available.[10] AID does report, however, that in the State of São Paulo over 85,000 individuals presented themselves for the exams in 1970. The certificate granted upon passing the exam is recognized as a legal equivalent to the regular, formal school diploma.

In 1970, there were over 17.3 million students enrolled in the Brazilian formal school system: 74.0 percent in primary school, 17.8 percent in middle school, 5.8 percent in high school, and 2.4 percent in universities.[11]

Almost 4 percent of all Brazilian secondary students (both the middle and high school levels) were enrolled in industrial vocational programs in 1971 (see table 6). Over 43 percent of these industrial students were in the State of São Paulo.

Publicly financed industrial training in the State of São Paulo has a long history.[12] Prior to the 1900's the government generally felt that industrial training was only appropriate for "[. . .] the poor [. . .] orphans, the miserable [. . .] the abandoned, the blind, the deaf and

TABLE 6.--Students Enrolled in Brazilian Secondary Educational Programs, 1971.

Type	Middle School		High School		Total Secondary	
	Enrollment	% of Total	Enrollment	% of Total	Enrollment	% of Total
Academic	2,914,745	84.66	549,343	49.07	3,464.088	75.93
Commercial	233,174	6.77	244,770	21.86	477,944	10.48
Normal	51,753	1.51	248,798	22.23	300,551	6.59
Industrial	116,111	3.38	64,550	5.77	180,661	3.96
Agricultural	11,143	.32	9,565	.85	20,708	.45
Others: Art	1,166	.03	223	.02	1,389	.03
Home Economics	2,174	.06	1,626	.15	3,800	.08
Nursing	2,590	.08	546	.05	3,136	.07
"Work Oriented Ginásios"	109,849	3.19	---	---	109,849	2.41
Total	3,442,705	100.00	1,119,421	100.00	4,562,126	100.00

Source: USAID/Brazil, Human Resources Office, Brazil-Education Sector Analysis (Rio de Janeiro: Human Resources Office, November, 1972), p. 44.

dumb."[13] Though the view changed slowly over time, it was not until the pressures of a growing industrial sector were felt that the government actively entered the area of industrial training to meet the needs of the industrial sector. These pressures developed rapidly. In 1907 there were 314 industrial establishments in São Paulo, by 1912 there were 3,321. (São Paulo's share of the Brazilian total jumped from 10.5 percent to 35 percent.)

The federal government was the first to respond to the need by establishing an industrial training school in 1910. The state established two schools in 1911 and two more in 1913. Until 1919 academic classes were not taught in the state schools. When they were introduced, "the reaction against the introduction of general cultural courses into the teaching of industrial skills was very strong."[14] The pressures of industrialization slowly overcame the traditional views and by 1931 there were nine state-sponsored industrial training schools. In 1936 the number was 28, and by 1940 the number had grown to 42.

> [. . .] industrial education in São Paulo progressed! It passed the phase of indifference and almost hostility on the part of the people. In 1940, all realized its advantages and applauded enthusiastically whatever new attempt to increase its realization [. . .] in 1911, 2 schools with 435 students [. . .] in 1940, 42 schools with 11,503 students.[15]

In 1942, there were two important laws passed which changed the character of Brazilian industrial education. The first was the Organic Law of Industrial Education (Lei Orgânica do Ensino Industrial) which legally recognized industrial education as part of the formal school system. The second was the law which created the SENAI industrial training system. As noted previously, industrial training within the formal school system still exists today. The peak of its importance, however, was in the early 1940's. Though there are no reliable time series data available, it is clear that the relative importance of the formal school system in the preparation of skilled industrial labor has declined.

1.2.4 The SENAI System

The SENAI industrial apprenticeship and training system was established by an act of the federal government (Decreto-Lei No. 4048) in January, 1942. It was created in response to the demands of industry for more and better trained qualified industrial workers. The objectives of SENAI are:[16]

1. To realize in schools installed and maintained by SENAI or in cooperation with industry, a system of industrial apprenticeship for youth between the ages of 14 and 18.

2. To assist firms in the elaboration and execution of general programs of training for workers at various skill levels, and to assist in the realization of apprenticeship programs within firms.

3. To give workers over 18 years of age the opportunity to complete their professional development in short courses given either in SENAI schools or in the firms where they are employed.

4. To give study scholarships for the purpose of upgrading to both SENAI personnel and to individuals employed in industry.

5. To cooperate in the development of technical research of interest to industry.

SENAI's initial efforts were concentrated in the development of apprenticeship courses. Over time the range of SENAI training has increased to the present variety of courses:[17]

1. Apprenticeship--These courses are for youth ages 14 to 18 who are either presently employed in industry or who are potential employees. By law, each industrial firm in Brazil must employ and enroll in SENAI schools the number of apprentices equivalent to 5 to 15 percent of its total skilled workers. (In practice this does not occur--the number enrolled in SENAI schools depends on SENAI's capacity.) A complete four-year primary education and entrance tests (general education and aptitude) are required to enter the program. The courses take between 1,600 and 3,000 hours and have a duration of between 18 and 36 months. Training is offered in over 40 occupational areas.

2. Industrial Preparation--Intended for those over 16 years old who do not have the qualifications for a skilled job. The courses are divided in three blocks of approximately 180 hours each. Most courses are offered at night.

3. Upgrading--Intended for individuals who are already working at the skilled level but who want to improve and update their technical skills and theoretical knowledge. The duration of the courses varies.

4. Specialization--Intended for individuals who are already working at the skilled level but who wish to specialize in a specific area within their field. The duration of the courses varies.

5. Technical--Intended for individuals with a complete middle school education who want to work at levels between the skilled workers and the engineer. Course generally takes over 1,200 hours.

6. Technical Assistant--Intended for individuals who wish to assist technicians. The course duration is approximately 300 hours.

7. Other--Many other types of training courses are also provided in response to industries' needs. Content and duration depend on the need.

SENAI is a national organization, subdivided into 19 administrative regions. There is a National Council controlled by the National Confederation of Industry (Confederação Nacional da Indústria) and a regional council, for each administrative region, which is controlled by the corresponding State Federation of Industries (Federação das Indústrias). Representatives of the Ministry of Education (Ministério da Educãçao) and the Ministry of Labor (Ministério do Trabalho) are part of the National Council. Every council has a department under its direction charged with implementing the policies adopted. Each region has a great deal of autonomy in establishing and directing its own programs.

The SENAI system is financed by a compulsory 1 percent tax on the payrolls of all Brazilian industrial establishments. The tax is collected through the National Social Security System (Instituto Nacional de Previdência Social) and is channeled to the National Department and dispensed as follows:

85 percent is returned to the state where it was collected

5 percent goes to the National Department

4 percent is used to assist less developed regions

4 percent goes to the north and northeast regions of the country

2 percent goes to the National Confederation of Industry

In addition to the regular 1 percent tax, firms having more than 500 employees are taxed an additional .2 percent which is collected by each regional department of SENAI and transferred directly to the National Department. Over US$34 million was collected by SENAI in 1971.

Because the State of São Paulo has the highest concentration of industry, the Regional Department of SENAI in São Paulo (Departamento Regional de São Paulo) is the largest in the country. In 1972, SENAI owned and operated 135 industrial training centers throughout Brazil.[18] Of these, 47 (34.8 percent) were in the State of São Paulo. Also in 1972, SENAI supervised 100 training centers which were owned and operated by large industrial firms. Of these centers, 20 (20 percent) were in the State of São Paulo. São Paulo's share of individuals enrolled in the various SENAI programs is even greater. The total for all Brazil in 1972 was 237,126; São Paulo had enrolled 114,484 (48.3 percent).

SENAI of São Paulo began operation in 1943, graduating 554 adults from its rapid training and upgrading courses (see table 7). In 1972, 57,372 adults were graduated. The first class of apprenticeship trainees was graduated in 1943 and contained 176 individuals. The 1972 apprenticeship class contained 6,089 individuals. In its

TABLE 7.--Training Certificates Awarded by SENAI of São Paulo, 1943-1972.

Year	Minors	Adults				Minors plus Adults (Total)	SENAI Schools in Firms (Total)	Grand Total
	Apprenticeship (Total)	Rapid Training	Up-Grading of skills	Other	Total			
1943	---	323	211	20	554	554	---	554
1944	176	458	344	114	946	1,122	---	1,122
1945	421	621	365	186	1,172	1,593	---	1,593
1946	1,131	602	433	79	1,114	2,245	---	2,245
1947	852	674	413	---	1,087	1,939	---	1,939
1948	928	628	197	---	825	1,753	---	1,753
1949	1,283	645	219	66	930	2,213	---	2,213
1950	1,376	817	290	298	1,405	2,781	---	2,781
1951	1,680	531	52	302	885	2,565	---	2,565
1952	1,416	471	93	390	954	2,370	---	2,370
1953	1,739	497	65	421	983	2,722	---	2,722
1954	2,051	574	149	408	1,131	3,182	---	3,182
1955	2,489	626	72	651	1,349	3,838	---	3,838
1956	2,458	660	74	1,014	1,748	4,206	---	4,206
1957	2,076	576	116	990	1,682	3,758	---	3,758
1958	2,084	557	215	1,354	2,126	4,210	---	4,210
1959	2,195	839	243	1,269	2,351	4,546	---	4,546
1960	2,486	1,041	307	1,927	3,275	5,761	---	5,761
1961	2,424	1,179	568	1,320	3,067	5,491	---	5,491

TABLE 7.--Continued.

	Minors	Adults				Minors plus Adults (Total)	SENAI Schools in Firms (Total)	Grand Total
Year	Apprenticeship (Total)	Rapid Training	Up-Grading of skills	Other	Total			
1962	2,770	1,553	781	2,018	4,352	7,122	---	7,122
1963	2,793	2,709	1,046	2,445	6,200	8,993	---	8,993
1964	2,818	3,658	1,732	2,091	7,481	10,299	---	10,299
1965	3,307	5,604	1,445	1,932	8,981	12,288	---	12,288
1966	3,422	6,962	840	2,812	10,614	14,036	---	14,036
1967	3,615	7,522	1,156	3,969	12,647	16,262	2,349	18,611
1968	3,857	8,133	1,214	4,644	13,991	17,848	5,682	23,530
1969	4,333	10,925	1,579	9,152	21,656	25,989	7,993	33,982
1970	5,235	10,189	5,006	23,720	38,915	44,150	12,896	57,046
1971	6,050	11,874	5,044	30,767	47,685	53,735	27,214	80,949
1972	6,089	15,207	4,037	38,128	57,372	63,461	22,440	85,901
Total	73,554	96,655	28,308	132,515	257,478	331,032	78,574	409,606

Source: Serviço Nacional de Aprendizagem Industrial (SENAI), Departamento Regional de São Paulo, Relatório 1972 (São Paulo: SENAI/SP, 1972).

early years, SENAI owned no schools and "borrowed" the facilities of the public school system. Over the past 30 years the growth of the SENAI system has been impressive.

1.2.5 Other Sources of Industrial Training

Private industrial training schools have existed for many decades in São Paulo. No study has been published on the origin and history of these schools, and data on their outputs are not collected by any central agency. All private schools which offer training (industrial or other) are required to register with the State Department of Technical Education (Departamento do Ensino Professional) in São Paulo. However, schools are not classified in the department's records by the type of training they provide, nor are data collected on the number of students enrolled or graduated. All that is known is that a large system of tuition-charging, profit-oriented private industrial training exists and that it has made some contribution to the development of skilled industrial manpower.

Other sources of industrial training are (1) the industrial firms themselves, (2) religious organizations, (3) trade organizations, and (4) correspondence courses. There are no data available on any of these, and it is quite possible that other "unknown" sources of training also exist.

1.3 The Importance of the Study

As Myint has noted in The Economics of Developing Countries:

> It is increasingly recognized that many underdeveloped countries are held back by [. . .] a shortage of skills and knowledge [. . .] attention has shifted from capital to education [. . .] to investment in human capital.[19]

The importance of education, and particularly industrial education, has long been appreciated in the State of São Paulo. The high rates of industrial expansion which have been noted would not have been possible without large investments in the development of skilled industrial labor. For the past 30 years, at least 1 percent of all industrial wages and salaries paid in São Paulo have been channeled to SENAI for the purpose of developing skilled industrial workers. The magnitude of other similar investments is not known.

By all measures, São Paulo's industrial expansion is impressive. The State may be viewed as an example of highly successful rapid industrial development. Much can be learned from the study of how this was accomplished, in particular by the study of how the necessary skilled industrial manpower was developed. New educational laws presently being implemented in São Paulo, were developed without complete knowledge of either the past or the present system of industrial skill development. Other parts of Brazil, as well as other countries, are presently at the stage of industrial development that São Paulo was in 30 or 40 years ago. Many of the problems that will be encountered as these areas industrialize will probably be the same problems that were solved in São Paulo many years ago.

The major problem is that it is not known how skilled manpower problems were solved in São Paulo. The SENAI program is the only part of the industrial training system that is well known. The contribution of SENAI, or any other source of industrial training, cannot be evaluated without knowledge of the total skill development system. The objective of this study is to provide this type of information.

The methodology employed is that of a "reverse tracer study." A sample of individuals presently employed as skilled industrial workers is selected, and information is gathered which will allow the reconstruction of their work and learning histories. The type and organization of this information is discussed in Chapter II, which deals with the general model used in the study.

FOOTNOTES--CHAPTER I

[1]Brazil, Governo do Estado de São Paulo, Secretaria de Economia e Planejamento, Departamento de Estatística, Seção de Estatísticas da Produção Industrial do Estado de São Paulo. These figures were calculated from Industrial Census data and released by the above mentioned department.

[2]Ibid. This figure was calculated from unpublished data and released by the above mentioned department.

[3]Brazil, Ministério do Planejamento e Coordenação Geral, Fundação IBGE, Instituto Brasileiro de Estatística, Departamento de Censos, Censo demográfico Brasil, VII recenseamento geral, 1970, V. I (Rio de Janeiro: Fundação IBGE, 1970), p. 2, Table I.

[4]Ibid., p. 81, Table 21.

[5]Brazil, Ministério do Trabalho e Previdência Social, Departamento Nacional de Mão de Obra, Composição e distribuição de mão de obra, São Paulo (Rio de Janeiro: Departamento Nacional de Mão de Obra, 1970), p. 13.

[6]Italo Bologna, A mão de obra industrial (São Paulo: Centro de Estudos Roberto Mange, 1967), p. 2. (Mimeographed)

[7]This discrepancy is caused by the change in the definition "qualified" noted in Table 4. The lower estimate is calculated directly from the published date. The upper figure is obtained by applying the 1955 adjustment ratio to the published 1946 data. Both figures should be regarded a rough estimate.

[8]Adapted from: Robert J. Havighurst, and Aparecida J. Gouveia, Brazilian Secondary Education and Socio-Economic Development (New York: Praeger Publishers, 1969), p. 20. There is some variation in the structure of the formal school system in different areas of Brazil. In some rural areas, only three years of primary school are offered, while in some urban areas, pre-primary as well as one or two years of supplemental primary school is offered.

[9]USAID/BRAZIL, Human Resources Office, Brazil

Education Sector Analysis (Rio de Janeiro: Human Resources Office, November, 1972), p. 25. (Mimeographed)

[10]Ibid., p. 42.

[11]Brazil, Ministério do Planejamento e Coordenação Geral, Fundação IBGE, Instituto Brasileiro de Estatística, Anuário estatístico do Brasil 1972 (Rio de Janeiro: Fundação IBGE, 1972).

[12]The following discussion relies heavily on: Celso Suckow da Fonseca, História do ensino industrial no Brasil, vols. I & II (Rio de Janeiro: Escola Técnica Nacional, 1961).

[13]Ibid., p. 313.

[14]Ibid., p. 326.

[15]Ibid., p. 356.

[16]Italo Bologna, SENAI: origens, evolução, organização (São Paulo: Centro de Estudos Roberto Mange, 1972), p. 10. (Mimeographed)

[17]João Batista Salles da Silva, and Paulo Ernesto Tolle, SENAI: An Instrument of Brazilian Industries for Manpower Training Through Formal and Non-Formal Education (São Paulo: SENAI/SP, 1974), pp. 11-14.

[18]Serviço Nacional de Aprendizagem Industrial (SENAI), Departamento Nacional, Relatório 1972, ed. provisória (Rio de Janeiro: SENAI/DN, 1972), p. 24.

[19]Hla Myint, The Economics of Developing Countries (New York: Praeger Publishers, 1964), p. 173.

CHAPTER II

THE MODEL

2.1 Introduction

This study will examine three basic questions concerning the development of skilled industrial labor in Brazil. First, what is the origin of present skilled industrial laborers? The study will attempt to determine if in fact they were drawn randomly from the Brazilian population, or if their geographic, socio-economic, and other characteristics of origin make them significantly different from the remainder of the population. Second, how did these individuals learn and develop their mental and manual skills? An examination will be made of the institutional arrangements, content, duration, and sequence of their learning experiences. Third, and perhaps most important, do variations in an individual's origin and method of learning influence the nature, quality, and market value of his work?

2.2 The Conceptual Frame

There are two basic problems in answering the above questions. First, the questions are all interrelated, and second, there is almost no initial information except that skilled industrial workers do exist. A first step toward the solution of these problems is the development of a simple, conceptual frame to identify factors which may be important in the development of skilled industrial labor. The frame will also facilitate the organization of relevant information to describe meaningfully what has happened in the Brazilian case. Further, it will allow for the analysis of different types of learning to determine if some have had more favorable results than others.

The conceptual frame has three elements: birth, learning that has taken place over time, and the present situation (see figure 1).

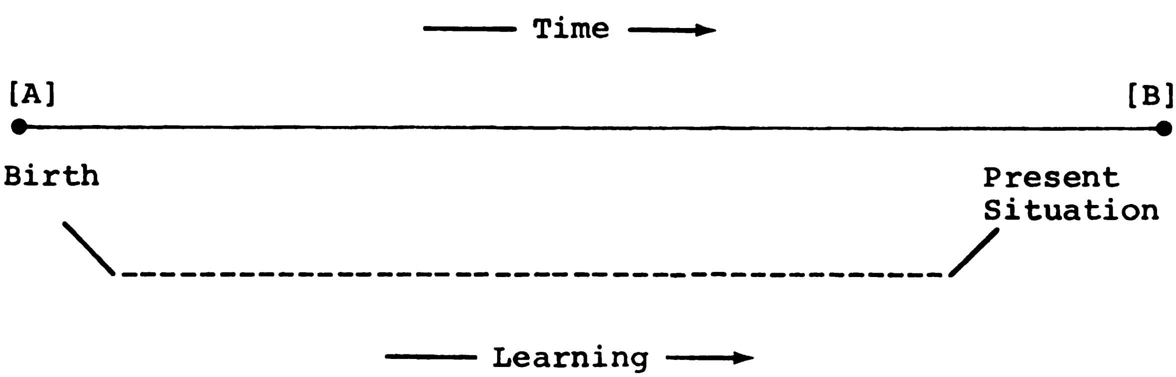

Figure 1.--The Conceptual Frame.

At this level of abstraction it is suggested that the conditions of birth (time, place, socio-economic status, educational level of parents, etc.) may have had some influence not only on the present situation of the individual (occupation, socio-economic status, etc.) but also on the types of learning experiences (formal education, training, work, etc.) to which the individual has been exposed. It is further suggested that the combination of both factors, the conditions at birth and the learning experiences, may have resulted in differences in the present situation of the individual.

This study is specifically concerned with the development of skilled industrial labor. Beginning with the existence of these skilled workers, the simple conceptual frame can be expanded. First, skilled industrial workers can be identified by the general type of work they perform. Standard occupational titles and definitions can be used to distinguish different occupations. The standard definitions, however, only set the limits which define an occupation but, within a given occupation, there can be variation in the specific type of work performed. That is, different individuals working in a given occupation may perform related but not identical operations. They might produce at different rates and the quality of work may vary. Accordingly, there may be variation in the wage they receive. The model, thus, allows for the heterogeneity of labor within specific occupations.

Second, the model assumes there are three broad types of learning experiences relevant to the development of skilled industrial labor. The first is formal education, the learning which takes place in the graded, age-specific, formal school system. The ability to read, the knowledge of basic science, and the development of elementary mathematical tools can be important for specific skilled occupations. These types of things generally are learned in the formal school system.

Work experience is the second broad type of learning. It is the learning which takes place as a normal by-product of working in a specific occupation, at some specified level, during a certain period of time. An unskilled "helper" for a skilled worker probably learns something about the skilled worker's trade. Over time as he gains experience his responsibilities might increase until eventually he reaches the skilled level.

The third type of learning is training experience. Training is job-oriented learning which takes place under various forms of sponsorship, for various periods of time, but is directed toward a specific occupation. Training, unlike work experience, is planned and has a defined structure, whereas learning through work experience is only a by-product of the normal production process. Regardless of the lack of structure and planning, work experience is recognized as a valid form of skill development. The regular upgrading and promotion of individuals in firms, which is partially based on years of experience, is an example.

The discussion to this point can best be summarized and placed in context with the aid of figure 2.

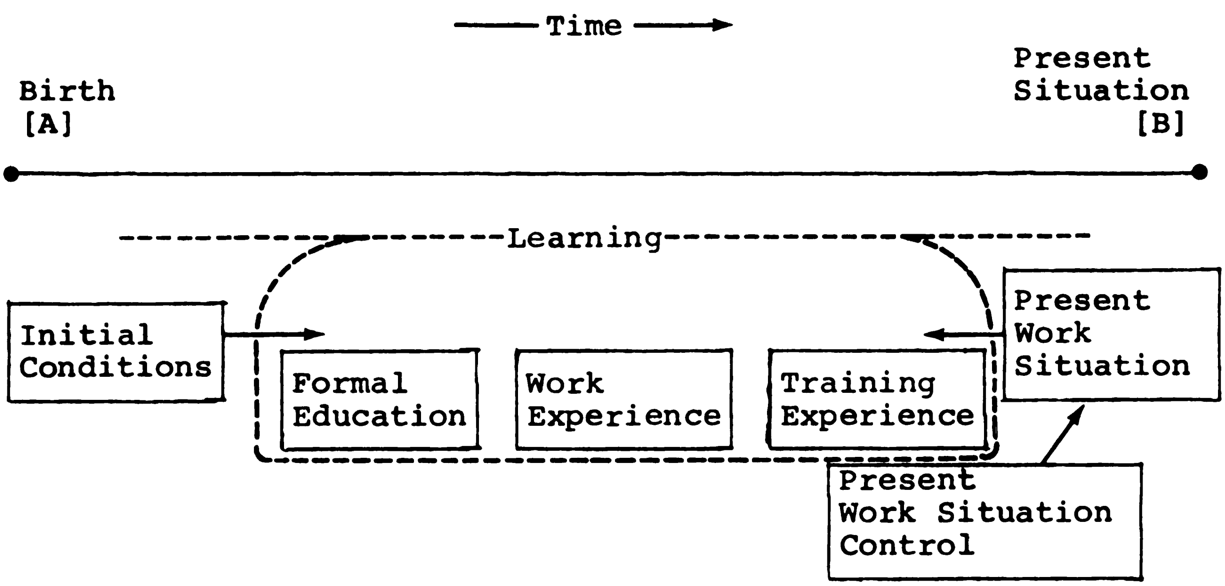

Figure 2.--The General Model.

As in figure 1, there are the three basic elements of birth, learning over time, and the present situation. The conditions at birth are represented by the block labeled <u>Initial Conditions</u>. Learning has been divided into the three suggested classifications which are represented by the blocks <u>Formal Education</u>, <u>Work Experience</u>, and <u>Training Experience</u>. The position of these three learning blocks is not intended to suggest ordering in time or that the types of learning take place during separate periods. The present situation is restricted, in this case, to the present work situation, which in turn is divided into two separate components. The Present Work Situation block represents the operations performed on the job and the remuneration received. The second block, labeled Present Work Situation Control, represents those factors which may influence what is done on the job and the remuneration, but which are not directly related to initial conditions or learning. Such factors are the size and final product of the factory in which the individual works, the type of machine used, and the length of time the individual has been working in the factory.

The specific elements of each block of the general model are discussed in more detail in the following sections.

2.3 Elements in the General Model

The conceptual frame or general model developed is a useful tool for identifying and relating the principal areas of interest in this study. It provides a simple means for viewing the important aspects of a complex situation. Most important, it is a basis for the development of an operational model to answer the questions posed in this study.

The model will serve three basic purposes. First, it will be a basis to describe what has actually happened in the Brazilian case. Second, it will allow the various parts of the study to be placed in perspective with each other, and with the whole. Third, it will serve as a frame to analyze the effects of what has happened.

The model may be broken into six major parts, corresponding directly to the six major informational blocks in the general conceptual frame. The six major parts of the model are:

1. Present Work Situation (PWS)
2. Present Work Situation Control (PWSC)
3. Initial Conditions (IC)
4. Formal Education (FED)
5. Work Experience (WEX)
6. Training Experience (TEX)

In the following sections the specific elements of each of the six parts will be discussed.

2.3.1 Present Work Situation (PWS)

The initial information is that skilled industrial workers exist. They can be identified by occupation and located in the various factories in which they are employed. Within limits determined by the occupation, differences among individual workers are expected. Specifically, some individuals may do more varied types of work, some may do more difficult work, and these differences may be reflected in labor market prices.

Two types of operational information are required--what is actually done on the job, and the corresponding pay rates. In the first case, previous research by SENAI can be used. Some of the most interesting and useful products of this research are the analytical tables (quadros analíticos) of tasks and operations that are generally associated with specific skilled industrial occupations.[1] In the analytical table a task is defined as the turning-out of some specific intermediate product (e.g., a gear) in the firms' productive process. The completion of a task requires one or more distinct, physical operations. As the complexity of the task increases, the number and complexity of the required operations also increase. The specific operations associated with an occupation are finite in number and arranged in order of increasing difficulty. Using the operations table as a basis, two types of information can be developed. First, the number of specific operations performed on the job can be established, and second, an index reflecting the degree of difficulty can be constructed. Information is also needed on how the market values the work performed. It is assumed that, other things equal, differences in the quality of work are reflected in differences in pay rates. Gross monthly earnings adjusted for hours of work will be used as the measure of market valuation.

In summary, the Present Work Situation (PWS) block contains three specific elements:

1. The number of operations performed
2. An index of the degree of difficulty of operations performed

3. A measure of the market evaluation of work performed

2.3.2 Present Work Situation Control (PWSC)

It is possible that factors not related to initial conditions or learning may influence the present work situation. The final product produced by the firm can influence the types of operations performed on the job. SENAI has developed and uses an industrial classification system which is based on the final output.[2] All industrial establishments are classified with a four-digit code, and using this code it is possible to control for variations which are due to differences in the final product.

Somewhat related are differences in factory size. Individuals working in small job shops which concentrate on specialized, small-scale contract work might be expected to perform different operations than individuals working in large establishments employing mass production techniques. Even within the larger factories, variations might be expected between individuals working in production and others working in maintenance. Differences in the specific type of machine used might also be expected to lead to differences in operations performed.

Given that these factors might be expected to influence the number and types of operations performed, four specific elements are placed in the Present Work Situation Control (PWSC) block:

1. Factory industrial group
2. Factory size
3. Sector of work in the factory
4. Type of machine used

In addition to the number and types of operations performed, wage rates may be influenced by the occupational level at which an individual was first employed in the factory and by the number of years he has been employed. For example, an individual who entered a factory at the apprentice level and worked his way up to the skilled level without ever entering the outside labor market might, because of his lack of labor market knowledge, offer his services to the factory at a relatively low rate. Other things equal, however, a positive correlation between the wage rate and the number of years of service might be expected. Accordingly, two more elements are added to the block:

5. Factory entry level
6. Number of years working in the factory

2.3.3 Initial Conditions (IC)

It is reasonable to assume that the situation in which an individual was born (when, where, and to whom) would influence not only what is perceived as an acceptable occupational goal, but also the practical possibility of achieving a specific goal. More basically, possible occupations are limited to the occupations actually known.

It is conceivable that the son of an illiterate farm worker from northern Brazil would have no idea that skilled industrial occupations even exist. His opportunities are limited to what he or his parents know. Within the set defined by his knowledge he may perceive the occupation of farm foreman as an acceptable goal. However, if the occupation of foreman requires some formal education, and if the costs associated are judged to be too high, the occupation is not part of the set of practical possibilities. The individual is limited by both his knowledge and his resources.

From a different point of view, consider the hypothetical position of the son of a doctor living in the Greater São Paulo area. This individual would almost certainly have the occupation of farm foreman in the set of occupations defined by his knowledge. It would also be in the set limited by his real resources. However, it probably would not be within the set of acceptable occupational goals. The individual is limited by three factors, what is known, what is possible, and what is acceptable.

Even when an occupation falls within the sets of what is known, what is possible, and what is acceptable, additional constraints may influence the particular path taken toward the realization of the occupational goal. For example, there are alternative ways to develop the skills associated with a qualified industrial occupation. An individual with few resources may learn through work experience only, while an individual with greater resources might pay for a special course.

It is therefore possible that the initial conditions of an individual may influence the occupation chosen and the path taken toward that occupation. Consequently, the following elements are entered in the Initial Conditions (IC) block:

1. Age
2. Place of birth
3. Place of primary education
4. Educational level of father
5. Educational level of mother
6. Occupational area of father
7. Occupational status of father

2.3.4 Formal Education (FED)

Generally, an individual learns to read and write, acquires the knowledge of basic science, and learns the basic use of mathematical tools in the formal school system. As the individual moves through the higher levels of the system the objectives and the specific content of learning changes. The lower levels may be viewed as foundation building for the higher levels. Entry into skilled industrial occupations may require some critical minimum of formal education. On the other hand, there may be a point beyond which more formal education is not required for the satisfactory performance of the tasks of a skilled industrial worker. There also may be a strong relationship between the level of formal education and what is viewed as an acceptable occupation. In Brazil probably few high school graduates work in blue collar positions. On the other hand, more formal education might facilitate specific skill development. In sum, formal education may be important in the development of skilled industrial labor, so the following elements are entered in the Formal Education (FED) block:

1. Age started school
2. Highest grade completed
3. Program of highest grade completed
4. Age when highest grade completed

2.3.5 Work Experience (WEX)

Through informal demonstration, imitation, and experimentation an individual may learn by simply working in any occupational area. The importance or relevance of what is learned depends on the final occupational objective. Other things equal, two years of work experience as a farm laborer are less relevant to the occupation of tool and die maker than are two years of work experience as a machinist's helper.

The individuals in this study are presently working as skilled industrial laborers; however, they probably have not always worked in these positions. Each individual has a complete work history of specific sequences and types of work experience. Variations in individual sequences and types of work experiences and the associated variations in learning might be expected to have influenced the present work situation. The specific manner in which work experience enters the general frame can best be explained with the aid of figure 3, as shown below.

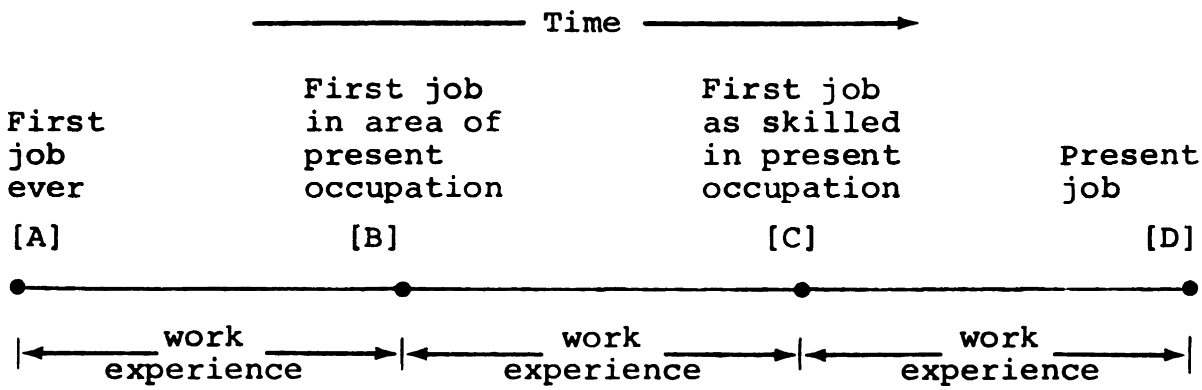

Figure 3.--Work History.

Time is plotted on the horizontal axis, with four points of interest. Point [A] represents the first job of any type that the individual held, and is the beginning of his work history. Point [B] represents the first job the individual had in the area of his present occupation. For example, if the individual is presently a skilled machinist, his first job in the area might have been as a machinist's helper. The point when the individual was first hired or classified as a fully skilled worker in his present occupation is point [C]. Point [D] represents the present work situation. In some cases two or more points may coincide; however, in the general case the four points are distinctly separated by time.

The next step is to define explicitly the meaning of each point, and to establish the relevance of what took place between each of these points in time. Assume that the set of all possible occupations is defined by the largest circle in figure 4. Further, assume that the innermost circle represents all different skill levels in a specific, given, industrial occupation. The point in the center of the diagram represents the skilled level in that given occupation. In this study the area defined by the innermost circle is referred to as "the area of the given occupation." The point in the center is referred to as "the skilled level in the given occupation." The second ring represents all occupations related to the given occupation. All other industrial occupations are represented by the third ring. The largest ring is divided into two parts. One represents all agricultural occupations and the other represents all other occupations not previously defined. What has been developed is a scheme for classifying occupations with respect to their relevance to the given industrial occupation. Other things equal, the work experience associated with an occupation is less relevant the farther it is from the center.

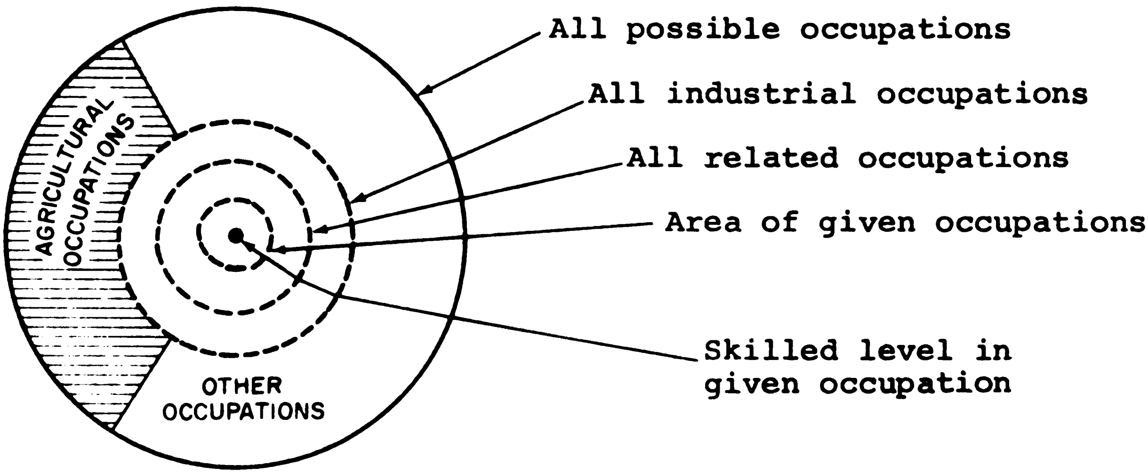

Figure 4.--Occupational Relevance.

Using this scheme, a scale of work experience relevance may be constructed as follows (smaller numbers reflect a higher degree of relevance):

1. In the area of the given occupation
2. Related to the given occupation
3. Some other industrial occupation
4. Agricultural occupation
5. Other occupation

With this scale it is possible to classify the individual's first job, his work history starting point, with respect to the present occupation. Further, given the time sequence of other jobs held between points [A] and [B] as defined in figure 3, it is possible to know how close the individual came to the given occupational area, point [B], before actually entering it. Other things equal, one would expect that the closer the approach and the longer the duration, the more relevant and beneficial the work experience to what happens after point [B]. The skill level of the first job in the area of the given occupation, point [B], may be classified as either learning (apprentice or helper), semi-skilled, or skilled. Work experience after point [B], the initial entry into the area of the given occupation, may again be classified as to its relevance to the given occupation. If the individual leaves the area of the given occupation, the degree, as well as the duration of the departure can be measured. The measurement technique applies equally to both time spans after point [B], (i.e., the time span between [B] and [C], the first job as skilled in the given occupation; and the time span between [C] and [D], the present work situation).

The index of occupational relevance and knowledge of the sequence and duration of an individual's previous occupations allows his entire work history be given specific meaning and dimension. With this information variations in work history can be discovered and tested for their effect on the present work situation.

The specific elements in the Work Experience (WEX) block are:

1. Age at the time of (a) first job ever, (b) first job in the area of the given occupation, and (c) first job as skilled in the given occupation.

2. Position on relevance scale for first job ever
3. Level of entry into the area of the given occupation
4. Relevance and duration of work experience between (a) first job ever and first job in the area of the given occupation, (b) first job in the area of the given occupation and first job as skilled, and (c) first job as skilled and the present work situation

2.3.6 Training Experience (TEX)

Training experience has been previously defined as job-oriented learning which takes place under various forms of sponsorship, for varying periods of time, but is oriented toward a specific occupation. It differs from work experience (learning on the job) because it generally has some type of structure. In the Brazilian context, training experience is represented by the many and varied types of courses available from a wide range of sources. The SENAI apprenticeship programs are an excellent example of the types of long-term training experiences available. SENAI, as well as various other public and private entities, also offers a wide range of shorter courses. A wide range of courses is available from a great variety of sources, but no central clearing house for information on these courses exists. SENAI keeps its own records, and although private schools generally are registered with the state government, no records are kept on the number of individuals who have taken private school courses. Courses given by the factories are recorded only by the factories themselves. Even in the case of the courses given through the public school system, no time series data are available. In short, a training system exists, but there is no way to estimate its total magnitude or to place its components in perspective.

Training courses may be extremely important to the development of skilled industrial labor, and the following elements are entered in the Training Experience (TEX) block:

1. Number of courses taken
2. For each course:
   a. Sponsor
   b. Occupational area
   c. Content (theory/practice)[3]
   d. Total hours planned
   e. Duration in months
   f. Percentage of courses completed
   g. Year course started
   h. Geographic location

2.4 Summary of the Model

The model to be used in this study has six major blocks of variables, which correspond directly to the six major informational areas suggested by the general conceptual frame. The variable blocks and their specific variables are listed below:

I. Present Work Situation (PWS)

1. Gross hourly earnings
2. Number of operations performed
3. Index of the complexity of operations performed

II. Present Work Situation Control (PWSC)

1. Size of factory
2. Industrial group of factory
3. Sector of factory
4. Type of machine used
5. Factory entry level
6. Years working in factory

III. Initial Conditions (IC)

1. Age
2. Place of birth
3. Place of primary education
4. Educational level of parents
5. Occupational area of father
6. Occupational status of father

IV. Formal Education (FED)

1. Age
    a. started school
    b. finished school
2. Highest grade completed
3. Program of highest grade completed

V. Work Experience (WEX)

1. Age
    a. First job
    b. First job in present occupational area
    c. First job as skilled in present occupational area
2. Occupational area of first job

3. Entry level in area of present occupation
4. Work experience
    a. After first job, but before entry into present occupational area
    b. After entry into present occupational area, but before reaching the skilled level
    c. After reaching the skilled level

VI. Training Experience (TEX)

1. Number of courses taken
2. For each course taken
    a. Occupational area
    b. Sponsor
    c. Total hours completed
    d. Duration of course in months
    e. Age course began

The specific variables used in each block, and their associated codes, will vary with the specific type of analysis being conducted. The analysis will be done at two levels. First, the model will be used to organize and describe relevant information. Second, the model will serve as a basis for the development of several regression models. The most comprehensive regression model will have the general forms (PWS) = f (PWSC, IC, FED, WEX, TEX).

Regression analysis will be used to determine (1) which blocks of variables and (2) which specific variables are significant in explaining variations in the present work situation.

FOOTNOTES--CHAPTER II

[1] Serviço Nacional de Aprendizagem Industrial (SENAI), Departamento Nacional, Manual do docente de tornearia (Rio de Janeiro: SENAI/DN, 1972).

[2] Serviço Nacional de Aprendizagem Industrial (SENAI), Departamento Regional de São Paulo, INPS-codificação de atividades (São Paulo: SENAI/SP, 1972). (Mimeographed)

[3] In Brazil industrial training courses generally have two parts: one, theory (aula) which is the classroom study of design, shop theory, etc. and two, practice (oficina) which is supervised shoproom work in which machines are used.

CHAPTER III

THE COLLECTION OF THE DATA

3.1 Restrictions On the Study

Because of time and other resource constraints it was necessary to restrict the study in three ways. First, it was decided that one important industrial occupation would be studied, metal lathe setter-operators (torneiros mecânicos). Second, the study was limited to the three highly industrialized counties (municípios) of Santo André, São Bernardo do Campo, and São Caetano do Sul. These three counties are more commonly known as the "ABC" area of Greater São Paulo. Finally, the study was restricted to the important industrial group of machinery production (mecânica). Each of these restrictions will now be discussed in more detail.

3.1.1 Metal Lathe Setter-Operator

The machining of metal in the modern industrial production process is immensely important. Most modern industrial products have machined metal components, or machined metal tools are used in some stage of their production. The cutting, shaping, drilling, grinding, and milling of metals is essential to the manufacture and repair of industrial equipment and machines.

"The lathe is probably the oldest of the developed machine tools."[1] The distinguishing feature of the modern power metal lathe is that "it normally functions by rotating the workpiece against the cutting edge of the tool held stationary in a holder."[2] The piece of metal to be worked is placed between the two centers of the lathe and is rotated at a chosen speed. To cut and remove portions, the cutting tool is moved into position against the metal. The rotation of the metal against the tool shaves off parts of the metal. Typical products are tapered pins, bolts, screws, pulleys, shafts, disks, etc.

To set up and operate the lathe requires basic knowledge of mechanical design, shop mathematics (geometry and trigonometry), knowledge of the technical properties of various metals, as well as knowledge of the techniques for performing various operations.

The occupation of lathe setter-operator is coded 8-33.20 in the 1968 edition of the International Standard Classification of Occupations. The occupational description is:

> Sets up and operates a power-driven metal-working lathe:
>
> examines drawings and specifications of part to be made; fastens metal and tools in position on lathe using chucks, jigs and other fixtures as required; adjusts guides and stops; sets rotation speed of metal and starts machine; manipulates hand wheels, or sets and starts automatic

controls to guide cutting tool into or along metal; controls flow of lubricant on edges of tools; checks progress of cutting with measuring instruments and makes necessary adjustments to machine setting.

May specialise in a particular type of lathe and be designated accordingly.

According to the 1970 Demographic Census of the State of São Paulo, 19 of every 1,000 workers in the industrial sector are employed in the area of lathe operation.[4] SENAI estimates that 30 percent of the qualified workers in the machinery subgroup are lathe setter-operators. Since 1956, SENAI of São Paulo has trained 9,225 lathe setter-operators through its apprenticeship program.[5] This is 18.5 percent of all industrial apprentices trained by SENAI since 1956. Since 1958 the SENAI school located in Santo André has trained nearly 37 percent of its apprentices in the occupation of lathe setter-operator. In 1972, SENAI of São Paulo had 19,780 individuals younger than 18 enrolled in its apprenticeship program, of which 3,437 (17.3 percent) were enrolled in the lathe setter-operator program.

3.1.2 The "ABC" Area

The three counties of Santo André, São Bernardo do Campo, and São Caetano do Sul were selected primarily because they are extremely important in Brazilian industrial production. The ABC area is slightly more than 600 square kilometers yet, in 1967, it accounted for approximately 10.8 percent of the total value of Brazilian manufacturing production.[6] According to 1970 estimates, 6.2 percent of all Brazilian industrial establishments and 5.6 percent of all Brazilian industrial employees were located in the ABC area.[7] SENAI of São Paulo estimates that in 1972 approximately 12.7 percent of the qualified industrial workers in the state were employed in these three counties.[8] Interestingly, only 30 years ago the three counties consisted only of small towns and farms.

In addition to its high concentration of industry and skilled workers, the ABC area was selected because of its accessibility. It is located only 25 minutes by train or one hour by car from the main SENAI offices in downtown São Paulo. Further, relatively recent industrial census information on the ABC area was available. The industrial census of Santo André was conducted in 1971. São Bernardo do Campo and São Caetano do Sul censuses were conducted in 1968. The censuses will be discussed in more detail in the section that deals with the selection of the workers to be interviewed.

3.1.3 The Machinery Industrial Sub-Group

Metal lathe setter-operators can be found in all types of industrial establishments. Wherever there are machines to be repaired and maintained a lathe setter-operator may be employed. However, the highest concentration of lathe setter-operators is in industries which specialize in the production and repair of machines and machine parts. It is in this type of establishment that the lathe setter-operator works in both production and maintenance capacities.

Since its beginning SENAI has been conducting industrial censuses. All industrial establishments are classified according to the type of final product they produce. There are 15 major industrial groups and each is divided into subgroups. Most skilled lathe setter-operators are found in SENAI Industrial Group 14, Metallurgy-Machinery-Electrical Material, which is divided into 22 subgroups.[9] Seven subgroups (16-22) are related to the production of electrical materials and are not of present interest. The remaining 15 subgroups are all related either to the production or working of metal, or the production or repair of metal products or machines. The subgroups of interest are:

14-01 Factories which smelt, refine and laminate iron and steel.

14-02 Factories which cast and mold metals.

14-03 Factories which produce metal products in general.

14-04 Factories which cut and shape metals.

14-05 Factories which machine metal.

14-06 Factories which plate metal.

14-07 Factories which build and maintain machines.

14-08 Factories which produce cutlery, guns, and fine metal work.

14-09 Factories which produce weights, balances, and precision instruments.

14-10 Factories which produce products using their rolled metal.

14-11 Factories which stamp metal.

14-12 Factories which produce metal furniture.

14-13 Factories which built and repair vehicles.

14-14 Factories which repair vehicles and build vehicle parts and accessories.

14-15 Factories involved in naval construction.

3.2 The Sample

The objective in selecting the group to be interviewed was to obtain the best possible cross-section representation of the total population of lathe setter-operators in the ABC area. Two basic types of information were used in the selection. First, the existing SENAI industrial census data were used to identify firms in which lathe setter-operators are employed. This was complicated by the fact the census of Santo André was conducted in 1971 and those of São Bernardo do Campo and São Caetano do Sul were conducted in 1968. It was initially assumed, and later confirmed, that the industrial employment situation has changed considerably since the censuses. The census data were, however, the best available source of information upon which to base estimates of the current employment situation.

The second major source of information was the knowledge and experience of the field agents of SENAI's Division of Census and Control (Cadastro e Controle).

The division has been conducting industrial censuses since 1943 in the State of São Paulo. Its field agents provide SENAI with factory level contact in the industrial sector. Within a given census area, it is the field agents who locate the factories, assign industrial group and subgroup codes, and classify each individual in the factory by sector of work, occupation, and occupational level. There is probably no other group of individuals in Brazil which knows and understands the industrial employment and occupational structure as well. Several of the agents have been working with SENAI in this capacity since it was founded in 1942. When needed, it was the field agents who provided invaluable assistance.

As previously noted, skilled lathe setter-operators are found in all of the first 15 subgroups of SENAI Industrial Group 14, Metallurgy-Machinery-Electrical Material. However, they are primarily found in subgroups 03, 05, and 07 which are directly concerned with the production or maintenance of metal machines or machine parts. Both production and maintenance sector work is common. Subgroups 01, 11, and 13 also have relatively high concentrations of lathe setter-operators. The remaining subgroups use lathe setter-operators generally in a maintenance capacity. The large automobile producing firms which are part of subgroup 13 do use large numbers of lathe setter-operators in both production and maintenance capacities. These firms were, however, excluded from the study as being atypical because most have their own special training centers, supervised by SENAI, for the development of their own skilled workers.

The specific firms from which the representative group of lathe setter-operators was drawn were chosen using the following criteria applied to the available census data.

1. In Santo André--all firms in subgroups 03, 05, and 07 having more than one lathe setter-operator.
2. In São Bernardo do Campo and São Caetano do Sul--all firms in subgroups 03, 05, and 07 having more than five lathe setter-operators.
3. In Santo André, São Bernardo do Campo, and São Caetano do Sul--all firms in subgroups 01, 11, and 13 having more than five lathe setter-operators, with at least three working in the production sector.

These criteria were adopted for two reasons: first it was not possible because of time and other resource constraints to conduct interviews in all of the over 3,500 firms in the ABC area; second, the 1968 census data does not accurately reflect the present employment situation in the São Bernardo and São Caetano areas. It was thus necessary to rely on the knowledge and experience of the field agents in selecting the firms from which the representative group was drawn.

In subgroup 03, the size of the firms range from one or two employees to over 2,000. There is no direct relationship between the size of the firm and the number of lathe setter-operators employed. Factories with less than 1,000 employees which have lathe setter-operators generally have from one to five. Those factories with over 1,000 employees tend to have from 15 to 25. In subgroups 05 and 07 only one firm had more than 350 employees, and the majority have less than 50 employees. It is not unusual to find in firms with less than 50 employees more than five lathe setter-operators. In the total ABC area there are 288 firms in the 03, 05, and 07 subgroups. A total of 158 (54.9 percent) are located in Santo André, and of these, 57 had no lathe setter-operators, and 35 had only one. The remaining 41.7 percent had two or more. In São Bernardo and São Caetano 47 firms had no lathe setter-operators and 24 had only one. The remaining 45.4 percent had two or more.

The firms in subgroups 01, 11, and 13 (with the exception of auto repair shops) generally employ over 350 workers. Lathe setter-operators are usually found in the maintenance sector of the factory. There are factories, however, which do use them in the production line. It was decided that factories having both maintenance and production lathe setter-operators would yield a more representative type of worker.

Using the selection criteria developed, 97 firms were chosen from the census lists as target firms for the study--40 in the 03 subgroup, 19 in the 05 subgroup, 23 in the 07 subgroup, and 15 in the 01, 11, and 13 subgroups.

3.3 The Questionnaire

The questionnaire was developed with three specific objectives in mind. First, it was to provide the type of information required to meet the stated objectives of the study. Second, as interviews were to be conducted during regular working hours, the questionnaire had to be designed to facilitate the rapid collection of the desired information. Third, in order to reduce the coding time, self-coding responses were utilized whenever possible.

Work on the questionnaire was initiated three months prior to the starting date (April, 1973) of the field work. The supervisor of the SENAI census takers was involved in every stage of development. His aid was invaluable. The questionnaire was tested and revised on three separate occasions. A total of 27 individuals were interviewed in the testing stage--15 were skilled lathe setter-operators who were interviewed in the firms where they were employed, six were SENAI apprentices studying to be lathe setter-operators and seven were SENAI office personnel.

The tests indicated two things. First, the questionnaire was too long (average interview time was over

25 minutes); and second, the section dealing with the individual's work history was not easily understood by the person interviewed. Corrections in this section were made and in the latter tests the average interview time dropped to approximately 15 minutes, which was considered acceptable.

In its final form (see Appendix 1) the questionnaire was 10 pages and was divided into the following general sections:

1. Control Information--name of interviewer, date and hour of interview, time required, name and address of firm.

2. Origin--age, place of birth, age arrived in São Paulo, place of primary education, educational level of parents, occupation of father, and size of family.

3. Formal Education--for each of the three levels (primary, middle, high) of formal school (a) age started, (b) age finished, (c) program enrolled in, and (d) highest grade completed; also, special rapid middle and high school programs.

4. Training Courses Taken--For each course (a) occupational area, (b) name and address of school, (c) sponsor of course, (d) duration, (e) total hours per week and division between classroom and shop work, (f) percentage of course completed, and (g) the age or year the course was completed.

5. Work History--There were no specific questions in this section, rather the interviewee was guided by the interviewer in the completion of a "work history table." Four important points in the work history were first established:

   (1) First job ever (occupation, age, year)
   (2) First job in area of lathe operation (level, age, year)

(3) First job as skilled lathe setter-operator (age, year)
(4) Present work situation (known)

After these points were identified and the time span between each was established in the mind of the interviewee, he was asked to indicate the type and duration of all other jobs he held between the already identified major points. The procedure provided automatic feedback to the interviewer and insured that the parts of the work history were consistent with the whole.

6. Present Work Situation--(a) length of time in firm and entry level, (b) regular and extra hours worked per week, (c) gross monthly salary, (d) type of lathe used, and (e) sector of work.

7. Operations Performed on the Job--A list of 41 different operations was presented and the interviewee was instructed to indicate which operations he used in his present job. If the operation was not understood the "don't know" column was marked.

Missing data (blank answers) were not permitted. Where necessary, a "don't know" alternative response was provided.

3.4 The Field Work

In the final week of March, 1973, three days were devoted to the training of the seven interviewers. Five were regular SENAI census fieldworkers and two were SENAI office workers who usually proofed the census field reports. All were familiar with occupational classifications and had little trouble grasping the purpose of the study and understanding how the questionnaire was designed.

The primary interviewing was conducted during April, 1973. Each interviewer was assigned to specific firms and was given a letter of introduction, written by the director of SENAI of São Paulo, which was to be presented to the personnel director at each factory. The letter explained the purpose of the study and that SENAI was collaborating in its execution. It requested that all lathe setter-operators presently employed in the firm be interviewed. To conduct the interviews it was necessary for the worker to be taken away from his normal duties. The backing of SENAI and the persuasive powers of the interviewers were extremely important in gaining entrance to the factory. In some cases it was necessary for the interviewer to return to a factory several days in a row before permission to conduct the interviews was granted.

Of the 97 firms selected, nine refused to collaborate in the study. It is estimated that 47 lost interviews resulted. Five firms no longer existed, two had moved outside the ABC area, and seven no longer employed lathe setter-operators. A total of 74 firms allowed interviews to be conducted. Based on the SENAI census data, it was expected that 738 lathe setter-operators would be interviewed. The actual number was 546. Given that the census data for São Bernardo do Campo and São Caetano do Sul were over four years old, this divergence between what was expected and what was realized was not surprising.

The editing process indicated that three questionnaires were not usable and the interviewees could not be recontacted to make corrections. The three questionnaires were discarded. Only three individuals interviewed did not have any formal education. This caused severe coding problems and these three questionnaires also were withdrawn. A total of 540 questionnaires were usable and were coded for computer analysis.

FOOTNOTES--CHAPTER III

[1]Robert S. Woodbury, History of the Lathe to 1850, in Robert S. Woodbury, Studies in the History of Machine Tools (Cambridge and London: The M.I.T. Press, 1972), p. 13.

[2]Harold V. Johnson, General Industrial Machine Shop (Peoria, Ill., Chas. A. Bennett Co., 1963), p. 168.

[3]International Standard Classification of Occupations (Geneva: International Labour Office, 1969), p. 199.

[4]Brazil, Ministério do Planejamento e Coordenação Geral, Fundação IBGE, Instituto Brasileiro de Estatística, Departamento de Censos, Censo demográfico São Paulo VIII recenseamento geral, 1970, V. I (Rio de Janeiro: Fundação IBGE, 1970).

[5]In 1970 there were approximately 38,000 individuals working in the industrial sector in the area of lathe operation. The number of skilled lathe setter operators was surely much less.

[6]Brazil, Governo do Estado de São Paulo, Secretaria de Economia e Planejamento, Departamento de Estatística, Seçaõ de Estatísticas da Produção Industrial do Estado de São Paulo. This figure was calculated from unpublished data and released by the above mentioned institution.

[7]Brazil, Ministério do Trabalho e Previdência Social, Departamento Nacional de Mão de Obra, Composição e distribuição de mão de obra (Rio de Janeiro: Departamento Nacional de Mão de Obra, 1970).

[8]Serviço Nacional de Aprendizagem Industrial (SENAI), Departamento Regional de São Paulo, "Levantamento industrial 1972." (Unpublished internal document)

[9]Serviço Nacional de Aprendizagem Industrial (SENAI), Departamento Regional de São Paulo, INPS-codificação de atividades (São Paulo: SENAI/SP, 1972). (Mimeographed)

CHAPTER IV

THE FINDINGS

4.1 Introduction

In the first part of this chapter the simple descriptive findings are summarized largely in tabular form. The objective is to document and describe within sample variations and, where possible, to compare the sample with the total industrial labor force of the State of São Paulo. The format of presentation is based on the outline of the model previously developed. In the second part, special attention is given to the learning experiences of those in the sample. Basic "learning paths" are constructed by combining variables from the Formal Education (FED), Work Experience (WEX) and Training Experience (TEX) blocks.

4.2 Simple Descriptive Findings

4.2.1 Present Work Situation (PWS)

Earnings.--As the occupation under study is generally well defined, and, given that the labor market area from which the sample was drawn is small geographically, the large variation in earnings was unexpected (see table 8).

Gross monthly earning range from a low of Cr$280 to a high of Cr$2,882. A majority of workers (66.67 percent) earn between Cr$900 and Cr$1,800. The sample mean and standard deviation are Cr$1,443.86 and Cr$462.82, respectively. Some of the variation may be eliminated by adjusting monthly earnings for hours of work. Even hourly earnings range, however, from Cr$1.40 to Cr$11.16 with a mean of Cr$6.30 and a standard deviation of Cr$1.69.

The high degree of variation in earnings may have two basically different, but not mutually exclusive, explanations. First, it is possible that individuals in the sample perform more or less the same quantity and quality of work, and it is the labor market which is very imperfect. On the other hand, the individuals in the sample may produce very different quantities and quality of work, and the market values them accordingly.

There is some partial and preliminary evidence which tends to support the latter explanation. First, as noted before, the labor market area is relatively small, and second, there consistently was a large number of "help-wanted" advertisements for skilled metal lathe operators placed in the local newspapers during the time the field research was being conducted. This would lead one to believe that knowledge of the prevailing market situation should have been very high. Further support is

TABLE 8.--Gross Monetary Earnings (In Cruzeiros*).

Monthly			Hourly		
Cruzeiros	Number	Percentage	Cruzeiros	Number	Percentage
Less than 300	1	.18	Less than 2	7	1.30
300 to 599	14	2.59	2 to 2.99	20	3.70
600 to 899	53	9.81	3 to 3.99	46	8.52
900 to 1,199	92	17.04	4 to 4.99	77	14.26
1,200 to 1,499	154	28.52	5 to 5.99	119	22.04
1,500 to 1,799	114	21.11	6 to 6.99	114	21.11
1,800 to 2,099	63	11.67	7 to 7.99	100	18.52
2,100 to 2,399	34	6.30	8 to 8.99	46	8.52
2,400 to 2,699	12	2.22	9 to 9.99	7	1.30
2,700 or more	3	.56	10 or more	3	.56
Total	540	100.00	Total	540	100.00

*In 1973 U.S.$1.00 equaled approximately Cr$6.30.

added by two findings of this study to be discussed in detail later. First, turnover rates tend to be very high, and second, there is a high degree of variation in the number of operations performed on the job. At this stage, however, the intent is only to establish that differences in market valuation do exist. This phenomenon will be explained later.

Relative to all industrial employees in the State of São Paulo, the earnings of those in the sample are relatively high (see table 9).

Over 81 percent of those in the sample earn over three minimum salaries.[1] The comparable figure for all industrial employees in the state is only 25.4 percent. At the top end of the scale 4.1 percent of all industrial employees earn more than eight minimum salaries; no individual in the sample has earnings in this class. In general, those in the sample are in the upper percentiles of the income distribution.

Operations performed on the job.--Over the past 30 years SENAI had been developing and perfecting its techniques for teaching various skilled industrial trades. In 1972, SENAI published a complete teaching manual for the development of skilled lathe setter-operators (Manual do docente de tornearia).[2] The manual presents step by step the theoretical and practical skills that should be mastered if an individual is to perform at the skilled level as a metal lathe setter-operator. One of the most interesting

TABLE 9.--Estimated Gross Monthly Earnings, Excluding Payments for Overtime Work.

Sample			All Industrial Employees (State of São Paulo--1970)		
	Individuals			Individuals	
Minimum Salary(s) Units*	Number	Percentage	Minimum Salary(s) Units	Number (Thousands)	Percentage
Less than 1	1	.19	Less than 1	155.8	9.1
1	20	3.70	1 to 1.99	755.4	45.3
2	79	14.63	2 to 2.99	345.7	20.2
3	151	27.96	3 to 3.99	164.3	9.6
4	279	51.67	4 to 5.99	150.6	8.8
6	10	1.86	6 to 7.99	49.6	2.9
8	0	.00	8 to 9.99	25.7	1.5
10	0	.00	10 or more	44.5	2.6
Total	540	100.00	Total	1,711.6	100.0

*The minimum salary is fixed by law. It is the minimum monthly salary that a full time employee can be paid. Adjustments in the minimum salary are made based on the rate of inflation (indexing). Most salaries in Brazil are expressed as multiples of the minimum salary.

Source: Data for all industrial employees is from Brazil, Ministério do Trabalho e Previdência Social, Departamento Nacional de Mão de Obra, Composição e distribuição de mão de obra-São Paulo (Rio de Janeiro: Departamento Nacional de Mão de Obra, 1972), p. 76.

and useful parts of the manual is the analytical table (quadro analítico) of tasks and operations generally performed by metal lathe operators. A task is a desired end product and one or more operations is required to complete a task. As the complexity of the tasks increase so do the complexity and number of operations required. Drawing on SENAI's 30 years of experience, a list of 41 operations which skilled metal lathe setter-operators are generally considered to perform in their daily work was taken from the analytical table. The operations are arranged in order of increasing difficulty; two being more difficult than one, three being more difficult than two, etc. The individuals in the sample were asked to indicate if they used each operation in their present work. Great care was taken to emphasize interest was only in finding if the operation was actually performed, not in if the individual knew how to perform the operation. If an individual did not understand a particular operation, the interviewer was instructed to mark the "don't know" column. The results are presented in table 10.

As the complexity of the operations increases, there is a slight tendency for the percentage of individuals performing those operations to decline. In the more difficult range, the percentage of individuals who do not recognize or understand specific operations tends to increase. The average performance rate for the 41 operations is 74.39 percent.

TABLE 10.--Operations Performed on the Job.

Operation	Do #	Do %	Do not do #	Do not do %	Don't Know #	Don't Know %
1. Turn an external cylindrical surface, using a universal chuck	487	90.19	50	9.25	3	.56
2. Face	526	97.41	14	2.59		
3. Bore center hole	504	93.33	35	6.48	1	.19
4. Turn cylindrical surface, using chuck and tailstock	482	89.26	44	8.15	14	2.59
5. Sharpen facing tool	448	82.96	92	17.04		
6. Turn an external conical surface, using the upper carriage	480	88.89	57	10.56	3	.56
7. Drill, using tailstock	475	87.96	59	10.93	6	1.11
8. Cut off working stock	522	96.67	17	3.15	1	.19
9. Cut internal threads, using tap	426	78.89	114	21.11		
10. Turn an internal cylindrical surface	473	87.59	52	9.63	15	2.78
11. Cut threads, using dies	347	64.26	191	35.35	2	.37
12. Turn a cylindrical surface between points, using dogs	488	90.37	48	8.89	4	.74
13. Knurl	442	81.85	97	17.86	1	.19
14. Center work piece on chuck with four independent jaws	499	92.41	37	6.85	4	.74
15. Internal facing	504	93.33	35	6.48	1	.19
16. To cut grooves, with cutting tool	354	65.56	123	22.78	63	11.67

TABLE 10.--Continued.

Operation	Do #	Do %	Do not do #	Do not do %	Don't Know #	Don't Know %
17. Finish hole, using finishing reamer	367	67.96	168	31.11	5	.93
18. Turn convex or concave surfaces, using bimanual movement	348	64.44	120	22.22	72	13.33
19. Open external triangular thread, using perpendicular penetration	351	65.00	145	26.85	44	8.15
20. Turn conical surface, using dislocation of tailstock	368	68.15	166	30.74	6	1.11
21. Open external triangular thread, using oblique penetration	299	55.37	163	30.19	78	14.44
22. Open external square thread	401	74.26	134	24.81	5	.93
23. Turn pieces, using mandrel	436	80.74	93	17.22	11	2.04
24. Roll wire	304	56.30	226	41.85	10	1.85
25. Eccentric turning	445	82.41	91	16.85	4	.74
26. Turn, using follower rest	432	80.00	104	19.26	4	.74
27. Drill using drill chuck fastened to headstock	358	66.30	151	27.96	31	5.74
28. Open a right internal triangular thread	426	78.89	103	19.07	11	2.04
29. Mill external cones and cylinders	308	57.04	224	41.48	8	1.48
30. Turn taper, using taper attachment	178	32.96	297	55.00	65	12.04
31. Open an internal square thread	393	72.78	143	26.48	4	.74

TABLE 10.--Continued.

Operation	Do #	Do %	Do not do #	Do not do %	Don't Know #	Don't Know %
32. Open internal and external trapezoidal threads	381	70.56	154	28.52	5	.93
33. Open internal and external multiple threads	298	55.19	216	40.00	26	4.81
34. Turn, using mandrel	328	60.74	197	36.48	15	2.78
35. Sharpen carbide tools	279	51.67	192	35.56	69	12.78
36. Turn, using face plate	427	79.07	97	17.96	16	2.96
37. Turn a spherical surface	387	71.67	141	26.11	12	2.22
38. Turn, using steady rest	469	86.85	68	12.59	3	.56
39. Turn, using dummy centers	368	68.15	137	25.37	35	6.48
40. Turn pieces held with clamps	366	67.78	161	29.81	13	2.41
41. Mill grooves	295	54.63	243	45.00	2	.37

The number of different operations performed by the individuals in the sample ranges from 1 to 41, the mean is 30.50, and the associated standard deviation is 9.58. The majority of individuals (65.19 percent) performed 30 or more different operations (see table 11). Over 13.8 percent performed 40 or 41 operations. Only 8.7 percent performed less than 15 operations.

TABLE 11.--Number of 41 Different Operations Performed.

Operations	Individuals Number	Individuals Percentage	Operations	Individuals Number	Individuals Percentage
Less than 4	6	1.11	25 to 29	61	11.30
5 to 9	21	3.89	30 to 34	113	20.93
10 to 14	20	3.70	35 to 39	164	30.37
15 to 19	34	6.30	40 or 41	75	13.89
20 to 24	46	8.52			
			Total	540	100.01

4.2.2 Difficulty of Operations Performed

As the operations in SENAI's analytical table were arranged in order of increasing difficulty, it was possible to construct an index which reflected differences in the degree of difficulty of the operation performed on the job. The operations were numbered consecutively from 1 to 41, one corresponding to the least difficult operation and 41 to the most difficult. The number of the most difficult operation performed determined the rank on the difficulty scale. Results are presented in table 12. Regardless of differences in the number of operations performed, over 93 percent perform at least one of the four most difficult operations. The lowest rank is 14, and mean rank on the scale is 39.4

TABLE 12.--Difficulty of Operations Performed (Scale of 1 to 41).

	Individuals			Individuals	
Rank	Number	Percentage	Rank	Number	Percentage
1	---	---	:	---	---
:	---	---	29	2	.37
14	8	1.48	:	---	---
:	---	---	35	2	.37
16	2	.37	36	9	1.67
:	---	---	37	8	1.48
18	1	.19	38	40	7.40
19	1	.19	39	54	10.00
:	---	---	40	114	21.00
23	1	.19	41	295	54.62
:	---	---			
27	3	.56	TOTAL	540	100.00

4.2.3 Present Work Situation Control (PWSC)

Factory Size.--The factories in which the individuals in the sample are employed range in size from one employee to over 2,000 employees. The smaller factories are generally small-scale job shops in which the primary business is either repair work for other small-scale enterprises, or specialized contract work for larger factories. The smallest are sometimes little more than workshops at the back of a house, employing only one or two lathes. The larger factories are as modern as any in the world.

They produce not only for the domestic market, but also for export. The sample contains workers from the full range of factories (see table 13).

TABLE 13.--Factory Size.

	Individuals in Sample	
Number of Employees	Number	Percentage
Less than 25	55	10.19
25 to 49	36	6.67
50 to 99	33	6.11
100 to 359	81	15.00
350 to 999	67	12.41
More than 1,000	268	49.63
Total	540	100.00

The sample's heavy concentration of workers from factories which employ more than 1,000 is consistent with the total employment picture in the ABC area. According to SENAI reports, factories with over 1,000 employees account for over 49 percent of the total number of industrial employees.[3]

Sector of work.--Over 69 percent of those in the sample are employed in the production sector of their firms (see table 14).

For convenience, the factories can be divided into three categories--small (less than 50 employees), medium (50 to 349 employees), and large (350 employees or more).

TABLE 14.--Factory Workers by Sectors.

Sector	Individuals	
	Number	Percentage
Production	375	69.44
Maintenance	165	30.56
Total	540	100.00

The percentage of individuals working in the maintenance sector is 20.88 percent in the small factories; 17.54 percent, medium; and 27.61 percent, large. The distinction between maintenance and production in the larger factories is clear. In the smaller factories there may be some shifting between sectors. When this was the case, the individual was asked the sector in which he most generally worked, and he was classified accordingly.

Type of lathe used.--Basically three different types of power metal lathes are used. The "modern" lathe is used most frequently. It is distinguished by a special, external gearbox which allows almost instantaneous changes in the speed of rotation and movement of the carriage. The second type of lathe is classified as old. It can perform the same basic operations as the modern lathe, however the external gearbox is missing. Any changes in the speed of rotation and movement of the carriage are accomplished by opening the machine and manually withdrawing one gear and replacing it with another. The final class of lathes has various highly specialized machines. Several vertical and hydroelectric lathes were encountered. These lathes are used for very specialized jobs and in some cases require two operators. The percentage of modern lathes in use was found to be high, 87.96 percent (see table 15). Old and special lathes accounted for 7.41

TABLE 15.--Type of Lathe Used.

	Individuals	
Lathe	Number	Percentage
Modern	475	87.96
Old	40	7.41
Special	15	2.88
Don't Know	10	1.85
Total	540	100.00

percent and 2.88 percent of the total sample, respectively. There were 10 cases in which the individual did not know what type of lathe he was using.

It is interesting to note that the modern lathes are not concentrated in the large factories. Using the small, medium, large size class scheme previously defined, the respective percentages of modern lathes in each class are 87 percent, 96 percent, and 85 percent. The special lathes, however, are concentrated in the large factories.

Entry level and years in factory.--Over 78 percent of the workers in the sample entered their present employment already classified as skilled lathe setter-operators (see table 16). Of the remaining 118 individuals, 93 entered as lathe operators but at a less than a skilled level, and 25 entered in occupations outside the area of lathe operation. It is rare than an individual is hired in his first job as a skilled worker, and most of the individuals in the sample are not presently employed in the factories where they received their first work experience in lathe operation. Over 55 percent of those in the sample have been employed in their present firm less than four full years. Two things are indicated: (1) the labor market for lathe setter-operators is very active, and (2) firms tend to place a higher value on lathe setter-operators who have work experience in other firms.

4.2.4 Initial Conditions (IC)

Age.--The individuals in the sample are young. The mean age is 30.7 years. Over 87 percent (472 individuals) are less than 40 years old (see table 17).

The most noticeable differences between the age distribution of the sample and the age distribution of all industrial employees in the State of São Paulo, occur in the less-than-20-years-old class and the more-than-50-years-old class. In both cases the sample percentage is

TABLE 16.--Entry Level and Years Working in Factory.

Years	Lathe Setter-Operator: Skilled #	%	Lathe Setter-Operator: Less than Skilled #	%	Other Occupation Area #	%	Total #	%
Less than 1	105	24.88	0		1	4.00	106	19.63
1 to 3	169	40.05	24	25.81	2	8.00	195	36.11
4 to 6	93	22.04	31	33.33	6	24.00	130	24.07
7 to 9	23	5.45	8	8.60	3	12.00	34	6.30
10 to 12	21	4.97	14	15.05	6	24.00	41	7.59
13 to 15	7	1.66	3	3.23	3	12.00	13	2.41
16 or more	4	.95	13	13.98	4	16.00	21	3.89
Total	422	100.00	93	100.00	25	100.00	540	100.00

significantly lower. The low number of workers under 20 could be explained by the time it takes to reach the skilled level. On the other hand, the older, qualified workers with many years of work experience might be found in supervisory positions. A definitive answer to the second question is beyond the scope of this study, but the first will be dealt with later.

Place of birth and place of primary education.--Over 78 percent of those in the sample were born in the State of São Paulo (see table 18). The comparable figure for all employees (industrial and commercial) is just under 69 percent. It was expected the sample would contain a higher

TABLE 17.--Age Distribution.

Age Group	(a) Sample		(b) All Industrial Employees (State of São Paulo--1970)	
	Number	Percentage	Number (Thousands)	Percentage
Less than 20	30	5.56	258.5	15.1
20 to 24	100	20.37	366.3	21.4
25 to 29	120	22.22	292.7	17.1
30 to 34	122	22.59	246.5	14.4
35 to 39	90	16.67	181.4	10.6
40 to 44	26	4.81	147.2	8.6
45 to 49	28	5.19	95.8	5.6
50 or more	14	2.59	123.2	7.2
Total	540	100.00	1,711.6	100.0

Source: Data for All Industrial Employees is from: Brazil, Ministério do Trabalho e Previdência Social, Departamento Nacional de Mão de Obra, Composição e distribuição de mão de obra--São Paulo (Rio de Janeiro: Departamento Nacional de Mão de Obra, 1972), p. 56.

percentage of individuals who were born, educated, and trained outside of São Paulo who immigrated to São Paulo due to the lack of job opportunities in their home states. This does not prove to be the case (see table 19). Although only 78 percent of those in the sample were born in the State of São Paulo, over 87 percent received their primary education there. In fact, of those born outside the state, almost 44 percent were educated in São Paulo. On the other hand, only four individuals (.74 percent of

TABLE 18.--Place of Birth.

	Sample		All Industrial and Commercial Employees (State of São Paulo--1970)	
	Number	Percentage	Number (Thousands)	Percentage
State of São Paulo	424	78.52	1,845.4	68.87
Southeast (excluding State of São Paulo	31	5.74	283.9	10.60
Extreme South	18	3.33	51.0	1.90
Central West	0		11.6	.43
Northeast	45	8.33	378.9	14.14
North	1	.19	11.0	.41
Other Country	21	2.89	97.7	3.65
Total	540	100.00	2,679.5	100.00

TABLE 19.--Place of Birth and Place of Primary Education.

Birth / Primary School	Greater São Paulo (city)	Interior of São Paulo (rest of state)	Other State	Other Country	Total
Greater São Paulo (city)	197				197
Interior of São Paulo (rest of state)	96	127	4		227
Other State	36	4	55		95
Other Country	8	3	1	9	21
Total	337	134	60	9	540

the sample) were born in São Paulo and educated elsewhere. It is also interesting that only 197 individuals (36.48%) were born in the greater São Paulo area, however, 337 individuals (62.41%) received their education there.

Educational level of parents.--Over 61 percent of those in the sample have at least one parent with a complete four-year primary education (see table 20).

For Brazil this is an extremely high figure. According to data published in the 1970 Brazilian Demographic Census, less than 27 percent of the total population of 30 years of age and older has a complete primary education.[4] On the other hand, approximately 14 percent of the sample had parents who had no formal education. In general, the educational levels of the parents must be considered relatively high.

Occupational area of father.--As stated in Chapter III, the occupational classifications used in this study are based on the 1968 edition of the International Standard Classification of Occupations published by the International Labour Office. Reviewing briefly, the specific occupation under study is lathe setter-operator (8-33.20); related occupations are considered to be blacksmiths, toolmakers and machine-tool operators (8-3) and machinery fitters, machine assemblers and precision instrument makers (except electrical) (8-4); construction refers to bricklayers, carpenters, and other construction workers (9-5); other

TABLE 20.--Educational Levels of Parents.

Father / Mother	No Formal Education	Primary Incomplete	Primary Complete	More than Primary Compete	Total
No Formal Education	78	4	10	1	93
Primary Incomplete	44	83	20	1	148
Primary Complete	42	31	181	1	255
More than Primary Complete	2	2	16	10	30
Total	166	120	227	13	526

Note: There were 14 individuals who did not know the educational level of at least one parent.

industrial occupations are considered to be all remaining occupations in production and related workers, transport equipment operators and labourers (major group 7/8/9); other refers to all occupations not classified within major group 7/8/9.

Over 51 percent of the sample had fathers who had industrial occupations (see table 21). Less than 18 percent

TABLE 21.--Occupational Area of Father.

	Individuals	
	Number	Percentage
Lathe Operation	15	2.78
Related to Lathe Operation	20	3.70
Other Industrial (not construction)	172	31.85
Construction	71	13.15
Agriculture	93	17.22
Other	141	26.11
Unknown	28	5.19
Total	540	100.00

had fathers who worked in agricultural occupations. According to 1970 census results, about 17 percent of the economically active population is employed in the industrial sector. Some 20 or 30 years ago this percentage was certainly less. The data suggest that having a father who worked in an industrial occupation gives an individual a higher probability of becoming an industrial worker.

<u>Occupational status of father</u>.--The lowest level of occupational status is associated with unskilled manual workers. Over 63 percent of the sample had fathers who had occupations which ranked above the non-skilled level (see table 22). Further, over 39 percent had fathers at or above the skilled worker level.

TABLE 22.--Occupational Status of Father.

Status Scale	Number	Percentage
1. White collar and higher	51	9.44
2. Supervision of manual workers	36	6.67
3. Skilled worker	124	22.96
4. Semi-skilled worker	130	24.07
5. Unskilled worker	171	31.67
Unknown	28	5.19
Total	540	100.00

4.2.5 <u>Formal Education</u>

In the total sample of 540 individuals, only 32 individuals (5.93 percent) do not have at least a complete four-year primary education (see table 23). A majority (59.63 percent) have completed, but not studied beyond the primary level. Of those who do have some secondary education, 66.67 percent were enrolled in standard academic programs, and 6.45 percent were enrolled in job-oriented business or commercial programs. The remaining 26.88

TABLE 23.--Formal Education, Grade and Program.

Highest Grade Completed	Primary	Secondary			Number	Percentage
		Academic	Industrial	Commercial		
1.	1				1	.19
2.	5				5	.93
3.	26				26	4.81
4.	322				322	59.63
5.		54	4	3	60	11.11
6.		25	8	4	37	6.85
7.		24	13	2	39	7.22
8.		13	18	1	32	5.93
9.		2	3	1	6	1.11
10.		4	4	0	8	1.48
11.		3	0	0	3	.56
12		0	0	1	1	.19
Total	354	124	50	12	540	
Percentage	65.56	22.96	9.26	2.22		100.00

percent (50 individuals) were enrolled in industrial middle and high school programs. In the total sample 9.26 percent received industrial training within the formal school system.

When compared to all employees (industrial and commercial) in the State of São Paulo, the sample differs in two respects (see table 24). First, the sample has a lower percentage of individuals with less than a complete primary education. In the general labor force there are many individuals who work at the unskilled level. It is expected that a large percentage of such individuals would not have a complete primary education. Second, the general labor force has a higher percentage of individuals with more than a complete middle school education. If the individuals in the sample had such high levels of formal education, they probably would be working in white collar occupations and not as skilled blue collar workers.

Very few individuals (37.04 percent) at any level completed their formal education in the "normal" time of one calendar year for each grade (see table 25). It was not possible to separate those individuals who were not passed at various levels from those who simply dropped out of school and then later returned. It is known, however, that 23.6 percent of the sample finished their formal education after they had already taken regular, full-time employment. If the number of extra years to complete a grade are taken as a measure of effort, then those in the

TABLE 24.--Formal Education Levels.

	Sample		All Employees (State of São Paulo-1970)	
	Number	Percentage	Number* (Thousands)	Percentage
No formal education	---	---	25.8	1.4
Primary School				
Incomplete	32	5.92	295.3	16.0
Complete	322	59.63	954.1	51.7
Middle School				
Incomplete	123	22.97	208.5	11.3
Complete	45	8.33	118.1	6.4
High School				
Incomplete	14	2.59	66.4	3.6
Complete	4	.74	108.9	5.9
University	0	0.00	68.3	3.7
Total	540	100.00	1,845.4	100.00

*Estimated.

Source: Data for all employees is from: Brazil, Ministério do Trabalho e Previdência Social, Departamento Nacional de Mão de Obra, Composição e distribuição de mão de obra--São Paulo (Rio de Janeiro: Departamento Nacional de Mao de Obra, 1972), p. 92.

TABLE 25.--Years Required to Complete Highest Grade of Formal Education.

Highest Grade Completed	Number	Extra Years Required to Complete Highest Grade						Percentage Requiring at Least One Extra Year
		0	1	2	3	4-5	6 or more	
1	1	1						0.00
2	5	4		1				20.00
3	26	8	6	6	4	2		69.23
4	322	170	89	35	19	4	5	47.20
5	60	7	13	11	9	13	7	88.33
6	37	2	6	12	5	4	8	94.59
7	39	4	10	3	7	8	7	89.74
8	32	2	7	5	9	4	5	93.75
9	6		1		1	1	3	100.00
10	8	1	5	1	1			87.50
11	3	1				1	1	66.67
12	1						1	100.00
Total	540	200	137	74	55	37	37	
Percentage	100.00	37.04	25.37	13.70	10.19	6.85	6.85	

sample have expended a great deal of effort in obtaining their formal educations.

As noted in Chapter I, a special program (madureza) offers adults the opportunity to complete a four-year academic middle school program or three-year high school program in one year. Based on the effort expended to obtain a regular formal school degree, it was expected that many in the sample would have completed or be in the process of completing such special programs. Again, this did not prove to be the case (see table 26). Over 92.5 percent of those in the sample have had no contact with these special programs. Of the 14 who have completed the middle school program, four are presently enrolled in the high school program. A total of 25 are presently enrolled in the middle school program, and one individual is enrolled in the high school program who did not complete the middle school program. No one has completed the high school program.

TABLE 26.--Special Program Equivalents for Middle and High School (Madureza).

Middle School \ High School	Completed Program	Completing Program	Never Enrolled	Total
Completed Program	0	4	10	14
Completing Program	0	0	25	25
Never Enrolled	0	1	500	501
Total	0	5	535	540

4.2.6 Work Experience

The mean age at which those in the sample first started working in regular, full-time jobs for a fixed salary is 14.29 years. The associated standard deviation is 2.12 years. Over 21 percent started their work lives before the age of 14; and by the age of 18, 95.75 percent had started working.

The majority (over 83 percent) started working in industrial occupations (see table 27). The percentages starting in agricultural or other occupational areas are 8.15 percent and 8.33 percent, respectively. A large percentage (39.63 percent) started directly in the area of lathe operation.

TABLE 27.--Occupational Area of First Job.

	Individuals	
Area of First Job	Number	Percentage
Lathe Operation	214	39.63
Related to Lathe Operation	85	15.74
Other Industrial Occupation	152	28.15
Agriculture	44	8.15
Other	45	8.33
Total	540	100.00

Of the 326 individuals who started outside the area of lathe operation, 41.1 percent either started in an area related to lathe operation or had work experience related to lathe operation (table 28). Another 47.11 percent either started in other industrial occupations or had such experience before entering the occupational area under study. In total, only 37 individuals came directly from agriculture or other occupations to the area of lathe operation.

The time span between the first job and the first job in lathe operation varies greatly in the sample (see table 29). Over 10 percent of those in the sample had more than nine years of work experience before entering the area of lathe operation. The combinations of type of work experience and years of work experience are extremely varied and there are no readily visible patterns.

The mean age at which the first job in the area of lathe operation was begun was 17.28 years. The associated standard deviation was 3.98 years. The percentage younger than 14 was 3.52 percent. The majority (60.74 percent) entered between the ages of 14 and 17. By age 21, 86.67 percent of the total sample had entered the area of lathe operation.

There are three possible skill levels of entry into the area of lathe operation. The first is as an apprentice or helper. The second is as a semi-skilled worker who can operate a lathe, but must have a skilled worker set up the

TABLE 28.--Occupational Area of First Job and Work Experience Before Entering Area of Lathe Operation.

First Job	Total	Work Experience Before Entering Area of Lathe Operation: Related to Lathe Operation	Other Industrial Occupation	Agriculture	Other
Related to Lathe Operation	85	85			
Other Industrial Occupations	152	24	(128)		
Agriculture	44	14	14	(16)	
Other	45	11	13	0	(21)
Total	326	134	155	16	21
Percentage	100.00	41.10	47.11	4.90	6.44

TABLE 29.--Type and Years of Work Experience Before Entering Area of Lathe Operation.

Type of Work Experience	Years of Work Experience						
	0	1-2	3-4	5-6	7-8	9 or more	Total
LO	214						214
RLO		47	25	6	1	6	85
OTH IND → RLO		3	4	6	6	5	24
OTH → RLO		0	8	1	2	14	25
OTH IND		67	26	18	8	9	128
OTH → OTH IND		3	5	3	2	14	27
OTH		13	5	3	5	11	37
Total	214	133	73	37	24	59	540

Note: LO--started in lathe operation; RLO--started in area related to lathe operation; OTH IND → RLO--started in other industrial occupation but had experience related to lathe operation; OTH → RLO--started on other occupation but had experience related to lathe operation; OTH IND--started in other industrial occupation and went directly to lathe operation; OTH → OTH IND--started in other occupation, had other industrial experience, then entered lathe operation; OTH--started in other occupation and went directly to lathe operation.

job for him. He usually does repetitive work using automatic lathes. The third level is as a fully skilled worker, capable of reading designs, setting up the lathe and executing the job. Only 36 individuals (6.67 percent) entered as skilled lathe operators (see table 30). The majority (74.26 percent) entered at the learning level. The mean number of years from entry into the area of lathe

TABLE 30.--Entry Level Into Area of Lathe Operation.

Level	Individuals: Number	Individuals: Percentage
Learning	401	74.26
Semi-skilled	103	19.07
Skilled	36	6.67
Total	540	100.00

operation until the qualified level was reached is 3.93. The standard deviation, however, is 2.87 years. The range is from 0 to 21 years. Leaving the area of lathe operation is not a significant factor in explaining these great variations, since only 3.15 percent of those in the sample ever left the area.

The mean age at which the skilled level was reached is 21.20 years; the standard deviation is 4.22 years; and the range is from age 15 to 45. Only 2.41 percent of the total sample left the area of lathe operation after the skilled level was attained.

The number of years those in the sample have been working as skilled lathe operators ranges from less than 1 to 41 years. The mean number of years is 9.53 and the standard deviation is 7.61 years. Less than 20 percent have been at the skilled level for over 15 years (see table 31). The entire distribution is skewed toward the lower levels.

TABLE 31.--Years Working as Skilled Lathe Setter-Operator.

Years	Individuals	
	Number	Percentage
Less than 1	24	4.44
1 to 3	107	19.82
4 to 6	98	18.15
7 to 9	86	15.92
10 to 12	62	11.48
13 to 15	59	10.93
15 to 18	39	7.22
19 to 21	21	3.89
More than 21	44	8.51
Total	540	100.00

4.2.7 Training Experience

SENAI apprenticeship program.--Prior to the study it was expected that over 60 percent of the skilled metal lathe operators in the ABC area would have gone through a three-year SENAI apprenticeship program. In the sample drawn for this study, the percentage was just under 27.6 percent (see table 32). There is no readily available standard by which to judge if this figure is high or low. Certainly it shows that the SENAI apprenticeship program has made a significant contribution to the development of this occupation. SENAI officials thought it had done more.

TABLE 32.--SENAI Apprenticeship.

SENAI Apprenticeship	Individuals	
	Number	Percentage
None	391	72.41
Lathe Operation		
Complete	125	23.15
Incomplete	13	2.41
Other		
Complete	9	1.66
Incomplete	2	.37
Total	540	100.00

Of the 149 who took SENAI's apprenticeship courses 137 took them in the Greater São Paulo area, four were taken in the interior of the state, and only eight were taken outside the State of São Paulo.

The first SENAI apprenticeship course was started in 1942, and one individual in the sample was part of that first group of students (see table 33).

Courses.--Training experience through special courses is numerically an important component in the development of the skilled workers in the sample. Over 68 percent of the sample have taken at least one specialized course (see table 34). Of the 171 without special courses, 86 have had special training through the SENAI apprenticeship program and 23 have been enrolled in industrial middle

TABLE 33.--SENAI Apprenticeship by Year.

Year	Number	Year	Number	Year	Number
1942	0	1952	10	1962	6
1943	1	1953	5	1963	7
1944	0	1954	7	1964	5
1945	1	1955	10	1965	3
1946	2	1956	4	1966	4
1947	0	1957	5	1967	10
1948	4	1958	6	1968	7
1949	2	1959	5	1969	13
1950	6	1960	9	1970	4
1951	8	1961	4	1971	1
Total					149

TABLE 34.--Number of Special Courses Taken.

Number of Courses Taken	Individuals		Courses	
	Number	Percentage	Number	Percentage
None	171	31.67		
One	219	40.56	219	38.69
Two	103	19.07	206	36.40
Three	47	8.70	141	24.91
Total	540	100.00	566	100.00

school programs. As the net result, only 62 individuals, 11.48 percent of the sample, have become skilled lathe setter-operators purely on the basis of work experience. All the remaining 88.52 percent have had their work experience supplemented by some form of special industrial training.

The types of courses taken are divided into four categories. First, there are courses specifically designed for teaching the operation of lathes. There are generally two parts to the course--theory and practice. The theoretical or classroom portion deals with such things as mathematics, design reading, precision measurements. The practical or shop work part is concerned directly with the development of lathe use skills. Though the division of time between classroom and shop varies, all courses in lathe operation have both components. Over 35 percent of those in the sample had at least one course in lathe operation (see table 35).

The second category is courses in mechanical design. The emphasis is placed on reading and interpretation. To some degree these courses are like the theoretical parts of the lathe operation courses. They differ because they are not restricted directly to the area of lathe operation and cover the area of design in more depth. Over 34 percent of the sample had at least one course specifically devoted to the study of mechanical design.

The third category consists of courses related to lathe operation. Any course on the cutting, grinding, or

TABLE 35.--Types of Courses Taken.

Types of Courses Taken	Individuals	
	Number	Percentage
Lathe Operation (only)	99	26.83
Lathe Operation + Design	39	10.57
Lathe Operation + Design + (Related to Lathe Operation or Other)	20	5.42
Lathe Operation + (Related to Lathe Operation or Other)	35	9.49
Design (only)	99	26.83
Design + (Related to Lathe Operation or Other)	30	8.13
Related to Lathe Operation + Other	3	.81
Related to Lathe Operation (only)	23	6.23
Other (only)	21	5.69
Total	369	100.00

shaping of precision metal tools or parts is included. Examples are courses in the use of power saws, power drills, shapers, milling machines, and grinding machines. The structure of the course is similar to that of the courses in lathe operation.

The final category is labeled "other" and includes industrial courses not directly related to lathe operations, as well as small numbers of courses not specifically industrial.

The percentage of courses originating from SENAI was found to be 31.6 percent (see table 36). As with the

TABLE 36.--Courses, By Sponsor and Type.

	Type								Type	
Sponsor	Lathe Operation		Design		Related to Lathe Operation		Other		Number	%
SENAI	77		43		35		24		179	31.6
Private	102		143		34		31		310	54.8
Public	21		12		9		1		43	7.6
Other	7		7		0		20		34	6.0
	N	%	N	%	N	%	N	%		
Total	207	36.6	205	36.2	78	13.8	76	13.4	566	100.0

SENAI apprenticeship program, this figure was much lower than expected. Most unexpected of all was the high percentage of courses sponsored by private industrial schools, 54.8 percent. There simply was no indication or expectation that private schools would be providing 1.7 times the number of courses as SENAI. Public schools, the industrial middle schools, supplied 7.6 percent of the training courses. Within the "other" category, 13 courses were sponsored by factories and the remaining 21 were sponsored by various religious groups and a few unidentified organizations.

Private school courses are not a recent phenomenon (see table 37). The first private course taken by an individual in the sample was in 1942, the same year SENAI was founded. The largest number of private courses are encountered after 1960. The private courses have existed for a long time, and they are important in terms of the total training experience system. The individual student generally pays for the private course, while SENAI courses are given free of charge to the student.

The variation of duration among courses is great (see table 38). The total number of hours planned per course ranges from 48 to over 5,000, and the time spans over which the courses are taught range from one month to over five years. For example, over 48.9 percent of private school courses in design are planned for over 1,000 hours. Only 9.3 percent of the SENAI design courses, on the other hand, are planned for over 1,000 hours. The determination

TABLE 37.--Courses by Year and Sponsor.

Year	Sponsor				Total Number
	SENAI	Private	Public	Other	
1941			1		1
1942		1	2	1	4
1943	2	1			3
1944		2	3		5
1945		1	1		2
1946	1		1		2
1947		1	1		2
1948	1	2		1	4
1949	1	2	2		5
1950	1	2			3
1951	3	4			7
1952	4	2	1		7
1953	2	4		1	7
1954	4	4	1	2	11
1955	3	5	2		10
1956	7	7		1	15
1957	4	8	2		14
1958	6	6	6		18
1959	4	8	2		14
1960	3	15		3	21
1961	1	14	2	2	19
1962	11	22		1	34
1963	7	25	2	5	39

TABLE 37.--Continued.

Year	Sponsor				Total Number
	SENAI	Private	Public	Other	
1964	6	24	1	5	36
1965	10	16	2		28
1966	9	23	2	3	37
1967	12	21	3	4	40
1968	11	24	3		38
1969	13	24		1	38
1970	19	17	1	2	39
1971	11	10	1		22
1972	16	4			20
1973	6	12	1	2	21
Total					566

as to whether or not these time differences are significant in explaining the quality of work performed is left to a future section.

Of those who have taken more than once course, 42.67 percent have taken their courses from different sponsors (see table 39). The remaining 57.33 percent have taken each of their courses from the same sponsor. Particularly interesting is the SENAI (only) case; the number of individuals having more than one course (36) is almost as great as the number having one course (38). In other words, almost 50 percent of those who have taken a SENAI

TABLE 38.--Courses, by Type, Sponsor, and Total Hours Planned.

Type and Sponsor	Total Hours Planned for Course									Courses	
	Less than 100	100-199	200-299	300-399	400-499	500-599	600-749	750-999	1,000 or more	Number	Percentage
Lathe Operation											
SENAI	3	9	15	9	12	6	16	4	3	77	13.60
Private	1	6	7	11	14	27	6	15	15	102	18.02
Public	0	1	0	0	1	0	2	2	15	21	3.71
Other	0	0	3	0	1	1	0	0	2	7	1.24
Design											
SENAI	3	11	11	3	5	0	4	2	4	43	7.60
Private	1	4	5	5	8	19	7	24	70	143	25.26
Public	0	0	0	0	0	1	0	2	9	12	2.12
Other	2	2	1	0	0	0	1	0	1	7	1.24
Related to Lathe Operation											
SENAI	1	10	6	3	6	3	2	1	3	35	6.18
Private	0	2	4	1	5	6	2	4	10	34	6.01
Public	0	0	3	1	0	0	0	0	5	9	1.59
Other	0	0	0	0	0	0	0	0	0	0	
Other											
SENAI	8	4	8	0	0	0	0	2	2	24	4.24
Private	0	8	9	4	2	1	1	4	2	31	5.48
Public	0	1	0	0	0	0	0	0	0	1	.18
Other	6	3	2	2	2	0	1	0	4	20	3.53
Total	25	61	74	39	56	64	42	60	145	566	100.00
Percentage	4.42	10.78	13.07	6.89	9.89	11.31	7.42	10.60	25.62	100.00	

TABLE 39.--Sponsors of Courses Taken.

Sponsors of Courses Taken	Individuals	
	Number	Percentage
SENAI (only)	74	20.05
SENAI + Private	37	10.03
SENAI + Private + (Public or Other)	6	1.63
SENAI + (Public or other)	5	1.36
Private (only)	190	51.49
Private + (Public or other)	16	4.34
Public (only)	25	6.78
Other (only)	16	4.34
Total	369	100.00

course have taken more than one. Of the total number of individuals who had at least one course (369), 33.06 percent had at least one SENAI course, and 67.48 percent had at least one private school course.

4.3 Learning Paths

At a highly aggregated level, four basic learning paths have been taken to reach the skilled occupational level. A complete four-year primary education seems to be a necessary base for the development of specific industrial skills. This level of formal education is common to all four paths. The distinguishing feature of each path is the major type of industrial learning experience after primary school is completed. The four paths are:

1. <u>SENAI</u>--those who have been enrolled in a SENAI apprenticeship program.

2. <u>Industrial School</u>--those who have not been enrolled in a SENAI apprenticeship program but have attended a formal industrial middle school.

3. <u>Courses</u>--those who have neither been enrolled in a SENAI apprenticeship program nor attended a formal industrial middle school, but who have taken part-time industrial training courses.

4. <u>Work</u>--those who have no specific industrial training (neither SENAI, industrial middle school, nor training courses) and developed their industrial skills through work experience only.

In the sample of 540 individuals, 149 (27.6 percent) have taken the SENAI apprenticeship training path, and 41 (7.6 percent) have taken the industrial school path. The majority, 288 (53.3 percent) have taken the courses path. Only 62 individuals (11.5 percent) have reached the skilled occupational level without some form of special industrial training.

Those who have taken the SENAI path tend to be younger than those who have taken other paths. The mean age for the SENAI class is 28.48 years (see table 39). On the other hand, those who attended industrial middle schools tend to be older than the others; the mean age is 35.20. Within each path, however, there is a great deal of variation and, thus, the differences between cell means should be interpreted with care.

TABLE 40.--The Four Major Learning Paths.

Path	Individuals		Age	
	Number	Percentage	Mean	Standard Deviation
(1) SENAI	149	27.6	28.48	7.10
(2) Industrial School	41	7.6	35.20	9.79
(3) Courses	288	53.3	30.40	7.50
(4) Work	62	11.5	34.77	11.34
Total	540	100.0	30.74	8.39

The educational levels of the parents of the individuals who have followed different paths does not vary greatly (see table 41). There is a noticeably high percentage (58.5 percent) of industrial school path individuals whose mothers have a complete primary education. The mothers of individuals in the course and work paths are more likely to have had no formal education (34.5 and 43.3 percent, respectively). In general, however, the educational levels do not vary greatly from one path to another.

With respect to the occupational area of the father, the SENAI learning path has a relatively high percentage (57.1 percent) who worked in industrial occupations and a correspondingly low percentage (3.6) who worked in agricultural occupations.

TABLE 41.--Educational Levels of Parents by Learning Path (percentage distribution).

Educational Level	Path				Total
	SENAI	Industrial School	Courses	Work	
(a) Father					
No Formal Education	14.3	17.5	18.5	22.0	17.6
Primary Incomplete	34.7	22.5	27.0	20.3	28.1
Primary Complete	45.6	47.5	50.9	45.8	48.6
More than Complete Primary	5.4	12.5	3.6	11.9	5.7
Total	100.0	100.00	100.00	100.00	100.0
(b) Mother					
No Formal Education	25.7	24.4	34.5	43.3	32.3
Primary Incomplete	27.0	14.6	23.0	13.3	22.4
Primary Complete	44.6	58.5	40.8	38.3	42.9
More than Primary Complete	2.7	2.5	1.7	5.1	2.4
Total	100.0	100.0	100.00	100.00	100.0

TABLE 42.--Occupational Area of Father by Learning Path (percentage distribution).

Occupational Area	Path				Total
	SENAI	Industrial School	Courses	Work	
Industrial (not construction)	57.1	35.0	34.8	30.7	40.4
Construction	12.2	17.5	13.3	17.7	13.9
Agriculture	3.6	27.5	22.6	25.8	18.2
Other	27.1	20.0	29.3	25.8	27.5
Total	100.0	100.00	100.00	100.0	100.00

The SENAI path also has a relatively low percentage (19.3 percent) of fathers who were unskilled workers (see table 43). The data tend to indicate that having a father who works in the industrial sector at the semi-skilled level or higher gives the individual a somewhat higher probability of entering a SENAI apprenticeship program.

As was noted, the four major learning paths identified are distinguished from one another by the major type of industrial learning experience. When other types of learning are added to the basic paths, they become more difficult to distinguish. For example, 44.3 percent of those in the SENAI path have more than a complete four-year primary education (see table 44). This percentage is much higher than for the courses and work paths (23.6 and 17.8 percent, respectively). Thus, the SENAI path is not a "pure" path, i.e., four years of primary education followed

TABLE 43.--Occupational Level of Father by Learning Path (percentage distribution).

Occupational Level	Path SENAI	Industrial School	Courses	Work	Total
Unskilled	19.3	37.5	39.6	35.5	33.4
Semi-skilled	32.1	10.0	23.7	27.4	25.4
Skilled	30.7	30.0	20.4	22.6	24.2
Supervision of manual workers	7.9	10.0	6.7	4.8	7.0
White collar	10.0	12.5	9.6	9.7	10.0
Total	100.0	100.00	100.0	100.00	100.00

TABLE 44.--Educational Level by Learning Path (percentage distribution).

Educational Level	Path SENAI	Industrial School	Courses	Work	Total
Primary Incomplete	---	---	7.3	14.5	5.9
Primary Complete	55.7	---	69.1	67.7	59.6
More than Complete Primary	44.3	100.0	23.6	17.8	34.5
Total	100.00	100.0	100.0	100.0	100.00

by SENAI apprenticeship followed by work experience. The paths are even more complicated due to training courses (see table 45).

TABLE 45.--Number of Courses Taken by Learning Path (percentage distribution).

Number of Courses	Path: SENAI	Industrial School	Courses	Work	Total
None	57.7	56.1	---	---	31.7
One	27.5	29.3	57.6	---	40.5
Two	11.4	14.6	27.8	---	19.1
Three	3.4	---	14.6	---	8.7
Total	100.00	100.00	100.00	---	100.0

Over 42 percent of those who have SENAI apprenticeships have also taken short training courses--27.5 percent have taken only one course, 11.4 percent have taken two courses and 3.4 have taken three courses. Approximately 44 percent in the industrial school path also have taken at least one training course.

It is interesting that of those in the SENAI path who have had at least one course, over 71 percent took at least one course from a private industrial school (see table 45). Over 30 percent also took at least one course from SENAI. SENAI apprenticeship was followed by SENAI training courses. Those in the industrial school path have also taken courses from SENAI as well as private schools.

Table 46 shows that "pure" learning paths do not exist. The number of possible combinations of formal education, training, and work experience is extremely high. Simple cross tabulations are not suited to the type of analysis that is required to evaluate the effects of different types of learning. There are too many variables to handle and linear regression techniques are required. In Chapter V several linear regression models are used to evaluate the effects of different types of learning experiences.

TABLE 46.--Percentage Having at Least One Course From a Given Sponsor by Learning Path.

	Path				
Sponsor of Course	SENAI	Industrial School	Courses	Work	Total
SENAI	30.2	38.9	33.3	---	33.1
Private	71.4	72.2	66.3	---	67.5
Public	6.3	5.6	11.5	---	10.3
Other	9.5	---	8.3	---	8.1

Note: The table is interpreted as follows: For the first path (SENAI)--of those who have had at least one training course, 30.2 percent have had at least one course sponsored by SENAI, 71 percent have at least one course from a private school, etc.

FOOTNOTES--CHAPTER IV

[1]During the time of the fieldwork the minimum salary in São Paulo was Cr$312 (approximately US$50).

[2]Serviço Nacional de Aprendizagem Industrial (SENAI), Departamento Nacional, Manual do docente de tornearia (Rio de Janeiro: SENAI/DN, 1972).

[3]Serviço Nacional de Aprendizagem Industrial (SENAI), Departamento Regional de São Paulo, "Levantamento industrial 1972." (Unpublished internal document)

[4]Brazil, Ministério do Planejamento e Coordenação Geral, Fundação IBGE, Instituto Brasileiro de Estatística, Departamento de Censos, Censo demográfico Brasil, VIII recenseamento geral, 1970, V. I (Rio de Janeiro: Fundação IBGE, 1970)

CHAPTER V

THE ANALYSIS OF THE FINDINGS

5.1 Introduction

It was shown in Chapter IV that there is variation in hourly wage rates and in the number and difficulty of specific operations performed on the job by metal lathe setter-operators. In terms of the model developed in Chapter II, there is variation in the Present Work Situation (PWS) block of variables. Variation in the time taken to reach the skilled occupational level also was shown in Chapter IV. The primary objective of this chapter is to "explain" these variations. Linear regression analysis is used and the regression model is derived directly from the model presented in Chapter II.

$$Y_{PWSi} = \alpha + \sum_{j=1}^{J} \beta_{PWSCj} X_{PWSCji} + \sum_{k=1}^{K} \beta_{ICK} X_{ICKi} +$$

$$\sum_{l=1}^{L} \beta_{FEDl} X_{FEDli} + \sum_{m=1}^{M} \beta_{WEXm} X_{WEXmi} +$$

$$\sum_{n=1}^{N} \beta_{TEXn} X_{TEXni} + e_i; \; i=1,2,\ldots,Q. \quad (5.1)$$

where: Y represents a dependent variable selected from the Present Work Situation (PWS) block, the X's represent explanatory variables, and e represents the stochastic disturbance. The subscript i refers to the ith observation (individual) and the PWSC, IC, FED, WEX, and TEX subscripts refer to explanatory variables selected from the respective variable blocks of Present Work Situation Control, Initial Conditions, Formal Education, Work Experience, and Training Experience. The subscript associated with each summation sign refers to the number of explanatory variables in each block. The total number of explanatory variables is P, where $P=J+K+L+M$, and $P<Q$, where Q is the total number of observations.

The standard assumptions of the classical normal linear regression model are made with respect to all observations.[1]

The primary interest is in how four important variables are influenced by the explanatory variable in the regression model. The four variables are:

1. Wage per Hour (WA H)
2. Number of Operations Performed (OP DO)
3. Difficulty of Operations Performed (TOP OP)
4. Time Taken to Reach the Skilled Occupational Level (YRS AR LO-SLO)

A specific regression model for each of the four dependent variables is constructed using elements contained in the six variable blocks of the general model. The general form of each model may be represented as:

WA H (PWS, PWSC, IC, FED, WEX, TEX)

OP DO (PWSC, IC, FED, WEX, TEX)

TOP OP (PWSC, IC, FED, WEX, TEX)

YRS AR LO-SLO (IC, FED, WEX, TEX)

where: WA H, OP DO, TOP OP, and YRS AR LO-SLO refer to the four specific dependent variables, and PWS, PWSC, IC, FED, WEX, and TEX refer to the variable blocks used in the construction of each specific regression model.

The ultimate objective in each case is to identify and isolate the coefficients of those independent variables which are statistically significant. The level of statistical significance selected for all tests of hypotheses in this study is the .05 level. The words "significant" and "significantly" are to be interpreted as "statistically significant at the .05 level."

The first hypothesis to be tested is that none of the independent variables in any of the variable blocks has an influence on the dependent variable.

$$H_o: \beta_1 = \beta_2 = \beta_3 = \ldots = \beta_P = 0 \qquad (5.2)$$

where: P is the total number of explanatory variables in the model.

Rejection of this hypothesis would indicate that at least one of the independent variables in the complete model has a statistically significant influence on the dependent variable. The actual number of variables and the specific variable blocks of which they are a part is not indicated.

Second, a series of tests of hypotheses is performed to identify the specific variable blocks which contain variables which significantly influence the dependent variable. The hypotheses tested are:

$$H_o\text{: all } \beta_1 = 0$$

$$H_o\text{: all } \beta_2 = 0 \qquad (5.3)$$

$$\vdots$$

$$H_o\text{: all } \beta_D = 0$$

where: the subscript refers to the variable block, and D is the total number of variable blocks in the model.

Rejection of the hypothesis for a specific variable block would indicate the block contains at least one variable which has a statistically significant influence on the dependent variable. Failure to reject the hypothesis would imply there is no variable in the block which has a significant influence. To check this conclusion further, the hypothesis can be tested that a group of variable blocks taken together has no significant influence. Specifically, the hypothesis tested is:

$$H_o\text{: all } \beta_1 = \text{all } \beta_2 = \ldots = \text{all } \beta_C = 0 \qquad (5.4)$$

where: the subscript refers to a variable block for which the hypothesis concerning the block in isolation was not rejected, and C is equal to the total of such blocks.

The failure to reject the hypothesis would indicate that none of the blocks in question contain a variable which has a statistically significant influence on the dependent variable.

This procedure leads to the identification of a reduced regression model in which all remaining blocks of variables contain at least one variable which has a statistically significant influence on the dependent variable. Finally, a more detailed analysis is made of each variable in each remaining block.

The basic model from which all specific linear regression models are formed is presented in table 47. Both quantitative and qualitative variables are present. Qualitative variable classes are represented in each regression model by a set of binary variables where 1 indicates the presence of the designated characteristic and 0 indicates its absence. For example, in the Present Work Situation Control (PWSC) block, the variable "entry level into the factory" (ENT LVL F) is divided into three mutually exclusive categories: (a) skilled lathe setter-operator (SKL LSO), (b) area of lathe operation (AR LO), and (c) other area (OTH). A given observation may fall into one and only one category. The category into which the observation falls is coded 1. The remaining categories are coded 0.

When a set of such binary variables is used in a linear regression model, one class must be dropped to avoid singularity in the moments matrix of the regression. The β coefficient associated with the remaining binary variables should be interpreted as the estimated difference between the mean cell value of the omitted category and the mean cell value of the retained category, other things held

TABLE 47.--General Form of the Basic Regression Model.

Variable Block	Variable Description	Variable Name Code	Code*
PWS	Present Work Situation		
	wage per hour	WA H	c
	number of different operations performed	OP DO	c
	index of difficulty of operations	TOP OP	c
PWSC	Present Work Situation Control		
	years working in factory	YRS F	c
	level of entry into factory (ENT LVL F)		
	a. skilled lathe setter-operator	SKL LSO**	b
	b. in area of lathe operation	AR LO	b
	c. other area	OTH	b
	sector of work in factory (SECTOR F)		
	a. production	P**	b
	b. maintenance	M	b
	type of lathe used (LATHE F)		
	a. modern & don't know	MOD**	b
	b. other	OTH	b
	industrial group and size of factory (IND GP & SZ F)		
	a. 03 - small	03-S	b
	b. 03 - medium	03-M	b
	c. 03 - large	03-L	b
	d. 05 or 07 - small	05,7-S**	b
	e. 05 or 07 - medium	05,7-M	b
	f. 01, 11, or 13 - medium	OT-M	b
	g. 01, 11, or 13 - large	OT-L	b

TABLE 47.--Continued.

Variable Block	Variable Description	Variable Name Code	Code*
IC	Initial Conditions		
	age	AGE	c
	place of birth (PL BIRTH)		
	a. greater São Paulo	GSP	b
	b. interior of state of São Paulo	SPI	b
	c. other state	OTH ST	b
	d. other country	OTH C**	b
	place of primary education (PL PRI ED)		
	a. greater São Paulo	GSP	b
	b. interior of state of São Paulo	SPI	b
	c. other state or other country	OTH ST or C**	b
	educational level of father (ED FATHER)		
	a. no formal education	NONE**	b
	b. primary incomplete	PR INC	b
	c. primary complete	PR CPLT	b
	d. middle school incomplete or higher	MID+	b
	e. don't know	DN	b
	educational level of mother (ED MOTHER)		
	a. no formal education	NONE**	b
	b. primary incomplete	PR INC	b
	c. primary complete	PR CPLT	b
	d. middle school incomplete or higher	MID+	b
	e. don't know	DN	b
	occupational level of father (OC LVL FTHR)		
	a. white collar and above	WC+	b
	b. supervisor of manual workers	SUPR MN	b
	c. skilled	SKLD	b
	d. semi-skilled	S-SKLD	b
	e. unskilled or don't know	N-SKLD**	b

TABLE 47.--Continued.

Variable Block	Variable Description	Variable Name Code	Code*
	occupational area of father (OC AR FTHR)		
	a. industrial	IND	b
	b. agricultural	AG**	b
	c. other	OTH	b
	d. don't know	DN	b
FED	Formal Education		
	level and program (LVL-PR SCHL)		
	a. primary incomplete	PRI INC	b
	b. primary complete	PRI CPLT**	b
	c. academic or commercial middle school incomplete	M AC INC	b
	d. academic or commercial middle school complete and higher	M AC CPLT+	b
	e. industrial middle school incomplete	M IND INC	b
	f. industrial middle school complete or higher	M IND CPLT+	b
	effort to complete highest grade (EFRT SCHL)		
	a. normal time	NORMAL	b
	b. 1 year extra	+1	b
	c. 2 years extra	+2	b
	d. 3 years extra	+3	b
	e. 4 or 5 years extra	+4 or 5	b
	f. 6 or more years extra	+6+	b
	special formal education (SPECIAL SCHL)		
	a. none	NONE	b
	b. middle school program incomplete	M INC	b
	c. middle school program complete or high school incomplete	M CPLT+	b

TABLE 47.--Continued.

Variable Block	Variable Description	Variable Name Code	Code*
WEX	Work Experience		
	experience before entering the area of lathe operation (BFOR AR LO)		
	a. started in area	ST LO	b
	b. started in related area	ST RLO	b
	c. started in other industrial area, but had related experience	OI RLO	b
	d. started in other area, but had related experience	OTH RLO	b
	e. started in other industrial area, and no related experience	OI	b
	f. started in other area, but had industrial experience	OTH OI	b
	g. started in other occupation, and had no industrial experience	OTH**	b
	time span between first job and first job in area of lathe operation	YRS WK- AR LO	c
	time span between first job in area of lathe operation and first job as skilled lathe setter-operator	YRS AR LO-SLO	c
	years working as skilled lathe setter-operator	YRS SLO	c
TEX	Training Experience		
	total course hours completed	CRS HRS CPLT	c
	types of courses taken (CRS TYPE)		
	a. lathe operation	LO	b
	b. lathe operation, design	LO+D	b
	c. lathe operation, design, related or other	LO+D+	b

TABLE 47.--Continued.

Variable Block	Variable Description	Variable Name Code	Code*
	d. lathe operation, related or other	LO+	b
	e. design	D	b
	f. design, related or other	D+	b
	g. related and other	RLO+O	b
	h. no course or other	NCR-O**	b
	number of courses taken (NUMBER CRS)		
	a. 1 course	1	b
	b. 2 courses	2	b
	c. 3 courses	3	b
	d. no courses	NCR**	b
	sponsors of courses taken (CRS SPONSOR)		
	a. SENAI	SN	b
	b. SENAI, private	SN+PR	b
	c. SENAI, private, public or other	SN+PR+	b
	d. private	PR	b
	e. private, public or other	PR+	
	f. public	PUB	b
	g. no courses or other	NCR-O**	b
	SENAI apprenticeship (SENAI APR)		
	a. lathe operation complete	LO CPLT	b
	b. lathe operation incomplete	LO INC	b
	c. related to lathe operation complete	RLO CPLT	b
	d. related to lathe operation incomplete	RLO INC	b
	e. no SENAI apprenticeship	NONE**	b

*Variable Code--(c) continuous
(b) binary

**Omitted binary variables.

equal. β coefficients associated with quantitative variables should be interpreted as estimates of the response of the dependent variable to a one unit change in the independent variable.

5.2 Wage Per Hour

In Section 4.2.1 it was shown that hourly wage rates for the 540 skilled lathe setter-operators interviewed ranged from less than Cr$2 to over Cr$10. The mean was Cr$6.30, with an associated standard deviation of Cr$1.69. Noting that the occupation of lathe setter-operator is generally well defined and that the labor market area in which the study was conducted is relatively small, the basic objective is to discover why such large variation exists. Specifically, can the variation in wage per hour be "explained" in terms of what is done on the job (PWS), the conditions under which work takes place (PWSC), the origin of the individual (IC), the learning experiences to which the individual has been exposed (FED, WEX, and TEX), or some combination of these factors?

It was suspected that individuals who have been working as skilled lathe setter-operators for a long period might be different, in some respects, from those who have recently reached the skilled occupational level. Thus, the total sample was split into two subsamples. The first contains individuals (229) who have been working at the skilled occupational level for six or less years.

Individuals (311) who have been working at the skilled level for seven or more years are placed in the second subsample. Henceforth, these two subsamples are referred to as the Professionally Young and Professionally Old subsamples.

A "complete" regression model containing the variable blocks PWS, PWSC, IC, FED, WEX, and TEX was estimated for the total sample and the two subsamples. Estimated β coefficients, t values, and R^2's for the three regressions are presented in table 48.

The first hypothesis tested with respect to the total sample and the two subsamples is:

$$\beta_{PWS} = \beta_{PWSC} = \beta_{IC} = \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0 \qquad (5.5)$$

where: β_i, i = PWS, PWSC, IC, FED, WEX, TEX refer to the vectors of β coefficients for the variable blocks Present Work Situation, Present Work Situation Control, Initial Conditions, Formal Education, Work Experience, and Training Experience, respectively.

In other words, the hypothesis is that none of the variables in any of the variable blocks significantly influence the dependent variable, wage per hour (WA H). Summary statistics for the test on the total sample and on the two subsamples are presented in analysis of variance form (see table 49).

In each of the three cases the ratio of the variance explained by the regression to the unexplained variance (the F statistic) is sufficiently large to reject the hypothesis at the .05 level (see table 50).

TABLE 48.--Regression Analysis of Wage Per Hour for the Total Sample and Two Subsamples--Complete Model.

Variable Block	Variable	Total	Profes-sionally Young	Profes-sionally Old
	Constant	4.426 (4.326)	4.520 (2.814)	3.990 (2.739)
PWS	OP DO	.033 (4.003)	.032 (2.247)	.026 (2.489)
	TOP OP	- .019 (1.143)	- .037 (1.431)	.012 (.469)
PWSC	YRS F	.054 (3.613)	.047 (.998)	.032 (1.833)
	ENT LVL F			
	AR LO	- 1.051 (5.495)	- .734 (2.458)	- .093 (.254)
	OTH	- .172 (.541)	.633 (1.055)	- .127 (.257)
	SECTOR F			
	M	- .308 (2.319)	- .259 (1.185)	- .241 (1.378)
	LATHE F			
	OTH	- .021 (.100)	- .470 (1.467)	.514 (1.809)
	IND GP & SZ F			
	03-S	- .817 (2.400)	- .663 (1.399)	- .907 (1.597)
	03-M	- .446 (1.740)	- 1.038 (2.623)	.353 (.849)
	03-L	1.474 (7.291)	.896 (2.719)	1.473 (5.308)
	05,7-M	- .255 (1.025)	- .171 (.472)	- .465 (1.266)

TABLE 48.--Continued.

Variable Block	Variable	Sample: Total	Sample: Profes-sionally Young	Sample: Profes-sionally Old
	OT-M	- .145 (.473)	.105 (.252)	- .491 (1.040)
	OT-L	1.027 (5.080)	.918 (2.921)	.789 (2,730)
IC	AGE	- .031 (.873)	.038 (.652)	- .018 (.372)
	PL BIRTH			
	GSP	.363 (1.055)	- .771 (1.137)	.718 (1.708)
	SPI	.618 (1.809)	- .504 (.698)	.693 (1.711)
	OTH ST	.216 (.638)	- 1.203 (1.660)	.514 (1.279)
	PL PRI ED			
	GSP	- .286 (1.126)	- .575 (1.299)	- .167 (.498)
	SPI	- .473 (1.701)	- 1.028 (1.925)	- .164 (.472)
	ED FATHER			
	PR INC	.266 (1.340)	.210 (.679)	.226 (.852)
	PR CPLT	.305 (1.547)	.143 (.490)	.220 (.829)
	MID+	.379 (1.114)	.518 (.879)	.289 (.650)
	DN	- .373 (.785)	- .841 (1.110)	.049 (.071)

TABLE 48.--Continued.

Variable Block	Variable	Total	Profes-sionally Young	Profes-sionally Old
	ED MOTHER			
	PR INC	- .212 (1.187)	- .302 (1.053)	.005 (.020)
	PR CPLT	.000 (.002)	- .161 (.615)	.146 (.675)
	MID+	- .217 (.488)	- 1.466 (1.975)	.171 (.295)
	DN	.115 (.157)	1.272 (.929)	.276 (.264)
	OC LVL FTHR			
	WC+	- .482 (1.920)	- .215 (.525)	- .039 (.121)
	SUPR MN	- .024 (.088)	.321 (.674)	- .092 (.272)
	SKL D	- .068 (.348)	.348 (1.040	- .048 (.199)
	S-SKLD	- .094 (.556)	.466 (1.714)	- .167 (.779)
	OC AR FTHR			
	IND	- .108 (.489)	- .252 (.702)	- .285 (1.039)
	OTH	- .094 (.427)	- .155 (.429)	- .359 (1.273)
	DN	- .376 (1.141)	.237 (.451)	- .471 (1.109)
FED	LVL-PR SCHL			
	PRI INC	- .309 (1.216)	- .523 (1.018)	- .285 (.986)
	M AC INC	- .052 (.299)	.118 (.425)	- .047 (.210)

TABLE 48.--Continued.

Variable Block	Variable	Sample: Total	Sample: Professionally Young	Sample: Professionally Old
	M AC CPLT+	- .191 (.623)	.231 (.570)	.066 (.128)
	M IND INC	- .284 (.706)	- .032 (.043)	- .018 (.035)
	M IND CPLT+	.160 (.598)	.440 (.992)	.074 (.216)
	EFRT SCHL			
	+1	.114 (.769)	- .141 (.557)	.196 (1.034)
	+2	.353 (1.850)	.483 (1.516)	.297 (1.253)
	+3	.171 (.794)	.107 (.284)	.198 (.729)
	+4 or 5	- .223 (.858)	.383 (.926)	- .677 (1.837)
	+6+	.571 (2.038)	.567 (1.421)	.162 (.362)
	SPECIAL SCHL			
	M INC	- .051 (.187)	- .046 (.129)	.064 (.149)
	M CPLT+	- .275 (.797)	.062 (.115)	- .347 (.749)
WEX	BFOR AR LO			
	ST LO	.495 (1.799)	.413 (.980)	.476 (1.280)
	STR LO	.460 (1.611)	.406 (.907)	.401 (1.054)
	OI RLO	.726 (2.000)	.999 (1.658)	.585 (1.213)
	OTH RLO	.568 (1.574)	.515 (.977)	.753 (1.533)

TABLE 48.--Continued.

Variable Block	Variable	Sample: Total	Sample: Profes-sionally Young	Sample: Profes-sionally Old
	OI	.427 (1.628)	.523 (1.284)	.359 (1.006)
	OTH OI	1.067 (3.192)	1.191 (2.350)	.705 (1.504)
	YRS WK-AR LO	.014 (.408)	- .003 (.054)	- .020 (.445)
	YRS AR LO-SLO	.062 (1.677)	.034 (.594)	.026 (.507)
	YRS SLO	.087 (2.405)	.244 (3.095)	.033 (.669)
TEX	CRS HRS CPLT	.000 (.329)	.000 (.551)	.000 (.874)
	CRS TYPE			
	LO	- .286 (.859)	.262 (.482)	- .578 (1.319)
	LO + D	- .091 (.204)	.286 (.433)	- .573 (.902)
	LO + D +	.019 (.033)	.854 (1.050)	.163 (.208)
	LO +	- .153 (.346)	.287 (.426)	- .559 (.858)
	D	- .028 (.083)	- .118 (.218)	.278 (.640)
	D+	- .254 (.575)	.119 (.189)	.593 (.952)
	RLO +	- .347 (.875)	.524 (.853)	- 1.269 (2.322)

TABLE 48.--Continued.

Variable Block	Variable	Sample: Total	Sample: Professionally Young	Sample: Professionally Old
	NUMBER CRS			
	1	.350 (.870)	.584 (.565)	.161 (.350)
	2	.557 (1.125)	.826 (.721)	.647 (1.035)
	3	.418 (.714)	.618 (.510)	.444 (.573)
	CRS SPONSOR			
	SN	- .130 (.339)	- 1.194 (1.137)	.486 (1.127)
	SN + PR	.123 (.274)	- .703 (.647)	.194 (.362)
	SN + PR +	- .151 (.263)	- 1.049 (.822)	.107 (.158)
	PR	.074 (.205)	- .832 (.841)	.382 (.967)
	PR +	.020 (.041)	- .811 (.720)	.518 (.819)
	PUB	.005 (.012)	- 1.116 (1.006)	.673 (1.407)
	SENAI APR			
	LO CPLT	- .147 (.860)	.053 (.174)	- .246 (1.180)
	LO INC	- .659 (1.693)	- .582 (.917)	- .308 (.618)
	RLO CPLT	.447 (.956)	.860 (.848)	.412 (.792)
	RLO INC	2.000 (2.114)	.744 (.565)	3.697 (2.842)

TABLE 48.--Continued.

Variable Block	Variable	Total	Sample Profes-sionally Young	Profes-sionally Old
	R^2	.5496	.6530	.4782
	SEE	1.233	1.152	1.150

Note: Omitted binary variables are: PWSC--(ENT LVL F) SKL LSO, (SECTOR F) P, (LATHE F) MOD, (IND GP & SZ F) 05, 7 S; IC--(PL BIRTH) OTH C, (PL PRI ED) OTH ST OR C, (ED FATHER) NONE, (ED MOTHER) NONE, (OC LVL F) N SKLD, (OC AR FTHR) AG; FED--(LVL PR S) PRI INC, (EFRT SCHL) NORMAL; WEX--(BFOR AR LO) OTH; TEX--(CRS TYPE) NCR O, (NUMBER CRS) NCR, (CRS SPONSOR) NCR O, (SENAI APR) NONE. For variable descriptions see table 47 on page 122.

TABLE 49.--Analysis of Variance of Wage Per Hour for the Total Sample and Two Subsamples--Complete Model.

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F Value
		(a) Total Sample		
Explained	858.792	76	11.300	7.435
Error	703.696	463	1.520	
Total	1,562.487	539		
		(b) Professionally Young Subsample		
Explained	379.782	76	4.997	3.764
Error	201.821	152	1.328	
Total	581.603	228		
		(c) Professionally Old Subsample		
Explained	283.580	76	3.731	2.822
Error	309.399	234	1.322	
Total	592.979	310		

TABLE 50.--Test for Significance of the Regression Equation for Wage Per Hour for the Total Sample and Two Subsamples--Complete Model.

H_o: $\beta_{PWS} = \beta_{PWSC} = \beta_{IC} = \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0$

F Value	Degrees of Freedom	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
(a) Total Sample			
7.435	76/463	1.32	R
(b) Professionally Young Subsample			
3.764	76/152	1.37	R
(c) Professionally Old Subsample			
2.822	76/234	1.35	R

Thus, it is concluded that at least one explanatory variable in the complete model has a statistically significant influence on wage per hour (WA H).

The second hypothesis tested is that the two subsamples were drawn from the same population:[2]

$$\beta_{PWS1} = \beta_{PWS2},\ \beta_{PWSC1} = \beta_{PWSC2},\ \beta_{IC1} = \beta_{IC2},$$

$$\beta_{FED1} = \beta_{FED2},\ \beta_{WEX1} = \beta_{WEX2},\ \beta_{TEX1} = \beta_{TEX2} \quad (5.6)$$

where: the subscripts 1 and 2 refer to the Professionally Young and Professionally Old Subsamples, respectively; and β_i = PWS, PWSC, IC, FED, WEX, TEX which refers to the vector of β coefficients for the variable blocks Present Work Situation, Present Work Situation Control, Initial Conditions, Formal Education, Work Experience, and Training Experience, respectively.

The hypothesis was rejected at the .05 level (see table 51). It was concluded that the two subsamples (Professionally Young and Professionally Old) come from different populations and should be treated separately in further analysis.

TABLE 51.--Test of Hypothesis that Both Subsamples Come From the Same Population--Complete Model.

Ho: $\beta_{PWS1} = \beta_{PWS2}, \beta_{PWSC1} = \beta_{PWSC2}, \beta_{IC2} = \beta_{ICI}, \beta_{FED1} = \beta_{FED2}, \beta_{WEX1} = \beta_{WEX2}, \beta_{TEX1} = \beta_{TEX2}$

F Value	Degrees of Freedom	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
1.917	76/387	1.33	R

5.2.1 The Professionally Young Subsample

It was established earlier in this section that at least one explanatory variable in at least one of the variable blocks of the complete model has a statistically significant influence on the dependent variable, wage per hour (WA H). The objective here is to establish if more than one block contains a significant variable and, if so, to identify the block(s). The complete model (containing the variable blocks PWS, PWSC, IC, FED, WEX, and TEX) is estimated for the Professionally Young Subsample. Next, six reduced models (a different variable block dropped for each estimation) are estimated. Finally, a reduced model containing the variable blocks PWS, PWSC, and WEX (variable blocks IC, FED, and TEX dropped) is estimated. The results for these regressions are presented in the analysis of variance format (see table 52).

The hypothesis that each variable block taken individually contains no statistically significant variable is tested. Formally, a set of hypothesis tests is involved:

$$\begin{aligned} H_o&: \beta_{PWS} = 0 \\ H_o&: \beta_{PWSC} = 0 \\ H_o&: \beta_{IC} = 0 \\ H_o&: \beta_{FED} = 0 \\ H_o&: \beta_{WEX} = 0 \\ H_o&: \beta_{TEX} = 0 \end{aligned} \tag{5.7}$$

where: β_i, i=PWS, PWSC, IC, FED, WEX, and TEX refer to the vector of β coefficients associated with the variable blocks Present Work Situation, Present Work Situation Control, Initial Conditions, Formal Education, Work Experience, and Training Experience, respectively.

It was not possible to reject the hypotheses concerning Initial Conditions (IC), Formal Education (FED), and Training Experience (TEX) (see table 53). The hypotheses concerning Present Work Situation Control (PWSC), and Work Experience (WEX) were rejected at the .05 level. Further analysis indicated that the PWS block should be retained

TABLE 52.--Analysis of Variance of Wage Per Hour for the Professionally Young

TABLE 52.--Analysis of Variance of Wage Per Hour for the Professionally Young Subsample--Complete and Reduced Models.

Variable Blocks Included in Model	Source of Variation	Sum of Squares (SS)	Degrees of freedom (df)	Mean Square (MS)	f Value
	Explained	379.782	76	4.997	3.764
PWS PWSC IC FED WEX TEX	Error	201.821	152	1.328	
	Total	581.603			
	Explained	373.076	74	5.042	3.723
-- PWSC IC FED WEX TEX	Error	208.527	154	1.354	
	Total	581.603			
	Explained	299.177	65	4.603	2.656
PWS --- IC FED WEX TEX	Error	282.426	163	1.733	
	Total	581.603			
	Explained	354.919	55	6.453	4.925
PWS PWSC --- FED WEX TEX	Error	226.684	173	1.310	
	Total	581.603			
	Explained	363.956	64	5.687	4.285
PWS PWSC IC --- WEX TEX	Error	217.647	164	1.327	
	Total	581.603			
	Explained	353.468	67	5.276	3.723
PWS PWSC IC FED --- TEX	Error	228.135	161	1.417	
	Total	581.603			

TABLE 52.--Continued.

TABLE 52.--Continued.

Variable Blocks Included in Model	Source of Variation	Sum of Squares (SS)	Degrees of freedom (df)	Mean Square (MS)	f Value
	Explained	365.194	55	6.640	5.308
PWS PWSC IC FED WEX ---	Error	216.409	173	1.251	
	Total	581.603			
	Explained	321.021	22	14.592	11.535
PWS PWSC --- --- WEX ---	Error	260.582	206	1.265	
	Total	581.602			

TABLE 53.--Tests of Hypotheses in Individual Blocks of Variables for Wage Per Hour for the Professionally Young Subsample.

Null Hypothesis	F Value	Degrees of Freedom (df)	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
$\beta_{PWS} = 0$	2.5253	2/152	3.06	FR
$\beta_{PWSC} = 0$	5.5188	11/152	1.85	R
$\beta_{IC} = 0$	1.0850	21/152	1.64	FR
$\beta_{FED} = 0$	.9933	12/152	1.82	FR
$\beta_{WEX} = 0$	2.2020	9/152	1.94	R
$\beta_{TEX} = 0$	.5232	21/152	1.65	FR

and the model for the Professionally Young subsample should contain the three variable blocks, PWS, PWSC, and WEX. As a further check the following hypothesis is tested:

$$H_o: \beta_{IC} = \beta_{FED} = \beta_{TEX} = 0 \qquad (5.8)$$

where: β_i, i=IC, FED, TEX refer to the vector of β coefficients for the variable blocks Initial Conditions, Formal Education, and Training Experience, respectively.

This hypothesis could not be rejected at the .05 level (see table 54).

It was thus concluded that the regression model for the Professionally Young subsample should contain only the variable blocks Present Work Situation (PWS), Present Work Situation Control (PWSC), and Work Experience (WEX).

The reduced model containing PWS, PWSC, and WEX is estimated next. Results in analysis of variance format are given in table 52, and estimated β coefficients, t values, and R^2 are presented in table 55.

5.2.2 The Professionally Old Subsample

As with the Professionally Young subsample, it was established that at least one explanatory variable in at least one variable block of the complete model has a statistically significant influence on the dependent variable, wage per hour (WA H). In order to establish if more than one of the variable blocks contain a significant variable, the complete model (containing the variable blocks PWS, PWSC, IC, FED, WEX, and TEX) is estimated for the

TABLE 54.--Test of Hypothesis on Set of Three Blocks of Variables for Wage Per Hour for Professionally Young Subsample.

Null Hypothesis	F Value	Degrees of Freedom (df)	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
$\beta_{IC} = \beta_{FED} =$				
$\beta_{TEX} = 0$	.8195	54/152	1.44	FR

TABLE 55.--Regression Analysis of Wage Per Hour for the Professionally Young Subsample--Reduced Model.

Variable Block	Variable*	Estimated β Coefficient	t value (Absolute values)
	Constant	3.782	4.529
PWS	OP DO	.032	2.760
	TOP OP	- .031	1.484
PWSC	YRS F	.075	1.918
	ENT LVL F		
	AR LO	- .681	2.723
	OTH	.197	.407
	SECTOR F		
	M	- .241	1.301
	LATHE F		
	OTH	- .705	2.573
	IND GP & SZ F		
	03-S	- .780	2.100
	03-M	- .759	2.333
	03-L	1.077	4.144
	05,7-M	- .139	.447
	OT-M	.099	.282
	OT-L	1.053	4.319
WEX	BFOR AR LO		
	ST LO	.314	.913
	ST RLO	.405	1.118
	OI RLO	.769	1.571
	OTH RLO	.231	.514
	OI	.507	1.574
	OTH OI	1.017	2.336

TABLE 55.--Continued.

Variable Block	Variable*	Estimated β Coefficient	t value (Absolute Values)
	YRS WK-AR LO	.019	.746
	YRS AR LO-SLO	.031	1.071
	YRS SLO	.301	6.118
	R^2	.5520	
	SEE	1.125	

Note: Omitted binary variables are: PWSC--(ENT LVL F) SKL LSO, (SECTOR F) P (LATHE F) MOD, (IND GP & SZ F) 05, 7-S; WEX--(BFOR AR LO) OTH. For variable descriptions see table 47 on page 122.

Professionally Old subsample. Next, six reduced models (a different variable block dropped for each estimation) are estimated. Finally, a reduced model containing only the variable blocks PWS and PWSC (variable blocks IC, FED, WEX and TEX dropped) is estimated. Results are presented in analysis of variance format (see table 56).

A set of hypotheses that each variable block viewed individually contains no statistically significant explanatory variable is tested:

$$H_o: \beta_{PWS} = 0$$

$$H_o: \beta_{PWSC} = 0$$

$$H_o: \beta_{IC} = 0$$

$$H_o: \beta_{FED} = 0 \qquad (5.9)$$

TABLE 56.--Analysis of Variance of Wage Per Hour for the Professionally Old Sample--Complete and Reduced Models.

Variable Blocks Included in Model	Source of Variation	Sum of Squares (SS)	Degrees of freedom (df)	Mean Square (MS)	f Value
	Explained	283.580	76	3.731	2.822
PWS PWSC IC FED WEX TEX	Error	309.399	234	1.322	
	Total	592.979			
	Explained	272.474	74	3.682	2.711
--- PWSC IC FED WEX TEX	Error	320.505	236	1.358	
	Total	592.979			
	Explained	144.539	65	2.224	1.215
PWS --- IC FED WEX TEX	Error	448.440	245	1.830	
	Total	592.979			
	Explained	270.120	55	4.911	3.879
PWS PWSC --- FED WEX TEX	Error	322.859	255	1.266	
	Total	592.979			
	Explained	269.711	64	4.214	3.207
PWS PWSC IC --- WEX TEX	Error	323.268	246	1.314	
	Total	592.979			
	Explained	272.099	67	4.061	3.076
PWS PWSC IC FED --- TEX	Error	320.880	243	1.320	
	Total	592.979			

TABLE 56.--Continued.

Variable Blocks Included in Model	Source of Variation	Sum of Squares (SS)	Degrees of freedom (df)	Mean Square (MS)	f Value
	Explained	253.801	55	4.615	3.469
PWS PWSC IC FED WEX ---	Error	339.178	255	1.330	
	Total	592.979			
	Explained	229.590	22	10.436	8.271
PWS PWSC --- --- --- ---	Error	363.389	288	1.262	
	Total	592.979			

$$H_o: \beta_{WEX} = 0$$

$$H_o: \beta_{TEX} = 0$$

where: β_i, i=PWS, PWSC, IC, FED, WEX, and TEX refer to the vectors of β coefficients for the variable blocks Present Work Situation, Present Work Situation Control, Initial Conditions, Formal Education, Work Experience, and Training Experience, respectively.

The hypotheses concerning Initial Conditions (IC), Formal Education (FED), Work Experience (WEX), and Training Experience (TEX) were not rejected at the .05 level (see table 57).

The hypotheses concerning Present Work Situation (PWS), and Present Work Situation Control (PWSC) were rejected at the .05 level. Thus in the case of the Professionally Old subsample, the conclusion seems to be that the "proper" model contains only the variable blocks Present Work Situation (PWS) and Present Work Situation Control (PWSC). To gain further support for this conclusion the following hypothesis is tested:

$$H_o: \beta_{IC} = \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0 \qquad (5.10)$$

where: β_i, i=IC, FED, WEX, and TEX refer to the vectors of β coefficients for the variable blocks Initial Conditions, Formal Education, Work Experience, and Training Experience, respectively.

The hypotheses could not be rejected at the .05 level (see table 58), and it was therefore concluded that the regression model for the Professionally Old subsample properly contains only the variable blocks Present Work Situation (PWS) and Present Work Situation Control (PWSC).

TABLE 57.--Tests of Hypotheses on Individual Blocks of Variables for Wage Per Hour for the Professionally Old Subsample.

Null Hypothesis	F Value	Degrees of Freedom (df)	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
$\beta_{PWS} = 0$	4.1997	2/234	3.04	R
$\beta_{PWSC} = 0$	9.5599	11/234	1.83	R
$\beta_{IC} = 0$	.4848	21/234	1.62	FR
$\beta_{FED} = 0$	.8741	12/234	1.80	FR
$\beta_{WEX} = 0$	.9648	9/234	1.92	FR
$\beta_{TEX} = 0$	1.0725	21/234	1.62	FR

TABLE 58.--Test of Hypothesis on Set of Four Blocks of Variables for Wage Per Hour for Professionally Old Subsample.

Null Hypothesis	F Value	Degrees of Freedom (df)	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
$\beta_{IC} = \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0$	.8194	63/234	1.42	FR

The reduced model containing PWS and PWSC was estimated and the results are presented in analysis of variance format in table 56. Estimated β coefficients, t values, and R^2 are presented in table 59.

5.2.3 Summary--Wage Per Hour

Present Work Situation (PWS).--The Present Work Situation block has two variables: the number of different operations performed on the job (OP DO) and the degree of difficulty of the operations performed (TOP OP). The general hypothesis that all β coefficients assoicated with the PWS block were simultaneously equal to zero, was rejected at the .05 level for both the Professionally Young and the Professionally Old subsamples. For both subsamples the β coefficient associated with the variable OP DO is positive and significant at the .05 level (Young $\beta_{OP\ DO}$ = .032, Old $\beta_{OP\ DO}$ = .021). Other things equal, performing more operations on the job is positively associated with higher hourly wage rates. The β coefficient associated with the variable TOP OP is not statistically significant for either subsample.

Present Work Situation Control (PWSC).--There are two groups of variables in the Present Work Situation Control block. The first concerns the worker's history with respect to the present factor: how long he has been working in the factory (YRS F) and at what level he entered the factory (ENT LVL F). The second concerns the actual

TABLE 59.--Regression Analysis of Wage Per Hour for the Professionally Old Subsample--Reduced Model.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	Constant	5.306	6.796
PWS	OP DO	.021	2.166
	TOP OP	.007	.337
PWSC	YRS F	.035	2.586
	ENT LVL F		
	AR LO	- .225	.716
	OTH	.005	.012
	SECTOR F		
	M	- .222	1.489
	LATHE F		
	OTH	.461	1.898
	IND GP & SZ F		
	03-S	- 1.185	2.500
	03-M	.250	.743
	03-L	1.387	6.096
	05,7-M	- .620	1.980
	OT-M	- .629	1.563
	OT-L	.579	2.418
	R^2	.3631	
	SEE	1.128	

Note: Omitted binary variables are: PWSC--(ENT LVL F) SKL LSO, (SECTOR F) P, (LATHE F) MOD, (IND GP & SZ F) 05,7 S. For variable descriptions see table 47 on page 122.

conditions under which the individual presently works: the sector of the factory (SECTOR F), the type of lathe used (LATHE F), and the size and industrial group of the factory (IND GP & SZ F). The general hypothesis that all β coefficients associated with the PWSC block were equal to zero was rejected at the .05 level for both subsamples.

(a) The Professionally Young Subsample.--The number of years working in the factory (YRS F) is not statistically significant. However, the second history variable, level of entry (ENT LVL F), is significant. Specifically, in comparison to those who entered the factory as skilled lathe setter-operators (SKL LSO), those who entered in the area of lathe operation, but at less than the skilled level (AR LO) earn less per hour ($\beta_{AR\ LO} = -.681$). The difference is significant at the .05 level. The mean wage per hour of those who entered in an area outside lathe operation (OTH) cannot be shown to be statistically different from those in the SKL LSO category.

Though the mean wage rate for those working in the maintenance sector (M) is lower ($\beta_M = -.241$) than the mean wage rate for those in the production sector (M), the difference is not statistically significant. However, for those using old and special lathes (OTH), the mean hourly wage rate is lower ($\beta_{OTH} = -.705$) than for those using modern lathes (MOD-DN), and the difference is statistically significant.

The size and the industrial group of the factory in which the individual works is important in explaining variation in wate rates. Taking medium size factories (less than 50 employees) in the 05 and 07 subgroups (05, 7-S) as the base category, mean wage rates in large factories (over 350 employees) are higher (β_{03-L} = 1.077 and β_{OT-L} = 1.053) and the difference in the means is statistically significant. Mean wage rates for small and medium factories in the 03 subgroups are significant and lower (β_{03-S} = -.780 and β_{03-M} = -.759). Mean wage rates for the 05, 7-M and OT-M categories are not statistically different from the 05, 7-S category.

(b) The Professionally Old Subsample.--The number of years working in the factory (YRS F) is significant and positively associated with higher wage rates ($\beta_{YRS\ F}$ = .035). Differences in entry level (ENT LVL F) are, however, not statistically significant.

Differences in the sector of work (SECTOR F) and in the type of lathe used (LATHE F) are also not statistically significant. As with the Professionally Young subsample, differences in factory size and industrial group are important. Again using the small factories (less than 50 employees) in the 05 and 07 subgroups (05, 7-S) as the base, mean wage rates in large factories are higher (β_{03-L} = 1.387 and β_{OT-L} = .579) and the difference in the means is statistically significant. The mean wage rate for the 05, 7-M category is statistically significant and lower ($\beta_{05,7-M}$ = -.620). The means for the 03-M and 05,7-M categories are not statistically different from the means of the base category (05,7-S).

Initial Conditions (IC).--The hypothesis that all β coefficients associated with the IC block of variables are simultaneously equal to zero was not rejected for either subsample at the .05 level. Therefore, it is concluded that differences in age (AGE), place of birth (PL BIRTH), place of primary education (PL PRI ED) educational level of father (ED FATHER), educational level of mother (ED MOTHER), occupational level of father (OC LVL FTHR), and occupational area of father (OC AR FTHR) have no statistically significant influence on hourly wage rates.

Formal Education (FED).--The hypothesis that all β coefficients associated with the FED block of variables are simultaneously equal to zero was not rejected at the .05 level. Thus, it is concluded that differences in level and type of formal education (LVL-PR SCHL), the number of years taken to reach a given grade (EFRT SCHL), and the fact that an individual has or has not been exposed to the special rapid school program (SPECIAL SCHL), have no statistically significant influence on wage per hour. Mean wage rates for those having either more or less than a complete primary education are not statistically different from those who have a complete primary education but did not go beyond this level. Regardless of the type of post primary education (academic or industrial), and regardless of whether the post primary program was completed, mean wage rates are not statistically different.

Work Experience (WEX).--(a) The Professionally Young Subsample.--Those who started in agricultural or other non-industrial occupations and then had some industrial experience not related to lathe operation (OTH OI) have a higher mean wage rate ($\beta_{OTH\ OI}$ = 1.017) than those who entered directly from a non-industrial occupational area (OTH). The means of the other categories (ST LO, ST RLO, OT RLO, OTH RLO) are not statistically different from the mean of the OTH category. The β coefficients associated with the time spent working before entering the area of lathe operation (YRS WK - AR LO) and the time span between the first job in the area of lathe operation and the attainment of the skilled lathe setter-operator level (YRS AR LO-SLO) are also not statistically significant. However, the number of years that the individual has been working as a skilled lathe setter-operator (YRS SLO) does have a statistically significant positive influence on the dependent variable, wage per hour ($\beta_{YRS\ SLO}$ = .301).

(b) The Professionally Old Subsample.--The hypothesis that all of the β coefficients associated with the WEX block of explanatory variables are simultaneously equal to zero was not rejected at the .05 level of the

Professionally Old subsample. Thus it is concluded that for those who have been working as skilled lathe setter-operators for seven or more years, type and duration of previous work experiences have no statistically significant influence on wage per hour.

Training Experience (TEX).--The hypothesis that all β coefficients associated with the TEX block of variables are simultaneously equal to zero was not rejected at the .05 level for either the Professionally Young or the Professionally Old subsamples. There is no evidence to suggest that those having no courses (NONE) receive either higher or lower salaries than those with one, two, or three courses. Nor can it be established that types of courses taken (CRS TYP), or different sponsors for the courses (CRS SPONSOR), or the total hours of course work completed (CRS HRS CPLT) have a statistically significant influence on hourly wage rates. Further, the fact that an individual has or has not taken part in the SENAI apprenticeship program (SENAI APR) cannot be shown to have a statistically significant influence on hourly wage rates.

5.3 Number of Operations Performed (OP DO)

Section 4.2.1 presented the list of 41 different operations which skilled lathe setter-operators generally are considered to perform. For the total sample of 540 individuals, the mean number of operations performed on the job was 30.5 and the associated standard deviation was 9.58.

The number of operations performed (OP DO) was shown in Section 5.2 to have a positive and statistically significant influence on hourly wage rates. The objective in this section is to "explain" the variation in the number of operations performed. The linear regression model employed is the identical model used in the previous sections, except the Present Work Situation (PWS) block of explanatory variables is dropped. The general form of the model is thus:

OP DO (PWSC, IC, FED, WEX, TEX)

where: OP DO is the dependent variable, and PWSC, IC, FED, WEX, and TEX refer, respectively, to the variable blocks Present Work Situation Control, Initial Conditions, Formal Education, Work Experience, and Training Experience which are used in the construction of the complete model.

Estimated β coefficients, t values, and R^2 for the complete model are presented in table 60.

The first hypothesis tested is that no variable in any of the explanatory variable blocks has a statistically significant influence on the dependent variable, the number of operations performed (OP DO):

$$H_o: \beta_{PWSC} = \beta_{IC} = \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0 \qquad (5.11)$$

where: β_i, i=PWSC, IC, FED, WEX, and TEX refer to the vector of β coefficients for the variable blocks Present Work Situation Control, Inditial Conditions, Formal Education, Work Experience, and Training Experience, respectively.

Summary statistics for the test of this hypothesis are given in table 61.

TABLE 60.--Regression Analysis of Number of Operations Performed--Complete Model.

Variable Block	Variable*	Estimated β Coefficient	t value (Absolute values)
	Constant	42.355	8.047
PWSC	YRS F	.183	1.857
	ENT LVL F		
	AR LO	- 1.221	.972
	OTH	- .541	.258
	SECTOR F		
	M	3.799	4.444
	LATHE F		
	OTH	- 8.352	6.397
	IND GP & SZ F		
	03-S	1.601	.716
	03-M	.648	.370
	03-L	2.024	1.536
	05,7-M	- 4.718	2.905
	OT-M	4.406	2.195
	OT-L	- 4.454	3.409
IC	AGE	- .315	1.345
	PL BIRTH		
	GSP	- 2.996	1.327
	SPI	- 2.978	1.330
	OTH ST	- 3.934	1.778
	PL PRI ED		
	GSP	.201	.121
	SPI	.616	.337
	ED FATHER		
	PR INC	- 1.559	1.197

TABLE 60.--Continued.

Variable Block	Variable*	Estimated β Coefficient	t value (Absolute values)
	PR CLPT	- 1.798	1.392
	MID+	- 1.051	.470
	DN	- 3.935	1.263
	ED MOTHER		
	PR INC	.196	.167
	PR CPLT	1.039	.952
	MID+	2,149	.734
	DN	- 9.269	1.948
	OC LVL FTHR		
	WC+	- .657	.399
	SUPR MN	- 1.062	.600
	SKLD	- .674	.525
	S-SKLD	- .947	.851
	OC AR FTHR		
	IND	- 3.211	2.233
	OTH	- 2.828	1.964
	DN	- 2.215	1.024
FED	LVL-PR SCHL		
	PRI INC	- .603	.361
	M AC INC	- .489	.430
	M AC CPLT+	2.440	1.219
	M IND INC	.275	.104
	M IND CPLT+	- 2.189	1.252

TABLE 60.--Continued.

Variable Block	Variable*	Estimated β Coefficient	t value (Absolute values)
	EFRT SCHL		
	+1	- .992	1.018
	+2	- .367	.299
	+3	- 1.616	1.147
	+4 or 5	.085	.049
	+6+	- 2.975	1.636
	SPECIAL SCHL		
	M INC	- .838	.471
	M CPLT+	- 2.528	1.116
WEX	BFOR AR LO		
	ST LO	1.671	.927
	ST RLO	1.412	.753
	OI RLO	2.880	1.209
	OTH RLO	- 3.924	1.659
	OI	1.044	.606
	OTH OI	- .439	.199
	YRS WK-AR LO	.136	.614
	YRS AR LO-SLO	.170	.698
	YRS SLO	.322	1.362
TEX	CRS HRS CPLT	.001	1.644
	CRS TYPE		
	LO	2.620	1.200
	LO + D	5.680	1.950
	LO + D +	9.036	2.481
	LO +	3.622	1.247

TABLE 60.--Continued.

Variable Block	Variable*	Estimated β Coefficient	t value (Absolute values)
	D	3.102	1.426
	D^+	3.984	1.376
	RLO^+	3.614	1.391
	NUMBER CRS		
	1	- 2.437	.923
	2	- 3.445	1.058
	3	- 5.985	1.556
	CRS SPONSOR		
	SN	- 1.687	.668
	SN + PR	- .916	.310
	SN + PR +	- .334	.089
	PR	- 1.609	.681
	PR +	- 1.324	.402
	PUB	- 2.396	.838
	SENAI APR		
	LO CPLT	1.109	.993
	LO INC	1.820	.713
	RLO CPLT	- 2.730	.891
	PLO INC	.746	.120
	R^2	.3817	
	SEE	8.108	

Note: Omitted binary variables are: PWSC--(ENT LVL F) SKL LSO, (SECTOR F) P, (LATHE F) MOD, (IND GP & SZ F) 05,7 S; IC--(PL BIRTH) OTH C, (PL PRI ED) OTH ST or C, (ED FATHER) NONE, (ED MOTHER) NONE, (OC LVL F) N SKLD, (OC AR FTHR) AG; FED--(LVL PR S) PRI INC, (EFRT SCHL) NORMAL; WEX--(BFOR AR LO) OTH; TEX--(CRS TYPE) NCR O, (NUMBER CRS) NCR, (CRS SPONSOR) NCR O, (SENAI APR) NONE. For variable descriptions see table 47 on page 122.

TABLE 61.--Analysis of Variance of Number of Operations Performed--Complete Model.

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F Statistic
Explain	18,870.630	74	255.009	3.879
Error	30,566.369	465	65.734	
Total	49,436.999	539		

The hypothesis was rejected at the .05 level (see table 62). It was thus concluded that at least one explanatory variable in one of the variable blocks significantly influenced the number of operations performed.

TABLE 62.--Test for Significance of the Regression Equation for Number of Operations Performed--Complete Model.

$$H_O: \beta_{PWSC} = \beta_{IC} = \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0$$

F Value	Degrees of Freedom (df)	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
3.879	74/465	1.32	R

To establish if more than one explanatory block has at least one statistically significant variable, a set of reduced models is estimated. The first set contains five reduced models. For each estimation, a different explanatory block of variables is dropped from the model. The sixth reduced model estimated contains only the Present Work Situation Control (PWSC) block of explanatory variables (the IC, FED, WEX, and TEX variable blocks were dropped). Results for the six reduced models and the complete model are presented in analysis of variance format in table 63.

A set of five hypotheses that a given variable block contained no statistically significant variable is tested:

$$
\begin{aligned}
H_o&: \beta_{PWSC} = 0 \\
H_o&: \beta_{IC} = 0 \\
H_o&: \beta_{FED} = 0 \\
H_o&: \beta_{WEX} = 0 \\
H_o&: \beta_{TEX} = 0
\end{aligned}
\qquad (5.12)
$$

where: β_i, i=PWSC, IC, FED, WEX, and TEX refer to the vectors of β coefficients for the variable blocks Present Work Situation Control, Initial Conditions, Formal Education, Work Experience, and Training Experience, respectively.

At the .05 level of significance it was not possible to reject the hypotheses concerning the variable block Initial Conditions (IC), Formal Education (FED), Work Experience (WEX), and Training Experience (TEX). The hypothesis concerning the block Present Work Situation Control (PWSC) was rejected (see table 64).

These results suggest that the regression model should contain only the Present Work Situation Control (PWSC) block of explanatory variables. As a further check the following hypothesis was tested:

TABLE 63.--Analysis of Variance of Number of Operations Performed--Complete and Reduced Models.

Variable Blocks Included in Model	Source of Variation	Sum of Squares (SS)	Degrees of freedom (df)	Mean Square (MS)	f Value
	Explained	18,870.630	74	255.009	3.879
PWSC IC FED WEX TEX	Error	30,566.369	465	65.734	
	Total	49,436.999			
	Explained	6,971.512	63	110.659	1.240
--- IC FED WEX TEX	Error	42,465.486	476	89.213	
	Total	49,436.998			
	Explained	17,105.786	53	322.751	4.852
PWSC --- FED WEX TEX	Error	32,331.212	486	66.525	
	Total	49,436.998			
	Explained	18,219.367	62	293.861	4.490
PWSC IC --- WEX TEX	Error	31,217.631	477	65.446	
	Total	49,436.998			
	Explained	18,028.928	65	277.368	4.186
PWSC IC FED --- TEX	Error	31,408.070	474	66.262	
	Total	49,436.998			
	Explained	17,195.558	53	338.029	5.212
PWSC IC FED WEX ---	Error	31,521.440	486	64.859	
	Total	49,436.998			
	Explained	15,094.887	11	1,372.262	21.098
PWSC --- --- --- ---	Error	34,342.111	528	65.042	
	Total	49,436.998			

TABLE 64.--Tests of Hypotheses on Individual Blocks of Variables for Number of Operations Performed.

Null Hypothesis	F Value	Degrees of Freedom (df)	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
$\beta_{PWSC} = 0$	16.456	11/465	1.81	R
$\beta_{IC} = 0$	1.279	21/465	1.60	FR
$\beta_{FED} = 0$	.827	12/465	1.78	FR
$\beta_{WEX} = 0$	1.423	9/465	1.90	FR
$\beta_{TEX} = 0$	.612	21/465	1.60	FR

$$H_o: \beta_{IC} = \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0 \qquad (5.13)$$

where: β_i, i=IC, FED, WEX, and TEX refer to the vectors of β coefficients for the variable blocks Initial Conditions, Formal Education, Work Experience, and Training Experience, respectively.

The hypothesis was not rejected at the .05 level (see table 65). It is thus concluded that the regression model for number of operations performed (OP DO) is the reduced model containing only the variable block Present Work Situation Control (PWSC). Estimated β coefficients, t values, and R^2 for this reduced model are presented in table 66).

5.3.1 Summary

There is no evidence to suggest that differences in Initial Conditions (IC), Formal Education (FED), Work Experience (WEX), and Training Experience (TEX) significantly influence the number of operations performed on the job (OP DO). There are, however, variables within the Present Work Situation Control block (PWSC) which are statistically significant.

The length of time working in the factory (YRS F) is significant and positively associated with the number of operations performed ($\beta_{YRS\ F} = .183$). Differences in mean cell values for factory entry level (ENT LVL F) are not statistically significant. Both the sector of work (SECTOR F) and the type of lathe used (LATHE F) significantly influence the number of operations performed. The

TABLE 65.--Test of Hypothesis on Set of Four Blocks of Variables for Number of Operations Performed.

Null Hypothesis	F Value	Degrees of Freedom (df)	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
$\beta_{IC} = \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0$	.9117	63/465	1.38	FR

TABLE 66.--Regression Analysis of Number of Operations Performed--Reduced Model.

Variable Block	Variable	Estimated β Coefficient	t-value (Absolute values)
	Constant	30.527	29.680
PWSC	YRS F	.183	2.425
	ENT LVL F		
	AR LO	- 1.187	1.181
	OTH	- 2.456	1.379
	SECTOR F		
	M	4.038	5.132
	LATHE F		
	OTH	- 8.873	7.295
	INC GP & SZ F		
	03-S	.929	.457
	03-M	.841	.519
	03-L	2.132	1.822
	05,7-M	- 4.491	2.960
	OT-M	3.896	2.092
	OT-L	- 4.948	4.217
	R^2	.3053	
	SEE	8,065	

Note: Omitted binary variables are: PWSC--(ENT LVL F) SKL LSO, (SECTOR F) P, (LATHE F) MOD, (IND GP & SZ F) 05, 7 S. For variable descriptions see table 47, page 122.

mean number of operations performed in the maintenance sector (M) is higher than the mean for the production sector (P) (β_M = 4.038). On the average, individuals using old or specialized lathes (OTH) do fewer operations (β_{OTH} = -8.873) than those using the more common, modern type lathes. Differences in the size and industrial group of the factory (IND GP & SZ F) in some cases has a statistically significant influence on the number of operations performed. Regardless of size, the average number of operations performed in the 03 industrial group cannot be shown to be statistically different from the mean by the base category (05, 7-S). However, differences between the mean of the base category and the means of the 05,7-M, OT-M, and OT-L categories are significant. Both the 05,7-M and OT-L categories have lower means ($\beta_{05,7-M}$ = -4.491 and β_{OT-L} = -4.948). On the other hand, the mean cell value of the OT-M group is higher (β_{OT-M} = 3.896).

5.4 Difficulty of Operations Performed (TOP OP)

In Section 4.2.1 an index was developed for the degree of difficulty of the operations performed on the job. The index (TOP OP) was used as an explanatory variable in the Present Work Situation (PWS) block of the regression model employed in Section 5.2. It was shown that while the index (TOP OP) is positively associated with higher hourly wage rates, the relationship is not statistically significant. As constructed, the index has a range from 1 to 41. With respect to the total sample (540 individuals) the mean rank on the scale was 39.4 and the associated standard deviation was 4.3. The objective in this section is to "explain" the variation in the index (TOP OP). The regression model employed is identical to the model used in Section 5.3. The general form of the model is:

TOP OP (PWSC, IC, FED, WEX, TEX)

where: TOP OP is the dependent variable, and PWSC, IC, FED, WEX, and TEX refer respectively to the variable blocks, Present Work Situation Control, Initial Conditions, Formal Education, Work Experience, and Training Experience, which are used in the construction of the complete model.

Estimated β coefficients, t values, and R^2 for the complete model are presented in table 67.

The first hypothesis tested is that none of the explanatory variables in any of the variable blocks have a statistically significant influence on the dependent variable (TOP OP). The hypothesis tested is:

$$H_o: \beta_{PWSC} = \beta_{IC} = \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0 \qquad (5.14)$$

where: β_i, i=PWSC, IC, FED, WEX, and TEX refer to the vector of β coefficients associated with the variable blocks Present Work Situation Control, Initial Conditions, Formal Education, Work Experience, and Training Experience, respectively.

Summary statistics for the test are given in table 68.

TABLE 67.--Regression Analysis of Difficulty of Operations Performed--Complete Model.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	Constant	44.417	17.145
PWSC	YRS F	.046	.943
	ENT LVL F		
	AR LO	- .391	.632
	OTH	.162	.157
	SECTOR F		
	M	1.078	2.561
	LATHE F		
	OTH	- 1.590	2.474
	IND GP & SZ F		
	03-S	.061	.055
	03-M	- 1.392	1.613
	03-L	- .850	1.311
	05,7-M	- 1.462	1.829
	OT-M	.530	.536
	OT-L	- 2.370	3.686
IC	AGE	- .058	.502
	PL BIRTH		
	GSP	- 1.572	1.415
	SPI	- 1.793	1.627
	OTH ST	- 2.095	1.924
	PL PRI ED		
	GSP	.105	.127
	SPI	.499	.550
	ED FATHER		
	PR INC	.396	.619

TABLE 67.--Continued.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	PR CLPT	.011	.018
	MID+	.547	.497
	DN	- 2.519	1.643
	ED MOTHER		
	PR INC	- .431	.744
	PR CPLT	- .392	.730
	MID+	- .027	.019
	DN	- 10.011	4.274
	OC LVL FTHR		
	WC+	.397	.489
	SUPR MN	- .323	.371
	SKLD	.750	1.188
	S-SKLD	.352	.642
	OC AR FTHR		
	IND	- 1.591	2.248
	OTH	- .827	1.167
	DN	- .070	.066
FED	LVL PR SCHL		
	PRI INC	.698	.849
	M AC INC	.583	1.044
	M AC CPLT+	2.572	2.610
	M IND INC	2.071	1.595
	M INC CPLT+	.416	.483

TABLE 67.--Continued.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	EFRT SCHL		
	+1	- .253	.527
	+2	.165	.273
	+3	- 1.037	1.496
	+4 or 5	- .630	.748
	+6+	- 3.056	3.414
	SPECIAL SCHL		
	M INC	.453	.518
	M CPLT+	.242	.217
WEX	BFOR AR LO		
	ST LO	- .798	.900
	ST RLO	.292	.317
	OI RLO	1.667	1.422
	OTH RLO	- 1.406	1.207
	OI	- .118	.139
	OTH OI	.249	.230
	YRS WK-AR LO	- .116	1.058
	YRS AR LO-SLO	- .024	.202
	YRS SLO	.068	.589
TEX	CRS HRS CPLT	- .000	.327
	CR TYPE		
	LO	1.399	1.302
	LO + D	2.243	1.564
	LO + D +	2.047	1.142
	LO+	2.434	1.702

TABLE 67.--Continued.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	D	2.085	1.947
	D+	- .229	.161
	RLO+	1.631	1.276
	NUMBER CRS		
	1	- .505	.388
	2	- .951	.593
	3	- 1.631	.862
	CRS SPONSOR		
	SN	- .981	.789
	SN + PRIV	.220	.151
	SN + PRIV +	.698	.376
	PR	- 1.225	1.053
	PR+	.697	.429
	PUB	- .350	.249
	SENAI APR		
	LO CPLT	1.041	1.892
	LO INC	1.820	1.448
	RLO CPLT	.772	.512
	RLO INC	- 1.001	.327
	R^2	.2635	
	SEE	3.991	

Note: Omitted binary variables are: PWSC--(ENT LVL F) SKL LSO, (SECTOR F) P, (LATHE F) MOD, (IND GP & SZ F) 05,7-S; IC--(PL BIRTH) OTH C, (PL PRI ED) OTH ST or C, (ED FATHER) NONE, (ED MOTHER) NONE, (OC LVL F) N SKLD, (OC AR FTHR) AG; FED--(LVL PR S) PRI INC, (EFRT SCHL) NORMAL; WEX--(BFOR AR LO) OTH; TEX--(CRS TYPE) NCR O, (NUMBER CRS) NCR, (CRS SPONSOR) NCR O, (SENAI APR) NONE. For variable descriptions see table 47 on page 122.

TABLE 68.--Analysis of Variance of Difficulty of Operations Performed--Complete Model.

Source of Variations	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F Statistic
Explained	2,649.624	74	35.806	2.248
Error	7,405.709	465	15.926	
Total	10,055.333	539		

The hypothesis that none of the variables at any of the variable blocks has a significant influence on the dependent variable (TOP OP) is rejected at the .05 level (see table 68).

TABLE 69.--Test for Significance of the Regression Equation for Difficulty of Operations Performed--Complete Model.

$$H_o: \beta_{PWSC} = \beta_{IC} = \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0$$

F Value	Degrees of Freedom (df)	Critical Value of F at the .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
2.248	74/465	1.32	R

It was thus conluded that at least one variable block in the complete model contains a statistically significant variable. Next a set of reduced models is estimated to determine if more than one variable block contains a significant variable. The first set consists of five reduced models in which a different variable block is dropped from the model for each of the estimations. The sixth reduced model contained only the variable blocks Present Work Situation Control (PWSC) and Initial Conditions (IC). Summary results for the estimations of the complete model and the six reduced models are presented in table 70.

The specific set of hypotheses tested with respect to the individual variable blocks is:

$$\begin{aligned} H_o&: \beta_{PWSC} = 0 \\ H_o&: \beta_{IC} = 0 \\ H_o&: \beta_{FED} = 0 \\ H_o&: \beta_{WEX} = 0 \\ H_o&: \beta_{TEX} = 0 \end{aligned} \qquad (5.15)$$

where: β_i, i=PWSC, IC, FED, WEX, and TEX refer to the vectors of β coefficients for the variable blocks Present Work Situation Control, Initial Conditions, Formal Education, Work Experience, and Training Experience, respectively.

The hypotheses concerning the variable blocks Formal Education (FED), Work Experience (WEX) and Training Experience (TEX) are not rejected at the .05 level. However, the hypotheses concerning the variable blocks Present Work Situation Control (PWSC), and Initial Conditions (IC) are rejected (see table 71). The results of the tests suggest that the regression model contains only the variable blocks Present Work Situation Control (PWSC) and Initial Conditions (IC). As a further check the following hypothesis is tested:

TABLE 70.--Analysis of Variance of Difficulty of Operations Performed--Complete and Reduced Models.

Variable Blocks Included in Model	Source of Variation	Sum of Squares (SS)	Degrees of freedom (df)	Mean Square (MS)	f Value
PWSC IC FED WEX TEX	Explained	2,649.624	74	35.806	2.248
	Error	7,405.709	465	15.926	
	Total	10,055.333			
--- IC FED WEX TEX	Explained	1,905.309	63	30.243	1.766
	Error	8,150.024	476	17.122	
	Total	10,055.333			
PWSC --- FED WEX TEX	Explained	1,886.732	53	35.599	2.118
	Error	8,168.601	486	16.808	
	Total	10,055.333			
PWSC IC --- WEX TEX	Explained	2,343.947	62	37,806	2.339
	Error	7,711.386	477	16.166	
	Total	10,055.333			
PWSC IC FED --- TEX	Explained	2,380.435	65	36.622	2.262
	Error	7,674.898	474	16.192	
	Total	10,055.333			
PWSC IC FED WEX ---	Explained	2,332.621	53	44.012	2.770
	Error	7,722.712	486	15.890	
	Total	10,055.333			
PWSC IC --- --- ---	Explained	1,653.573	32	51.674	3.118
	Error	8,401.760	507	16.572	
	Total	10,055.333			

TABLE 71.--Tests of Hypotheses on Individual Blocks of Variables for Difficulty of Operations Performed.

Null Hypothesis	F Value	Degrees of Freedom (df)	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
$\beta_{PWSC} = 0$	4.249	11/465	1.81	R
$\beta_{IC} = 0$	2.281	21/465	1.60	R
$\beta_{FED} = 0$	1.599	12/465	1.78	FR
$\beta_{WEX} = 0$	1.878	9/465	1.90	FR
$\beta_{TEX} = 0$	.948	21/465	1.60	FR

$$H_o: \quad \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0 \tag{5.16}$$

where: β_i, i=FED, WEX, and TEX refer to the vectors of β coefficients for the variable blocks Formal Education, Work Experience, and Training Experience, respectively.

The hypothesis was rejected at the .05 level (see table 72). Further analysis indicated, however, that the regression model for the difficulty of operations performed (TOP OP) is the reduced model containing the variable blocks Present Work Situation Control (PWSC) and Initial Conditions (IC). Estimated β coefficients, t values, and R^2 for this reduced model are presented in table 73.

5.4.1 Summary

There is no evidence to suggest that differences in Formal Education (FED), Work Experience (WEX), and Training Experience (TEX) have a significant influence on the difficulty of operations performed (TOP OP). Within the Initial Conditions (IC) block there is one variable which is significant at the .05 level. The set of binary variables used to present different educational levels for the mother (ED MOTHER) contains the binary variable coded DN which represents the category for which the individual did not know the educational level of his mother. The mean cell value for this category is statistically different from the mean cell value of the base category NONE ($\beta_{DN} = -8.744$). This is the only variable within the IC block which is statistically significant.[3]

TABLE 72.--Test of Hypothesis on Set of Three Blocks of Dummy Variables for Difficulty of Operations Performed.

Null Hypothesis	F Value	Degrees of Freedom (df)	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
$\beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0$	1.489	42/465	1.45	R

TABLE 73.--Regression Analysis of Difficulty of Operations Performed--Reduced Model.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	Constant	42.024	24.785
PWSC	YRS F	.064	1.344
	ENT LVL F		
	AR LO	- .954	1.638
	OTH	- .818	.861
	SECTOR		
	M	1.082	2.679
	LATHE		
	OTH	- 2.063	3.291
	IND GP & SZ F		
	03-S	.344	.322
	03-M	- 1.203	1.437
	03-L	- .466	.763
	05,7-M	- 1.571	2.006
	OT-M	.350	.365
	OT-L	- 2.244	3.692
IC	AGE	- .023	.789
	PL BIRTH		
	GSP	- .852	.793
	SPI	- 1.039	.980
	OTH ST	- 1.861	1.741
	PL PRI ED		
	GSP	- .220	.286
	SPI	.009	.011

TABLE 73.--Continued.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	ED FATHER		
	PR INC	.763	1.212
	PR CLPT	.382	.616
	MID+	.589	.539
	DN	- 1.444	.973
	ED MOTHER		
	PR INC	- .322	.560
	PR CPLT	- .145	.274
	MID+	.461	.327
	DN	- 8.744	3.756
	OC LVL FTHR		
	WC+	.398	.510
	SUPR MN	- .152	.178
	SKLD	.663	1.075
	S-SKLD	.430	.804
	OC AR FTHR		
	IND	- .736	1.112
	OTH	- .049	.074
	DN	.710	.698
	R^2	.1644	
	SEE	4.071	

Note: Omitted binary variables are: PWSC--(ENT LVL F) SKL LSO, (SECTOR F) P, (LATHE F) MOD, (IND GP & SZ F) 05,7-S; IC--(PL BIRTH) OTH C, (PL PRI ED) OTH ST or C, (ED FATHER) NONE, (ED MOTHER) NONE, (OC LVL F) N SKLD, (OC AR FTHR) AG. For variable descriptions see table 47 on page 122.

The Present Work Situation Control (PWSC) block contains three sets of variables which have a statistically significant influence on the difficulty of operations performed (TOP OP); (SECTOR F), (LATHE F), and (IND OP & SZ F). On the average, those working in the maintenance sector (M) do more difficult operations than those working in the production sector ($\beta_M = 1.082$). The mean cell value for those using old and specialized lathes (OTH) is lower ($\beta_{OTH} = -2.063$) than for those using the common modern lathes. In some cases, differences in the size and industrial group of the factory also have a significant influence on the difficulty of operations performed. Using the 05,7-M class as the base, both the 05,7-M and OT-L classes have lower mean cell values ($\beta_{05,7-M} = 1.157$ and $\beta_{OT-L} = -2.244$) which are statistically significant. The remaining classes do not have cell means which are significantly different from the cell mean of the base category.

5.5 Years Taken to Reach Skilled Occupational Level (YRS AR LO-SLO)

The objective in this final section of Chapter V is to "explain" the variation in the time individuals take to reach the skilled occupational level (YRS AR LO-SLO). This time span is determined by two events in the work history of the individual. The first is his initial job in the area of lathe operation. Possible occupational titles for this first job are apprentice lathe operator, lathe operator's helper, operator of automatic lathe, operator of pre-set lathe, or skilled lathe setter-operator. The other event is his first job as a skilled lathe setter-operator. In only 16 cases did the two events coincide; that is, the first job in the area of lathe operation was as a skilled lathe setter-operator. The mean number of years taken to reach the skilled occupational level is 3.9 and the standard deviation is 2.9.

The general form of the regression model used is:[4]

$$\text{YRS AR LO-SLO (IC, FED, WEX, TEX)} \qquad (5.17)$$

where: YRS AR LO-SLO is the dependent variable, and IC FED, WEX, and TEX refer, respectively, to the variable blocks Initial Conditions, Formal Education, Work Experience, and Training Experience which are used in the construction of the complete model.

Estimated β coefficients, t values, and R^2 for the complete model are presented in table 74.

The first hypothesis tested is that none of the variables in any of the variable blocks has a statistically significant influence on the dependent variable (YR AR LO-SLO):

$$H_o: \beta_{IC} = \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0 \qquad (5.18)$$

where: β_i, i=IC, FED, WEX, and TEX refer to the vector of β coefficients for the variable blocks Initial Conditions, Formal Education, Work Experience, and Training Experience, respectively.

Summary statistics for the test are given in table 75.

TABLE 74.--Regression Analysis of Years Taken to Reach the Skilled Occupational Level--Complete Model.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	Constant	3.356	2.825
IC	AGE	.089	5.278
	PL BIRTH		
	GSP	- .920	1.295
	SPI	- 1.149	1.635
	OTH ST	- .526	.751
	PL PRI ED		
	GSP	.358	.693
	SPI	.798	1.391
	ED FATHER		
	PR INC	.721	1.757
	PR CLPT	.298	.741
	MID+	1.026	1.451
	DN	.501	.511
	ED MOTHER		
	PR INC	- .488	1.325
	PR CLPT	- .163	.476
	MID+	- 1.405	1.522
	DN	- 1.148	.763
	OC OVL FTHR		
	WC+	- 1.092	2.118
	SUPR MN	- .799	1.430
	SKLD	- .257	.631
	S-SKLD	- .390	1.097

TABLE 74.--Continued.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	OL AR FTHR		
	IND	.346	.767
	OTH	.267	.596
	DN	- .430	.628
FED	LVL-PR SCHL		
	PRI INC	.112	.214
	M AC INC	- .397	1.118
	M AC CPLT+	- 1.316	2.081
	M IND INC	- 2.654	3.207
	M IND CLPT+	- 3.306	6.319
	EFRT SCHL		
	+1	- .023	.076
	+2	- .666	1.722
	+3	- .441	.993
	+4 or 5	.030	.055
	+6+	.773	1.371
	SPECIAL SCHL		
	M INC	- .009	.016
	M CPLT+	- 1.656	2.322
WEX	BFOR AR LO		
	ST LO	- .249	.442
	ST RLO	- 1.801	3.120
	OI RLO	- 2.389	3.213
	OTH RLO	- 1.103	1.516

TABLE 74.--Continued.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	OI	- 1.055	1.967
	OTH OI	- .236	.342
	YRS WK-AR LO	- .148	3.746
TEX	CRS HRS CPLT	- .000	.070
	CRS TYPE		
	LO	- .563	.708
	LO + D	.385	.336
	LO + D +	2.954	1.664
	LO +	.667	.589
	D	.466	.576
	D +	1.227	.973
	RLO	.563	.578
	NUMBER CRS		
	1	.173	.167
	2	- .280	.212
	3	- 1.447	.873
	CRS SPONSOR		
	SN	- .175	.187
	SN + PR	1.057	.918
	SN + PR +	- 1.428	.755
	PR	- .161	.185
	PR +	- .163	.130
	PUB	- 1.213	1.213

TABLE 74.--Continued.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	SENAI APR		
	LO CLPT	.336	1.016
	LO INC	.440	.548
	RLO CLPT	- 1.620	1.681
	RLO INC	- .224	.116
	R^2	.2702	
	SEE	2.600	

Note: Omitted binary variables are: IC--(PL BIRTH) OTH C, (PL PRI ED) OTH ST or C, (ED FATHER) NONE, (ED MOTHER) NONE, (OC LVL F) N SKLD, (OC AR FTHR) AG; FED--(LVL PR S) PRI INC, (EFRT SCHL) NORMAL; WEX--(BFOR AR LO) OTH; TEX--(CRS TYPE) NCR O, (NUMBER CRS) NCR, (CRS SPONSOR) NCR O, (SENAI APR) NONE. For variable descriptions see table 47 on page 122.

TABLE 75.--Analysis of Variance of Years Taken to Reach Skilled Occupational Level--Complete Model.

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F Statistic
Explained	1,196.432	61	19.614	2.901
Error	3,232.033	478	6.762	
Total	4,428.465	539		

The hypothesis was rejected at the .05 level (see table 76). It was thus concluded that at least one variable in one of the variable blocks significantly influences the time taken to reach the skilled occupational level.

TABLE 76.--Test for Significance of the Regression Equation of Years Taken to Reach Skilled Occupational Level--Complete Model.

$$H_o: \beta_{IC} = \beta_{FED} = \beta_{WEX} = \beta_{TEX} = 0$$

F Value	Degrees of Freedom (df)	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
2.901	61/478	1.38	R

To establish if more than one explanatory block has at least one statistically significant variable, a set of four reduced models is estimated. For each estimation a different explanatory block of variables is dropped from the model. The fifth reduced model estimated contains only the variable blocks Initial Conditions (IC), Formal Education (FED), and Work Experience (WEX). Results of the estimation of the five reduced models are presented in analysis of variance format in table 77.

A set of four hypotheses that a given variable block contained no statistically significant variable are tested:

$$H_o: \beta_{IC} = 0$$

$$H_o: \beta_{FED} = 0$$

$$H_o: \beta_{WEX} = 0$$

$$H_o: \beta_{TEX} = 0$$

where: β_i, i=IC, FED, WEX, and TEX refer to the vectors of β coefficients for the variable blocks, Initial Conditions, Formal Education, Work Experience, and Training Experience, respectively.

At the .05 level of significance it is not possible to reject the hypothesis concerning the variable block Training Experience (TEX). The hypotheses concerning Initial Conditions (IC), Formal Education (FED) and Work Experience are rejected (see table 78).

It is thus concluded that the regression model for the time taken to reach the skilled occupational level (YR AR LO-SLO) should be the reduced model containing only the variable blocks Initial Conditions (IC), Formal Education (FED), and Work Experience (WEX). Estimated β coefficients, t values, and R^2 for this reduced model are presented in table 79.

TABLE 77.--Analysis of Variance of Years Taken to Reach Skilled Occupational Level--Complete and Reduced Models.

Variable Blocks Included in Model	Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F Value
	Explained	1,196.432	61	19.614	2.901
IC FED WEX TEX	Error	3,232.033	478	6.762	
	Total	4,428.465			
	Explained	862.767	40	21.569	3.019
--- FED WEX TEX	Error	3,565.698	799	7.146	
	Total	4,428.465			
	Explained	767.997	49	15.673	2.098
IC --- WEX TEX	Error	3,660.468	490	7.470	
	Total	4,428.465			
	Explained	819.396	54	15.174	2.039
IC FED --- TEX	Error	3,609.069	485	7.441	
	Total	4,428.465			
	Explained	1,018.026	40	25.451	3.724
IC FED WEX ---	Error	3,410.439	499	6.835	
	Total	4,428.465			

TABLE 78.--Tests of Hypotheses on Individual Blocks of Variables for Years Taken to Reach Skilled Occupational Level.

Null Hypothesis	F Value	Degrees of Freedom (df)	Critical Value of F at .05 Level	Hypothesis (FR) Fail to Reject (R) Reject
$\beta_{IC} = 0$	2.350	21/478	1.60	R
$\beta_{FED} = 0$	5.280	12/478	1.78	R
$\beta_{WEX} = 0$	7.966	7/478	1.96	R
$\beta_{TEX} = 0$	1.256	21/478	1.60	FR

TABLE 79.--Regression Analysis of Years Taken to Reach Skilled Occupational Level--Reduced Model.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	Constant	2.937	2.589
IC	AGE	.088	5.506
	PL BIRTH		
	GSP	- .764	1.099
	SPI	- .929	1.344
	OTH ST	- .445	.645
	PL PRI ED		
	GSP	.401	.792
	SPI	.711	1.267
	ED FATHER		
	PR INC	.802	1.991
	PR CLPT	.250	.633
	MID+	1.160	1.659
	DN	.772	.799
	ED MOTHER		
	PR INC	- .524	1.432
	PR CLPT	- .169	.499
	MID+	- 1.273	1.409
	DN	- 1.400	.935
	OC LVL FTHR		
	WC+	- .984	1.931
	SUPR MN	- .786	1.415
	SKLD	- .223	.553
	S-SKLD	- .273	.781

TABLE 79.--Continued.

Variable Block	Variable	Estimated β Coefficient	t value (Absolute values)
	OC AR FTHR		
	IND	.411	.919
	OTH	.215	.487
	DN	- .308	.453
FED	LVL PR SCHL		
	PRI INC	.275	.530
	M AC INC	- .149	.434
	M AC CLPT+	- 1.346	2.203
	M IND INC	- 2.626	3.183
	M IND CPLT+	- 3.066	5.977
	EFRT SCHOOL		
	+1	.015	.050
	+2	- .705	1.847
	+3	- .581	1.320
	+4 or 5	- .151	.284
	+6+	.672	1.216
	SPECIAL SCHL		
	M INC	.284	.512
	M CPLT+	- 1.419	2.009
WEX	BFOR AR LO		
	ST LO	.017	.030
	ST RLO	- 1.864	3.360
	OI RLO	- 2.188	3.041
	OTH RLO	- .876	1.245

TABLE 79.--Continued.

Variable Block	Variable	Estimated β Coefficient	t value (Abvolute values)
	OI	- .948	1.798
	OTH OI	- .312	.456
	YRS WK-AR LO	- .141	3.678
	R^2	.2299	
	SEE	2.614	

Note: Omitted binary variables are: IC--(PL BIRTH) OTH C, (PL PRI ED) OTH ST or C, (ED FATHER) NONE, (ED MOTHER) NONE, (OC LVL F) N SKLD, (OC AR FTHR) AG; FED--(LVL PR S) PRI INC, (EFRT SCHL) NORMAL; WEX--(BFOR AR LO) OTH. For variable descriptions see table 47 on page 122.

5.5.1 Summary

There is no evidence to suggest that differences in Training Experience (TEX) significantly influence the time taken to reach the skilled occupational level (YRS AR LO-SLO). Variables within the initial Conditions (IC), Formal Education (FED) and Work Experience (WEX) variable blocks are statistically significant.

The variable (AGE), which should be interpreted as a time trend variable in the present analysis, is statistically significant and positively related to the time taken to reach the skilled occupational level (β_{AGE} = .088). Other things equal, as one moves further into the past, more time was taken to reach the skilled occupational level. The second significant variable in the Initial Conditions (IC) block is the educational level of the father (ED FATHER). Within this set of dummy variables, the mean of the category primary incomplete (PR INC) is statistically different from the mean of the omitted category, no formal education (NONE), ($\beta_{PR\ INC}$ = .802). The cell means of the other categories in this set of dummy variables are not statistically different from the cell mean of the omitted category.

Variables within the Formal Education (FED) block are statistically significant. In the set of dummy variables for the level and program of school (LVL PR SCHL), the cell means for (1) academic middle school complete or higher (M AC CPLT$^+$), (2) industrial middel school imcomplete (M IND INC), and (3) industrial middle school complete or higher (M IND CPL$^+$) are significantly different from the cell mean of the omitted category, complete primary education (PRI CPLT). The respective β values are: $\beta_{M\ AC\ CPLT^+} = -1.346$, $\beta_{M\ IND\ INC} = -2.626$, and $\beta_{M\ IND\ CPLT^+} = -3.066$. This result for individuals who received industrial training within the formal school system was expected as they received their training before they entered the labor market. If the time spent in full-time industrial study were added to the work years taken to reach the skilled occupational level, these individuals would not be greatly different from those who did not have formal industrial school training. The case of those in the complete middle school or higher category (M AC CPLT$^+$) is different. Whether or not these individuals entered the labor force before they completed their formal academic educations, they reached the skilled industrial level more rapidly. The same is true for individuals who complete their middle school academic education through the special rapid (madureza) program. They reached the skilled level more quickly than those who did not complete the program ($\beta_{M\ CPLT^+} = -1.419$).

In the Work Experience (WEX) block, both the type of work experience before entering the area of lathe operation (BFOR AR LO) and the duration of this work experience (YRS WK - AR LO) have a significant influence on the time taken to reach the skilled occupational level (YRS AR LO - SLO). Compared to the mean cell value of the other type of work experience (OTH) omitted category, the mean cell values for those who started working directly in an area related to lathe operation (ST RLO) and those who started in some other industrial occupation and then had some work experience related to lathe operation (OI RLO) are lower, ($\beta_{ST\ RLO} = -1.864$) and ($\beta_{OI\ RLP} = -2.188$). Other things equal, individuals having these types of work experiences prior to entering the area of lathe operation become skilled lathe setter-operators more quickly. The longer the duration of the work experience before the area of lathe operation is entered, the more rapidly the skilled occupational level is reached ($\beta_{YRS\ WK\ -\ AR\ LO} = -.141$).

FOOTNOTES--CHAPTER V

[1]Jan Kmenta, Elements of Econometrics (New York: Macmillan Co., 1971), p. 202.

[2]The test used is generally referred to as a "Chow Test." See: Gregory C. Chow, "Tests of Equality Between Sets of Coefficients in Two Linear Regressions," Econometrica, 28, pp. 591-605.

[3]This result was considered to be odd and further investigations were made. Since the educational level of the father (ED FATHER) and the educational level of the mother (ED MOTHER) are correlated, a second set of regressions (for the complete and all reduced models) was run in which the set of binary variables for ED MOTHER was dropped from the Initial Conditions (IC) block. The results for all tests of hypotheses concerning blocks of variables was the same. The significant variable in the IC block was ED MOTHER - DN. In the total sample of 540 individuals, 10 did not know the educational level of their mother, six did not know that of the father and three who did not know the educational level of either. Though the variable ED LVL - DN may be statistically significant it cannot be regarded as "important."

[4]The variable block Initial Conditions (IC) is identical to blocks used in previous models. Formal Education (FED), Work Experience (WEX), and Training Experience (TEX) blocks have been adjusted to include only those learning experiences which took place prior to reaching the skilled occupational level.

CHAPTER VI

SUMMARY AND CONCLUSIONS

6.1 Objectives of the Study

This study of the development of skilled industrial labor in São Paulo, Brazil was undertaken with three basic objectives:

1. To establish the origin of the present skilled industrial workers.
2. To identify the types and sources of the training they received.
3. To evaluate the effects of differences in both origin and training on (1) wages received, (2) what is done on the job, and (3) the time taken to reach the skilled occupational level.

6.2 The Realization of the Study

The first step in the realization of the study was the construction of a model or conceptual frame. Six areas of information or blocks of variables were involved:

1. Present Work Situation
2. Present Work Situation Control
3. Initial Conditions
4. Formal Education

5. Work experience

6. Training experience

The model was used for two purposes. First, it was used to organize information in a useful manner and to serve as a general framework for the description of the entire system of industrial skill development. Second, it provided the basis for the development of several linear regression models. The regression models were used to estimate the effects of various factors on (1) wage per hour, (2) number of operations performed, (3) the difficulty of operations performed, and (4) the time taken to reach the skilled occupational level.

Basic information for the study was obtained through detailed interviews with 546 skilled lathe setter-operators who were employed in the "ABC" area of Greater São Paulo.

6.3 The Descriptive Findings

The most important simple descriptive findings of the study can be summarized. The format of presentation is based on the major informational areas of the general model used in the study.

6.3.1 Initial Conditions

1. The mean age for those studied is 30.7 years. Over 87 percent are less than 40 years old.

2. Approximately 78 percent were born in the State of São Paulo. Over 87 percent, however, received their primary education there.

3. Over 61 percent have at least one parent with a complete four-year primary education.

4. Over 51 percent have fathers who worked in industrial occupations.

5. More than 63 percent have fathers who were at least semi-skilled workers.

In general the skilled industrial workers studied had relatively high socio-economic starting points. Their parents were well educated in comparison to the general population. Most are second generation industrial workers (only 17 percent have fathers who worked in the agricultural sector). Also, most had fathers who worked at least at the semi-skilled level.

6.3.2 Formal Education

1. Over 94 percent have at least a complete four-year primary education.

2. About 33 percent went beyond the primary level.

3. Of those who did go beyond the primary level, 66.7 percent enrolled in academic programs, 6.4 percent in business oriented commercial programs, and 26.9 percent in industrial programs.

4. Only 9.3 percent of the total sample received industrial training at either the middle or high school levels of the formal school system.

5. Less than 8 percent have had contact with the special rapid middle and high school equivalency programs (madureza).

A complete four-year primary education seems to be a necessary base for the development of specific industrial skills.

6.3.3 Work Experience

1. Over 83 percent started their working lives in industrial occupations. Almost 40 percent started in the area of lathe operation. Few, 8 percent, started in the agricultural sector.

2. Over 74 percent entered the area of lathe operation at the "learning" level. About 19 percent entered at the semi-skilled level, and only 7 percent (36 individuals) entered at the skilled level.

3. Once the area of lathe operation was entered, less than 4 percent left for jobs in other occupational areas.

4. The mean age at which the skilled level was reached was 21.2 years.

5. The time taken to reach the skilled occupational level (the starting point being the first job in the area of lathe operation) ranged from 0 (see 2 above) to 21 years. The mean was 3.9 years.

In general there tends to be great variation in the type and especially the duration of work experience before the area of lathe operation is entered.

6.3.4 Training Experience

1. Only 28 percent had been enrolled in SENAI apprenticeship programs.

2. In the total sample, over 68 percent had taken at least one industrial training course. Of those who did not have a training course (32 percent) half had been enrolled in the SENAI apprenticeship program, and 13 percent had been enrolled in a formal school industrial program. Thus, in the total sample only 62 individuals (11.5 percent) reached the skilled occupational level without some form of special industrial training.

3. Over 54 percent of all the courses taken by the individuals in the sample were sponsored by private industrial schools. SENAI sponsored only 31 percent of the courses and public schools sponsored less than 8 percent.

4. The variation in the duration of the training courses was great, ranging from 48 hours to over 3,000 hours.

5. Private school courses have been offered at least since 1942, the year SENAI was founded.

Two findings are particularly significant. First, only 11.5 percent reached the skilled occupational level without some form of special industrial training, and second, the private schools have trained many more of the workers than SENAI. Private schools sponsored over 54 percent of the training courses, while SENAI sponsored only 31 percent. Further, of those who have taken at least one course, 66 percent have taken at least one private school course, while only 33 percent have taken at least one course from SENAI.

6.4 The Regression Analysis

Linear regression techniques were used to explain differences in four variables:

1. wage per hour
2. number of operations performed
3. difficulty of operations performed
4. time taken to reach the skilled occupational level

The most comprehensive regression model contained six blocks of variables:

1. Present Work Situation
   (a) number of operations performed
   (b) difficulty of operations performed
2. Present Work Situation Control
   (a) years working in firm
   (b) entry level in firm
   (c) industrial group and size of firm
   (d) sector of work
   (e) type of lathe used
3. Initial Conditions
   (a) age
   (b) place of birth
   (c) place of primary education
   (d) educational level of parents
   (e) occupational area of father
   (f) occupational level of father
4. Formal Education
   (a) level and program of formal school
   (b) effort to complete highest grade
   (c) special equivalency program (madureza)

5. Work Experience
   - (a) type and duration of work experience before entering the area of lathe operation
   - (b) years taken to reach skilled level
   - (c) years working at skilled level
6. Training Experience
   - (a) types of training courses
   - (b) sponsors of training courses
   - (c) hours of training courses completed
   - (d) SENAI apprenticeship

6.4.1 Wage Per Hour

There was great variation in hourly wage rates. The range was from less than Cr$2 to more than Cr$10. The mean hourly wage rate was Cr$6.30 and the associated standard deviation was Cr$1.69.

The linear regression model used to explain the variation in hourly wage rates contained six blocks of variables:

1. Present Work Situation
2. Present Work Situation Control
3. Initial Conditions
4. Formal Education
5. Work Experience
6. Training Experience

Differences in initial conditions, formal education, and training experience were not significant in explaining the variation in wage per hour. Initial conditions may have an influence on the occupational area that is entered and the type of learning experiences to which the individual is exposed; but after the skilled occupational level is reached, the effects of such differences are lost. There was no evidence to suggest that having more than a complete four-year primary education resulted in higher earnings. Regardless of the type of secondary education (academic or industrial), there was no statistically significant difference in earnings. Likewise, hourly wage rates were not significantly influenced by differences in training experience. It could not be established that SENAI apprenticeship graduates earn either more or less than those who did not have apprenticeship training. The hourly earnings of those who had private school training courses were not statistically different from those who took short-term SENAI training courses.

Work experience was found to influence hourly wage rates. The influence, however, is felt only in the early years of the professional work life. As the number of years working at the skilled level increases, the effects of prior work experience fade.

The two major factors which have an influence on hourly wage rates are: (1) the present work situation, what is done on the job; and (2) the present work situation control, the conditions under which work takes place. With respect to the present work situation, other things equal, the greater the number of operations performed on the job, the higher the hourly wage rate. Regardless of the stage of the professional work life, the size and industrial group in which the individual is employed has an influence on what is earned. Larger firms in general tend to pay more than smaller firms. The entry level into the firm and the type of lathe used have an influence early in the professional work life. This influence fades with time and the number of years that the worker has been employed in the firm begins to have a positive effect on wage rates.

In general, it does not seem to matter where the individual comes from, if he has more than a complete primary education, or what type of industrial training he receives. It is important only to obtain four years of primary education, take some type of industrial training course, and to start working as soon as possible. Once the skilled occupational level is reached, wage rates will be influenced primarily by the length of time working and the type of firm in which the individual is employed.

6.4.2 Number and Difficulty of Operations Performed

The number of different operations performed on the job ranged from 1 to 41. Over 65 percent performed more than 30 operations and approximately 9 percent performed less than 15. The mean number was 30.5 and the associated standard deviation was 9.6. As noted, there was a positive relationship between the number of operations performed and hourly wage rates.

The observed ranking on the index of the difficulty of the operations performed ranged from 14 to 41. Less than 7 percent ranked lower than 38 on the scale. The mean was 39.4 and the standard deviation was 4.3. Differences in rank did not influence hourly wage rates.

The regression models used to explain differences in what was done on the job (both number and difficulty of operation performed) contained five blocks of variables:

1. Present Work Situation Control
2. Initial Conditions
3. Formal Education
4. Work Experience
5. Training Experience

Initial conditions, formal education, work experience and training experience had no significant influence on what was done on the job. Only the present work situation control block contained variables that were statistically significant. There was a significant positive relationship between the number of operations performed and the length of time employed in the firm. Those working in the maintenance sector performed both a higher number of operations and more difficult operations than those working in production. Those using old and specialized lathes performed both fewer and less difficult operations than those using modern equipment. Workers in small and medium sized firms (less than 350 employees) performed more operations than those in large firms. The difficulty of the operations performed is also influenced by the size and industrial group of the firm. There is, however, no observable general pattern.

After the skilled occupational level is reached, differences in origin and learning experiences are not important. What is done on the job is determined by the conditions under which work takes place.

6.4.3 Years Taken to Reach the Skilled Occupational Level

The time taken to reach the skilled level was defined as the time span between the first job in the area of lathe operation and the first job as a skilled lathe setter-operator. The number of years taken to reach the skilled level ranged from 0 (36 individuals were hired in their first job in the area of lathe operation as skilled lathe setter-operators) to 21. The mean number of years was 3.9 and the associated standard deviation was 2.9.

The regression model used contained four blocks of variables:

1. Initial Conditions
2. Formal Education
3. Work Experience
4. Training Experience

Differences in training experience had no significant influence on the time taken to reach the skilled occupational level. It was not possible to establish that SENAI apprenticeship graduates reached the skilled level any more quickly than those who developed their skills through a combination of work experience and short courses. There was no statistical difference between private school courses and SENAI courses. Neither the form of the training (apprenticeship or course) nor the sponsor of the training (private or SENAI) was important in explaining the variation in time taken to reach the skilled level.

In the initial conditions block one variable (age) was statistically significant. Age in this case should be interpreted as a time trend variable. Those who have entered the area of lathe operation in the more recent past have tended to reach the skilled occupational level more quickly than those who entered in the more distant past. There are two possible explanations. First, it may be that as the pace of economic expansion increased standards for the first job in which an individual is classified as a skilled worker were lowered. This would have the effect of reducing the observed time which is taken to reach the skilled level. There is little doubt, however, that as the individual works at the skilled level (gains work experience) his deficiencies are quickly overcome. The second possible explanation is that individuals entering the area of lathe operation have simply gotten "better" over time. There is some partial evidence that those entering the area of lathe operation in the more recent past have somewhat higher levels of formal education than their predecessors. The effects of more formal education are discussed below.

Differences in formal education influenced the time taken to reach the skilled level. Compared to those who had only a complete primary education, those who either had industrial training or who graduated from an academic middle school, reached the skilled level more quickly. Further, those who completed the special middle school equivalency program (madureza) also reached the skilled level more quickly. The results for the industrial school were expected, since industrial training is generally completed before the work life begins. The industrial school graduate starts his work life already trained. This is not the case with formal academic education. Generally, industrial training (work experience and courses) does not begin until after the formal education is completed and the work life begins. The data indicate that more formal academic education facilitates the more rapid development of specific industrial skills. As noted, a skilled industrial worker must be able to do much more than perform certain physical operations. He must be able to read designs and make some rather difficult mathematical calculations. The classroom part of most industrial training courses is devoted to such topics. The better base developed in mathematics in the formal school system, the less that must be learned in courses as on the job. Further, it is possible that the formal school system teaches an individual how to learn. That is, the techniques of learning and the discipline obtained in the formal school system may be transferable to other types of learning situations. Though definitive answers are not possible, the study does show that more formal academic education is associated with reaching the skilled occupational level more quickly.

Work experience was also found to be important. Both the type and duration of work experience prior to entering the area of lathe operation had an influence on the time taken to reach the qualified level. Generally the closer the work experience approaches the area of lathe operation and the longer the duration of the experience, the more beneficial it was in terms of reducing the time required to reach the skilled level.

6.5 General Summary, Implications, and Suggestions for Further Research

1. The present skilled industrial workers in São Paulo were not drawn from the lower socio-economic levels of Brazilian society nor were they drawn from the agricultural sector. Other areas in Brazil which are now beginning to industrialize do not have such an urban-lower middle class pool from which to recruit potential skilled industrial workers. The problems to be faced in these

areas may be the problems faced in São Paulo during the first decades of the 1900's. The transfer of the industrial educational technology presently used in São Paulo may not be appropriate. Research, of a nature similar to this study, conducted in an area less industrialized than São Paulo would be useful to establish if such transfer problems exist.

2. More than a complete four-year primary education was not shown to result in higher earnings. Such formal education must be judged on other grounds if it is to be justified. SENAI's apprenticeship courses are currently being "upgraded" to include academic subjects which will make the SENAI program equivalent to the middle school level of the formal school system. Graduation from the SENAI program will give the individual the right to enter the formal high school. If the objective of the SENAI apprenticeship program is to develop skilled industrial workers, then two problems may develop. First, the type of individual who is drawn to the SENAI program may change. As has been noted, the Brazilian formal school system is extremely selective at all levels. Very few who begin a particular level complete that level. Of those who do, very few go on to the next. As graduation from the SENAI program will give the individual the legal right to reenter the formal educational stream, the SENAI apprenticeship program will become an alternative path to the university. Those who enter the SENAI program may

have no intention of ever working in a blue-collar industrial occupation. Second, even if the intentions of the students are to become skilled blue-collar workers, the added cost of providing academic subjects probably cannot be justified in terms of increased earnings. A clear statement of SENAI objectives would help to clarify the issue. Research on the characteristics of entering students before and after the new program is implemented would give an indication of the problems that might develop.

3. Industrial training of some sort is generally required to reach the skilled occupational level. The two major sources of such training are the private industrial schools and SENAI. Numerically, the private schools have given more courses and reached more individuals than SENAI has. In terms of earnings, what is done on the job, and the time taken to reach the skilled occupational level, private school training was not shown to be inferior in any way to SENAI training. This would tend to imply that, for those who do attain skilled industrial positions, the benefits of private school training are the same as the benefits of SENAI training. Other things equal, society's decision to invest in one form of training or another should be based on the comparison of relative costs and benefits.

The major question in comparative cost/benefit analysis is not whether the entire private school system is an alternative to the entire SENAI system but rather, whether some types of private school training are alternative to some types of SENAI training. Alternative programs are those designed for the same "types" of individuals and which have as an objective the development of the same specific type of skilled industrial worker. For example, the SENAI apprenticeship programs are designed for individuals 14 years of age who have recently completed their primary educations and have little work experience. If the objective is to train this type of individual, there is no alternative private school program. The only area in which real alternatives do exist is in the training of adult workers. Again the problem is that both the private schools and SENAI offer a wide range of courses for many different types of individuals. Even within a given occupational area there are entry level courses, rapid development courses, normal courses, up-grading courses, etc. Each is designed for a different type of individual. Further, courses for the same type of individual vary greatly in duration. Some private school courses in the area of lathe operation are planned for less than 200 hours, others for over 1,000 hours. In sum, the identification of real alternatives is not a simple task. Both the private school system and the SENAI system must be disaggregated to the point where real alternatives can be identified and comparative cost/benefit analysis becomes meaningful.

Even when real alternatives are identified the costing-out of the programs is not straightforward. First, it must be established who is paying the cost--government, society, or the individual. Second, costs must be identified. They may be explicit, implicit, or joint costs. The relevance of a specific type of cost depends on whose costs are being considered. Joint costs are probably the most difficult to handle. Both SENAI and the private schools have many different types of programs. Somehow, the general costs of administration, depreciation, and equipment used for different programs must be allocated to specific programs.

In sum, the identification and costing-out of alternatives is extremely difficult. Yet, if resources are to be allocated rationally and the most efficient programs identified, such research is called for. This study has provided some basic information on alternatives. The next logical step is to cost-out these alternatives.

4. This study dealt with only one important industrial occupation. The results probably are applicable to other similar skilled industrial occupations. There are, however, many industrial occupations which are dissimilar and to which extension of these results may be doubtful.

APPENDIX I

THE QUESTIONNAIRE

PESQUISA SOBRE A FORMAÇÃO PROFISSIONAL

DE TORNEIROS MECÂNICOS

Realização: Michigan State University - Estados Unidos da América
SENAI - Departamento Regional de São Paulo

DADOS DE CONTROLE

1. Número do questionário: ___________________
2. Nome do agente: ___________________________

3. Nome da empresa: __________________________
4. Bairro: ___________________________________

5. Data da entrevista : ______________________

6. Hora do início da entrevista: _____________
7. Hora do término da entrevista: ____________

8. Duração da entrevista: _________

AGENTE: Pergunte ao entrevistado

1. O senhor trabalha atualmente como OFICIAL DE TORNEIRO MECÂNICO?

☐ SIM
☐ NÃO ------- PARE COM A ENTREVISTA

2. O senhor trabalha em

☐ produção
☐ manutenção

(Não escreva debaixo desta linha)

Questionário
1 ☐
2 ☐
3 ☐

Tamanho
1 ☐ P
2 ☐ M
3 ☐ G

Grupo
1 ☐ 3
2 ☐ 5
3 ☐ 7
4 ☐

1 ☐ produção
2 ☐ manutenção

1. Quantos anos tem? __________

2. Estado onde nasceu? Estado ______________

Cidade ______________

1 [ ] GRANDE SÃO PAULO
2 [ ] São Paulo - interior

3 [ ] SUDESTE (MG - ES - RJ - GB - não SP)
4 [ ] EXTREMO SUL (PR - SC - RS)
5 [ ] CENTRO-OESTE (GO - DF - MT)
6 [ ] NORDESTE (MA - PI - CE - RN - PB - AL - SE - BA - PE)
7 [ ] NORTE (AM - PA - AC - RR - AP - RO)

8 [ ] Outro País ____________________

3. Se não nasceu no GRANDE SÃO PAULO, em que idade veio morar no GRANDE SÃO PAULO? __________

4 - 5. Grau de escolaridade dos pais?

	PAI ou (responsável)	MÃE ou (responsável)
1 analfabeto	1 [ ]	1 [ ]
2 semi-analfabeto	2 [ ]	2 [ ]
3 primário incompleto	3 [ ]	3 [ ]
4 primário completo	4 [ ]	4 [ ]
5 ginásio incompleto	5 [ ]	5 [ ]
6 ginásio completo	6 [ ]	6 [ ]
7 colégio incompleto	7 [ ]	7 [ ]
8 colégio completo	8 [ ]	8 [ ]
9 superior incompleto	9 [ ]	9 [ ]
10 superior completo	10 [ ]	10 [ ]
11 Não Sabe Informar	11 [ ]	11 [ ]

6. Estado onde fez o curso primário? Estado ______________

Cidade ______________

1 [ ] GRANDE SÃO PAULO
2 [ ] São Paulo - interior

3 [ ] SUDESTE (MG - ES - RJ - GB - não SP)
4 [ ] EXTREMO SUL (PR - SC - RS)
5 [ ] CENTRO-OESTE (GO - DF - MT)
6 [ ] NORDESTE (MA - PI - CE - RN - PB - AL - SE - BA - PE)
7 [ ] NORTE (AM - PA - AC - RR - AP - RO)

8 [ ] Outro País ____________________

7 - 8. Ocupação do pai ou responsável (na época em que o entrevistado tinha 15 anos)?

Ocupação ______________________________

O que ele fazia (cargo)? ____

☐ Não Sabe Informar

AGENTE: Usando a informação acima escrita, classifique-a de acordo com as tabelas Nº.7 e Nº.8.

(7) Escala Ocupacional (do pai ou responsável)

1 ☐ universitário e alta administração
2 ☐ supervisão de ocupações não manuais e técnicas
3 ☐ WHITE COLLAR (não manuais de baixo nível)
4 ☐ supervisão de ocupações manuais (mestre, contramestre, etc.)
5 ☐ manuais QUALIFICADAS
6 ☐ manuais SEMI-QUALIFICADAS
7 ☐ manuais NÃO QUALIFICADAS
8 ☐ Não Sabe Informar

(8) Área de Ocupação (do pai ou responsável)

1 ☐ torneiro mecânico
2 ☐ área de torneiro mecânico
3 ☐ outro tipo de mecânico
4 ☐ outra ocupação industrial
5 ☐ agrícola
6 ☐ outra
7 ☐ Não Sabe Informar

9. Número total de pessoas na família do entrevistado (na época em que o entrevistado tinha 15 anos)?

Número total de pessoas __________

10. CURSO PRIMÁRIO

a. Idade quando começou o primário? _________

b. Quantos anos completos fez (com aprovação)?

- [ ] primeiro
- [ ] segundo
- [ ] terceiro
- [ ] tirou diploma

c. Idade quando terminou o último ano completo do primário? _________

d MOBRAL

1. Tirou diploma de MOBRAL? [ ] sim ----- em que ano? _________ [ ] não

2. Está fazendo MOBRAL agora? [ ] sim [ ] não

11. CURSO GINASIAL

a. Começou o ginásio? [ ] sim [ ] não --------> (passe a f.) -------->

b. Idade quando começou o ginásio? _________

c. Curso feito?

- [ ] ginásio comum
- [ ] industrial
- [ ] industrial básico
- [ ] comercial
- [ ] agrícola

d. Quantas séries completas fez (com aprovação)?

- [ ] nenhuma
- [ ] primeira
- [ ] segunda
- [ ] terceira
- [ ] tirou certificado

e. Idade quando terminou a última série do ginásio? _________

f. MADUREZA (ginásio)

1. Tirou certificado de MADUREZA [ ] sim ----- em que ano? _________ [ ] não

2. Está fazendo MADUREZA agora? [ ] sim [ ] não

12. CURSO COLEGIAL

a. Começou o colégio? ☐ sim
☐ não --------> (passe a f.) -------->

b. Idade quando começou o colégio? _________

c. Curso feito?

☐ científico
☐ clássico
☐ técnico industrial ----- especialidade? ________________
☐ comércio
☐ agrícola
☐ normal

d. Quantos anos completos fez (com aprovação)?

☐ nenhum
☐ primeiro
☐ segundo
☐ terceiro (ou tirou certificado do científico ou clássico)
☐ tirou certificado

e. Idade quando terminou o último ano completo do colégio? _________

f. MADUREZA (colégio)

1. Tirou certificado de MADUREZA? ☐ sim ----- em que ano? _________
☐ não

2. Está fazendo MADUREZA agora? ☐ sim
☐ não

13. CURSOS DE TREINAMENTO OU FORMAÇÃO PROFISSIONAL - inclusive cursos rápidos realizados dentro ou fora desta empresa.

a. Fez pelo menos um curso de treinamento ou formação profissional?

☐ SIM ----- quantos cursos _________

☐ NÃO ---> (passe a página 7, pergunta Nº.14) -------->

b. RELACIONE NAS SEGUINTES PÁGINAS TODOS OS CURSOS DE TREINAMENTO OU FORMAÇÃO PROFISSIONAL QUE FEZ - inclusive cursos rápidos realizados dentro ou fora desta empresa.

CURSO Nº.1

1. Ofício que aprendeu

____

1 ☐ torneiro mecânico
2 ☐ outro tipo de mecânico
3 ☐ desenho
4 ☐ outro ofício industrial
5 ☐ outro

2. Nome da escola ou fábrica onde o curso foi dado

____

1 ☐ escola do SENAI
2 ☐ escola particular
3 ☐ escola estadual ou federal
4 ☐ FÁBRICA
5 ☐ outra

3. Local da escola ou fábrica onde o curso foi dado

Cid. ______________ Est. ______

1 ☐ GRANDE SÃO PAULO
2 ☐ São Paulo - interior
3 ☐ outro estado
4 ☐ outro país

4. Quem ministrou o curso

____

1 ☐ SENAI
2 ☐ PIPMO (programa do MEC)
3 ☐ EMPRESA
4 ☐ escola particular
5 ☐ outro

5. Duração do curso ______________ ----- QUANTO COMPLETOU? __________

6. Horas por semana - Total ________ / aula ________ oficina ________

7. ANO de conclução ________ 8. ☐ DIURNO ☐ NOTURNO

CURSO Nº.2

1. Ofício que aprendeu

____

1 ☐ torneiro mecânico
2 ☐ outro tipo de mecânico
3 ☐ desenho
4 ☐ outro ofício industrial
5 ☐ outro

2. Nome da escola ou fábrica onde o curso foi dado

____

1 ☐ escola do SENAI
2 ☐ escola particular
3 ☐ escola estadual ou federal
4 ☐ FÁBRICA
5 ☐ outra

3. Local da escola ou fábrica onde o curso foi dado

Cid. ______________ Est. ______

1 ☐ GRANDE SÃO PAULO
2 ☐ São Paulo - interior
3 ☐ outro estado
4 ☐ outro país

4. Quem ministrou o curso

____

1 ☐ SENAI
2 ☐ PIPMO (programa do MEC)
3 ☐ EMPRESA
4 ☐ escola particular
5 ☐ outro

5. Duração do curso ______________ ----- QUANTO COMPLETOU? __________

6. Horas por semana - Total ________ / aula ________ oficina ________

7. ANO de conclução ________ 8. ☐ DIURNO ☐ NOTURNO

CURSO Nº.3

1. Ofício que aprendeu

____

1 ☐ torneiro mecânico
2 ☐ outro tipo de mecânico
3 ☐ desenho
4 ☐ outro ofício industrial
5 ☐ outro

2. Nome da escola ou fábrica onde o curso foi dado

____

1 ☐ escola do SENAI
2 ☐ escola particular
3 ☐ escola estadual ou federal
4 ☐ FÁBRICA
5 ☐ outra

3. Local da escola ou fábrica onde o curso foi dado

Cid. ______________ Est. ______

1 ☐ GRANDE SÃO PAULO
2 ☐ São Paulo - interior
3 ☐ outro estado
4 ☐ outro país

4. Quem ministrou o curso

____

1 ☐ SENAI
2 ☐ PIPMO (programa do MEC)
3 ☐ EMPRESA
4 ☐ escola particular
5 ☐ outro

5. Duração do curso______________ ----- QUANTO COMPLETOU? __________

6. Horas por semana - Total __________ / aula __________ oficina __________

7. ANO de conclução __________ 8. ☐ DIURNO ☐ NOTURNO

CURSO Nº. 4

1. Ofício que aprendeu

____

1 ☐ torneiro mecânico
2 ☐ outro tipo de mecânico
3 ☐ desenho
4 ☐ outro ofício industrial
5 ☐ outro

2. Nome da escola ou fábrica onde o curso foi dado

____

1 ☐ escola do SENAI
2 ☐ escola particular
3 ☐ escola estadual ou federal
4 ☐ FÁBRICA
5 ☐ outra

3. Local da escola ou fábrica onde o curso foi dado

Cid. ______________ Est. ______

1 ☐ GRANDE SÃO PAULO
2 ☐ São Paulo - interior
3 ☐ outro estado
4 ☐ outro país

4. Quem ministrou o curso

____

1 ☐ SENAI
2 ☐ PIPMO (programa do MEC)
3 ☐ EMPRESA
4 ☐ escola particular
5 ☐ outro

5. Duração do curso ______________ ----- QUANTO COMPLETOU? __________

6. Horas por semana - Total __________ / aula __________ oficina __________

7. ANO de conclução __________ 8. ☐ DIURNO ☐ NOTURNO

14. HISTÓRIA PROFISSIONAL

AGENTE: Aqui estamos interessados na vida profissional do entrevistado. Queremos saber todas as profissões que o entrevistado teve desde a profissão do primeiro emprego até a sua profissão atual como oficial de torneiro mecânico. Todas as profissões as quais ele exerceu são importantes, mas três são de maior importância:

A. a profissão do primeiro emprego

B. a primeira profissão na área de torneiro mecânico

C. qual a data de seu primeiro emprego como oficial de torneiro mecânico

RELACIONE ABAIXO (em ordem de tempo) TODAS AS PROFISSÕES QUE O ENTREVISTADO TEVE

Para cada profissão anotada, classifique de acordo com as tabelas.

PROFISSÕES	Idade	Ano	Duração	Aprendeu sobre mecânica sim/não	SETOR Ind.	SETOR Ag.	SETOR Outro
(A) Profissão do primeiro emprego							
1							
2							
3							
4							
5							
(B) Primeira profissão na área de torneiro mecânico							
1 ☐ apr. de T. M. ☐ ajd. de T. M. ☐ operador de torno ☐ 1/2 oficial de T. M. ☐ oficial de T. M.							
2							
3							
4							
5							
6							
(C) Primeiro emprego como							
1 oficial de torneiro mecânico							
2							
3							
4							
5							
6							
(D) Emprego atual como oficial de torneiro mecânico		'73					

15. Há quanto tempo trabalha nesta empresa? ________________

16. Qual foi a sua primeira profissão nesta empresa?

____

1 ☐ oficial de torneiro mecânico
2 ☐ 1/2 oficial de torneiro mecânico
3 ☐ outra profissão na área de torneiro mecânico
4 ☐ outra profissão na área de mecânica
5 ☐ outra

17. Atualmente, quantas horas por semana trabalha nesta empresa?

Horas REGULARES __________

Horas EXTRAS __________

18. SALARIO ATUAL nesta empresa

	TOTAL (dinheiro)	PERÍODO
a) Salario integral (sem descontos)		
b) Horas extras		
c) Premios de produçao		
d) Outros		

19. Atualmente, o torno em que o Sr. geralmente trabalha é:

1 ☐ sem caixa NORTON
2 ☐ com caixa NORTON
3 ☐ Não Sabe Informar

20. Na relação da página seguinte, estão algumas das operações que os torneiros mecânicos geralmente fazem. Indique para cada operação se, em seu trabalho atual, o senhor FAZ, NÃO FAZ, ou NÃO SABE INFORMAR.

AGENTE: Explique ao entrevistado que nós queremos saber só se ele faz ou não faz as operações descritas. Nós não queremos saber se ele sabe ou não sabe fazê-las.

Se ele não entender a operação descrita, ele deverá marcar a coluna Não sabe informar.

OPERAÇÕES	FAZ	NÃO FAZ	NÃO SABE INFORMAR	
1) Tornear superf. cilíndrica externa na placa universal				1
2) Facear				2
3) Fazer furo de centro				3
4) Tornear superf. cilíndrica na placa e ponta				4
5) Afiar ferramenta de desbastar				5
6) Tornear superf. cônica externa usando o carro superior				6
7) Furar, usando cabeçote móvel				7
8) Sangrar e cortar no torno				8
9) Roscar com macho no torno				9
10) Tornear superf. cilíndrica internar (passante)				10
11) Roscar com tarraxa no torno				11
12) Tornear superf. cilíndrica entre pontas				12
13) Recartilhar no torno				12
14) Centrar na placa de quatro castanhas independentes				14
15) Tornear rebaixo interno (faceado interno)				15
16) Perfilar com ferramenta de forma				16
17) Calibrar furo com alargador no torno				17
18) Tornear superf. côncavas ou convexas (movimento bimanual)				18
19) Abrir rosca triang. externa por penetração perpendicular				19
20) Tornear superfície cônica com deslocamento da contra ponta				20
21) Abrir rosca triang. externa por penetração oblíqua				21
22) Abrir rosca quadrada externa				22
23) Tornear peças em mandril				23
24) Enrolar arame em forma helicoidal no torno				24
25) Tornear excêntrico				25
26) Tornear com luneta móvel				26
27) Furar com broca presa no eixo principal				27
28) Abrir rosca triangular direita interna				28
29) Retificar superf. cônicas e cilíndricas externas				29
30) Tornear cônico com aparelho conificador				30
31) Abrir rosca quadrada interna				31
32) Abrir rosca trapezoidal externa e interna				32
33) Abrir rosca múltipla (externa ou interna)				33
34) Mandrilar no torno				34
35) Afiar ferramenta de carboneto				35
36) Tornear em placa lisa				36
37) Tornear superfície esférica				37
38) Tornear com luneta fixa				38
39) Tornear com centros postiços				39
40) Tornear peças presas em cantoneira				40
41) Fresar rasgos no torno				41

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