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Types of Technology: Its Effect on Perceived Work Orientation Among Blue-Collar Workers

by

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TYPES OF TECHNOLOGY: ITS EFFECT ON PERCEIVED WORK ORIENTATION AMONG BLUE-COLLAR WORKERS

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The data utilized in this thesis were made available by the Inter-University Consortium for Political and Social Research. The data were originally collected by The Survey Research Center of The University of Michigan. Neither the original source or collectors of the data nor the Consortium bear any responsibility for the analyses or interpretations presented here.

ABSTRACT

The object of this study was to examine the effects of technology on workers' perceived orientation towards their work situation. The independent variable 'type of technology' was composed of three categories: manual, mechanical and automated. These categories were obtained by assessing the individual worker's control over his machinery. The dependent variables included: 'time needed to learn equipment', 'time spent operating equipment', 'repetition', 'physical mobility', 'ability to talk while working', 'control over the work pace', 'control over how work is organized' and 'job satisfaction'. Several factors were controlled for as well, including: 'occupation', 'sex', 'size of plant', 'length with present employer', 'union membership', 'age', 'education' and 'income'.

Secondary data from the Survey Research Center, University of Michigan, was used in this thesis. The sample obtained in the initial study was 2,662 respondents that were reported to be representative of the American labour force. A population of 962 blue-collar workers was selected for this thesis. The methodology used to test the hypotheses derived in this thesis included Analysis of Variance and Multiple Classification Analysis. The structural differences between types of technology were then assessed (as this was not a longitudinal study).

The results lend strength to the notion that technology affects the worker's perceived orientation to his work. Five out of eight hypotheses derived were supported by the results. In general, increasing automation (from manual through mechanized to automated technology) has the effect on the worker of:

1. increasing the time required to learn the equipment used
2. increasing the time spent operating equipment
3. increasing repetition
4. decreasing physical mobility
5. decreasing control over the work pace.

Two results were in the direction as predicted by the hypotheses but were not statistically significant. These included the hypotheses that increasing automation has the effect on the worker of:

1. decreasing his ability to talk on the job
2. decreasing his control over how work is organized.

The findings also lend support to the notion that increasing automation reduces job satisfaction. This result was contradictory to the direction predicted by the hypothesis and supports those writers that found increasing automation to have negative effects.

In addition, 'occupation' and 'sex' were correlated with the dependent variables.

For the variable 'occupation' two categories were used: 'craftsmen' and 'operator/labourer'. It was found that in comparison to operator/labourers, craftsmen have work situations that encourage:

1. greater time needed to learn the equipment used on the job
2. less time spent operating equipment
3. less repetitive work
4. greater opportunity to talk on the job
5. greater control over the work pace
6. greater control over how work is organized
7. greater job satisfaction.

When 'sex' was correlated with the variables below, it was found that in comparison to men, women have jobs that encourage:

1. greater repetition
2. less control over the work pace
3. less control over how work is organized
4. greater job satisfaction.

The results from this thesis lend support to the notion that technology has an important effect on the worker's perceived orientation towards his work situation.

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CHAPTER I

INTRODUCTION

The Problem

One of the most pervasive and significant activities undertaken by man is work. While a great deal has been written about work and work satisfaction, relatively little has been written about the effect technology has on workers. It is the general purpose of this thesis to explore the effects types of technology have upon workers' perceived orientation to work.

A number of writers of industrial sociology have suggested that the type of technology has a bearing on the attitudes and behaviors of those who are engaged in the productive process (see Blauner, 1964; Bright, 1958; Dubin, 1965; Faunce, 1960; Fullan, 1971; Walker and Guest, 1956; Woodward, 1958). Most of the above authors, however, have concentrated on the comparison between entire firms or industries as being characteristic of a certain type of technology rather than focusing on differences of technology encountered by each worker.

This study attempts to go beyond the above conventional view, by defining types of technology in terms of the worker's direct control of equipment and machinery used in the work process. The worker's orientation towards the organization, his work associates and his work will be examined in terms of type of technology rather than type of firm or type of industry. The different perspectives generated by this approach should help to clarify the debate between two opposing views on the impact increasing automation has on the worker. Those authors who have taken specific industries as representative of specific types of technology conclude that increasing automation reduces worker dissatisfaction. (Blauner, 1964; Fullan, 1971) On the other hand those authors who have studied differences within the most advanced automated technology have concluded that this is not the case (see Rhinehart, 1975; Faunce, 1960).

By distinguishing between the various types of technology irrespective of firm or industry, this study will attempt to shed some additional light on the debate concerning the effects of technology on work orientation.

Organization of the Thesis

Chapter II of this thesis provides the theoretical perspective which will guide our analysis. This involves a review of the literature in which a framework for this analysis is presented in the form of testable hypotheses.

Chapter III presents the methodology that is to be used in this thesis. This includes a description of the data along with the operationalization of all the variables that will be considered. Also the statistical methods to be used in order to test the hypotheses will be presented in this chapter.

The results of the analysis of the data will be presented in Chapter IV. These results will be discussed briefly as well in this chapter.

A more comprehensive discussion of the results and their implications will be given in Chapter V. In addition a summary and conclusion, the limitations of the study, and suggestions for future research will also be discussed.

CHAPTER II

THEORETICAL PERSPECTIVE

In this chapter a review of the existing literature is compiled in an attempt to clarify the research that has been undertaken so far with regard to technology and how it affects blue-collar workers and their work. The chapter starts with a review of the ways various writers have classified technology and why they have taken these approaches. From these approaches one classification of technology is established as the basis for this thesis. This classification includes manual, mechanical and automatic control over technology. Initially the characteristics of these three categories are elaborated individually. Then a comparative analysis is undertaken from which several hypotheses are generated. Finally a concluding section on control variables is included so that other relevant factors, which researchers have considered important in the study of the worker and his work, will also be taken into consideration.

Review of the Literature

The term 'technology' has been defined as "the manual and machine operations performed on an object in the process of turning out a final product." (Fullan, 1970: p. 350 see also Blauner, 1964: 6, Perrow, 1967: 195) Various rationale have been formulated to operationalize the different types of technologies found in production processes. From these classifications several writers have concluded that the relationship of the worker to his work is affected by the type of technology employed in an industrial organization. As will be shown, recent research has, however, not successfully established a reliable operationalization of the various types of technologies that workers encounter. This is revealed by a review of the various approaches found in the literature.

For example, Joan Woodward's major objective was to study the relationship between types of technology and organizational structures of various firms (Woodward, 1965). Unit and small batch production, large batch and mass production, and continuous flow or process production were used as criteria for defining differences in types of technology. These differences were analyzed in terms of number of employees, level of management, labour costs, ratio of managers and supervisory staff to total personnel, ratio of staff and line personnel within the organization, span of control, and the developing, marketing and production of materials. As a result of these studies, Woodward concluded that the organizational structure of a firm is dependent upon the type of technology in use and that these differences of structure affect human conditions in the plant:

> "There appear to be considerable differences between production systems in the extent to which the 'situational demands' create conditions conducive to human happiness" (Woodward, 1958: 30).

Robert Blauner has concentrated on the relationship between types of technology and the worker's alienation. Blauner makes use of the printing, textile, automative and chemical industries as representative of the following types of technology respectively: craft, machine-tending, assembly-line and continuous. Analyzing these technologies, Blauner argues that "structural differentiation has led to a situation where the industrial system distributes alienation unevenly among its blue-collar labour force, just as our economic system distributes income unevenly" (Blauner, 1964: 5).

William Faunce, in his article "Automation and the Division of Labour" (1965: 149-160), classified types of technology according to six criteria which include power source, processing procedures, types of work, material handling procedures, control procedures, and type of division of labour. From these six criteria major American industries are categorized according to three phases in the man-machine relationship: craft, mechanized and automated technologies. Faunce then goes on to claim automation reduces the degree of job specialization which in turn decreases alientation from work.

Eva Mueller in her study Technological Advance in An Expanding Economy used an automation scale derived from the degree of control the worker has over the equipment operated while on the job to define three types of technology; manual, fixed mechanical and automated. A major finding of this study was that "workers with automated equipment tend to enjoy their work more often still than those with more traditional equipment" (Mueller et. al., 1967: 34).

Woodwards, Blauner, Faunce and Mueller have all used different methods of organizing various types of technology. However, all four authors have come to the general conclusion that these different types of technologies affect the relationship of the worker to his work.

Although Woodward, Blauner and Faunce have started from different points in defining types of technology they have one shortcoming in common, namely the assumption that an entire firm or an entire industry is involved in a single type of technology. These authors in using this approach, have made generalizations about types of technology and their effects on various aspects of work. This approach simply ignores the vast array of types of technology found within each firm and industry.

James Bright, in 1958, developed the concept of a mechanized profile of various plants. This in-depth analysis involved the listing of every job in a given plant, accompanied by the given level of mechanization of the job. A profile of the Cleveland Engine Plant of the Ford Motor Company in 1955 found 17 jobs falling into the manual control category, 30 jobs falling into the mechanized category and 8 jobs entirely or partially contained in the automated category. This profile of an assembly-line shows the heterogeneity within any given plant or industry and the inherent tendency for error if these diverse jobs are combined in a single category.

Eva Mueller has attempted to overcome the problem of heterogeneity within a given plant by classifying workers individually according to an 'Automation Scale' (Mueller et al. 1969: 241-246) rather than according to occupation or industry. The 'Automation Scale' is based on the worker's direct control over the equipment used. Manual, fixed mechanical and automated operations[1] performed in the process of turning out a final product are looked at and the direct effects of these types of technology on the workers' orientation towards their work are assessed. Because of Mueller et al.'s ability to overcome the problems faced by most other studies that looked at entire plants or entire industries, it was felt that a further analysis using this approach was worthwhile. An analysis of the blue-collar worker's[2] relation to machines and in particular the control he has over these machines will, it is hoped, yield greater understanding of the effects these instruments have on the worker and his work situation.

Types of Blue-Collar Technology

In the section that follows an attempt will be made to summarize from the available literature some of the major relevant job characteristics of the various types of technology (manual, mechanized and automated).

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1. Mueller equates the manual control category as offering the greatest control, the fixed mechanical control category as offering reduced control and the automated category offering the worker little control over equipment worked with.

2. Of the classification schemes mentioned above, few of them have direct applicability for white-collar automation. The systems proposed by Blauner, Faunce and Bright are based either on the technical hardware and its materials, or on the control over these processes. This is due largely to the concentration on the manipulation of objects, which is the prime focus of blue-collar technology. Robert Blauner notes that "... it is in the factory that the impact of technology on social structure and the consequences of both on the experience of alienation and freedom are revealed most clearly" (Blauner, 1964: lX). It should be noted that this paper will limit its focus to the blue-collar labour force and the effects of technology on this group.

1. Manual Technology

The only authors to use manual control over equipment as a classification of types of technology are Mueller et al. In their study only those workers who were in direct control over the amount, direction and duration of operations performed were classified under manual technology. As there is little else written using the category of 'manual technology', it will be assumed that the job characteristics of manual technology are most closely associated with the classification of 'craft technology'. The main reason for the similarities in job characteristics between manual and craft technology is in the nature of control where both typologies use a high level of control as a defining characteristic. In some instances, the two classifications have been used interchangeably (see Blauner, 1964; Mills, 1951). The only clear distinction to be made between manual technology and craft technology being that craft technology, as will be shown, requires highly skilled craftsmen, while workers who deal with manually controlled machinery can be either unskilled or else very highly skilled.

The following section will elaborate on the characteristics associated with craft technology. With the exception of skill level, the characteristics of craft technology will be considered the same as for manual technology. Where hypotheses are derived, the manual category will be employed using the characteristics of craft technology. (see Appendix V for a comparison of occupations and types of technology)

Craft Technology - It is generally accepted that the highest skilled blue-collar worker is found in craft technology. The worker in craft technology is in direct contact with the object and the manufacturing process. The craftsman's job involves combining mind and body, to produce or repair a finished product. The opinion of C.W. Mills, is that "craftsmanship (is) a fully idealized model of work gratification" (Mills, 1951: 220). He further corroborates this statement enunciating six major features of the craft form of production:

> "There is no ulterior motive in work other than the product being made and the process of its creation. The details of daily work are meaningful because they are not detached in the worker's mind from the product of the work. The worker is free to control his own working action. The craftsman is thus able to learn from his work: and to use and develop his capacities and skills in its prosecution. There is no split of work and play, or work and culture. The craftsman's way of livelihood determines and infuses his entire mode of living" (C.W. Mills, 1951: 220).

The way to acquire the necessary skills to become a craftsman involves a lengthy training period (see Shepherd, 1971: 28 and Bright, 1958: 188). This period of training or apprenticeship usually ranges from three to seven years and often extends well into the journeyman years. During this period the trainee works under the guidance of a craftsman who teaches him the basic skills while on the job. Completing this apprenticeship entitles the craftsman to formal recognition to practice his trade. He is then presumed to have enough traditional knowledge and experience within his field to take total charge of initiating, manipulating and guiding his work, and is held responsible for the finished product.

An essential feature of craft technology is the lack of a standardized product. This curtails the development of elaborate machinery that necessarily leads to standardized work processes.

Craft production also limits division of labour. Faunce's findings emphasize the point that craft production leads to a low degree of differentiation (1965: 54). Blauner has also found that most craft workplaces are smaller and "the division of labour is naturally less in the smaller plants" (Blauner, 1964: 46). Although it may not involve completing the entire product, in most instances craft technology encourages a larger segment of the product worked on by one man than other forms of production. As a result, the craft worker is usually involved in a wide variety of operations and is more likely to work with several pieces of equipment rather than with one piece of equipment constantly. Repetition in this situation is reduced to a minimum (Blauner 1964: 45).

Because of the high standards of quality demanded of them, craftsmen in general require a great deal of personal freedom and control over their work pace (see Blauner, 1964: 42 and Shepherd, 1971: 27).

Since the worker is required to work with a greater number of machines and people, physical mobility tends to be high in craft technology (Blauner, 1964: 43). This greater mobility, along with limited job pressure and supervision associated with craft technology, makes it possible for the worker to have greater verbal interaction with work associates (Blauner, 1964: 50).

In conclusion, craft technology requires a lengthy training period to produce a highly skilled craftsman. This craftsman then has control over how his work is organized. In general, craft technology promotes limited division of labour and standardization of product which results in both limited interaction and repetition with any one piece of equipment. The work pace is generally controlled by the craftsman. Physical mobility is high in this type of technology which results in the ability of workers to interact with one another.

2. Machine Technology

Often referred to as machine-tending or mechanized-technology, this method of production utilizes machines which perform work by using energy sources other than man or animals. Machines convert several forms of energy into usable commodities. Although craft technology uses machines, the nature of control over these machines is different in machine technology. Control in machine technology is built into the very design of the machine. Although the operator can stop, start and feed the equipment, the actual manipulation of the materials is controlled by the machine.

A major outcome of removing the 'tool from the hands of the worker and fitting it into a machine' has resulted, to a large extent, in the elimination of the skilled craftsmen.

> "It was the machine which reduced the value of the old tools, the property of the individual craftsman or building-workers, and replaced (or 'made use of personally' or 'incorporated into itself') the accomplishments and intellectual powers of the worker" (Kuczynski, 1967: 45).

Although the worker in this mechanized stage acquires the necessary skill for manipulating these machines, these skills, however, are of a very limited and very specialized nature. As Marx has pointed out:

> "The worker's activity, limited to a mere abstraction is determined and regulated on all sides by the movement of the machinery, not the other way around" (Marx, 1973: 133).

The time needed to learn the essentail skills necessary for using this equipment is, therefore,minimal.

Control, in the machine technology environment has shifted from the animate to the inamimate, from the craftsman to the machine. The nature of the machine largely determines the nature of the job. Because the machine is pre-programmed and inflexible, those that tend these machines must, as a result, conform to these pre-set conditions. Since the machine is designed to perform certain operations, the method of production becomes standardized. Standardizing the method of production usually involves feeding the materials into the machine, starting the operation, stopping the operation and removing the product from the machine. Repetition in the work task, therefore, is inevitable.

Also, the pace of work is essentially determined by the set pace of the machine. Initiative, judgement and discretion, key elements in craft technology, are incorporated into the design of the machine. The result is "a high degree of repetitiveness in work tasks, minimum skill requirements for workers, standardization of tools and techniques, and minute subdivision of the product worked on" (Walker and Guest, 1952: 12, see also Shepherd, 1971: 26).

The repetitive nature of these jobs limits the opportunity to learn and the general interest in the work is low (see Walker and Guest, 1956: 53-55). Where repetition becomes the main feature of work, boredom and monotony become predominant characteristics in the work process. As Wyatt and Fraser point out "...[boredom] is most marked in semi-automatic processes which require enough attention to prevent mind-wandering but not enough for the complete absorption of mental activity (1929: 42). The above authors add further that boredom is less liable to arise when the work is conceived as a series of self-contained tasks rather than, as in most machine tending jobs, the work is conceived as a sequence of repeated motions apparently without an end.

Subdivision of tasks, characteristic of machine production, usually requires physically large plants. This has been found to affect the employer-employee relationship:

> "As a rule, the larger the factory, the more tenuous is the employee's sense of identification with the enterprise and the greater the social and sympathetic distance between him and management. The automobile assembly plant (mechanized production) stands at the apex of the historical development towards larger and larger factories: the proportion of workers employed in plants with more than 1,000 persons is 21% in printing (craft), ... and 82% in the transportation equipment industries (mechanized)! Automobile production may be the ideal example of an industry where large plants and firms have most contributed to the extreme development of an impersonal work atmosphere and to the breakdown of sympathetic communication and identification between employees and management " (Blauner, 1964: 177).

The high level of specialization and division of labour associated with mechanized technology has resulted in the separation of the productive process into simple, highly repetitive tasks. The worker, in this situation, is usually associated with one piece of equipment which he uses constantly. The best example of this type of repetitive work is found on the assembly-line (see Walker and Guest, 1962: 98, Blauner, 1960: 346, Dubin, 1958: 185).

The mobility in a mechanized job is limited. Either the worker is tied to a single machine or to an assembly-line. In either case the worker has to either keep up with a schedule or an assembly-line making it hard to leave the operating station for any reason (see Shepherd, 1971: 26, Fullan, 1971: 352 and Blauner, 1960: 346).

The lack of mobility, as well as the loud machinery, and the repetitive pace characteristic of mechanized technology result in limited opportunity to talk on the job. If work stations are close enough to each other there may be limited opportunity for workers to talk but usually this is not the case (Blauner, 1964: 114, Fullan, 1971: 352 and Walker and Guest, 1952: 79)

In mechanized technology, to summarize, the worker requires minimal skill as most of the skills have been incorporated into the machinery. The time required to learn how to use the equipment in this work situation is minimal. Also control over the equipment and the organization of work is minimal because these aspects are largely determined by the machinery. The worker who works with mechanized technology is closely tied to the machine he operates. His job is likely to be highly repetitive and largely paced by the equipment. In these circumstances there is little opportunity for mobility or little opportunity to talk.

3. Automated Technology

The most advanced method of production, involving the total elimination of man from the actual handling of the product, is known as automated or continuous-flow production. Materials are carried automatically from operation to operation, the result of the development of mechanical or automatic transfer systems. In addition to this transfer system, the development of "feedback" mechanisms allow for automatic, self-regulation and self-control of machinery by machinery.

A good example of self-controlled machinery is the recent development of numerically controlled machine tools. This development is considered the most important "new development in manufacturing technology since Henry Ford introduced the concept of the moving assembly-line" (Lynn, Roseberry, Babich, 1966: 89). This device allows for the self-control of machinery involving the movement of a tool or the work by means of numbers along three axes. This control unit is guided by punched cards bearing numeric information and by monitoring devices. These monitoring devices are located at various points, such as the point of contact between the tool and the work. With various sensing mechanisms, the monitors are able to send corrective information to the controlling device. With this information the numerical-controlling device can regulate speed, depth of cut, angle of cut, tool used, lubricant, etc. (Braverman, 1974: 197-206).

The technological innovations of transfer and feedback mechanisms have been responsible for the elimination of most of the jobs involved in the feeding of material, the starting and stopping of machines and the controlling of machines, etc. The result has been the elimination of man from the actual production of goods. To operate the automated plants, workers are responsible for the even flow of production by monitoring the system. Machinery does break down, however, and for this reason the maintenance personnel consist of highly skilled craftsmen. In this section however, only the operators will be considered as workers who are associated with automated technology.

What are the effects of automated production on the men who work with these automated machines? The recent advent of the age of automation has made much of the research in this area highly controversial and contradictory. Therefore, more research, of an exploratory nature is required.

Skill requirements, for example, are subject to controversy. The commonly held belief is that automation requires a highly educated, sophisticated labour force. Peter Drucker, the leading spokesman for the optimistic view of automation, predicted in 1954 the greatest upgrading of jobs ever seen. He writes convincingly that "automation will upgrade the semi-skilled machine operator of today into a highly skilled and knowledgeable technician " (Drucker, 1954: 38). On the other hand, we find writers such as Bright, Braverman and Faunce who claim that automation involves certain basic skills but in general reduces the skill level of the machine monitors.

In 1958, James R. Bright published Automation and Management in which he analyzed in great detail thirteen highly advanced production systems. The principal focus of Bright's study concerned the skill requirements of increasing mechanization. This study interestingly, was undertaken from the point of view of management. A controversial area of Bright's study can be found in the area "... regarding the skill required of the work force in the automated plant. The relationship of skill requirements to the degree of automaticity as a declining rather than increasing ratio is not commonly accepted or even considered " (Bright, 1958: Preface). He goes on to state:

> "When the variable control levels (totally automatic levels) are reached, we find that the worker contributes

> little or no physical or mental effort to the production activity. More of the functions are mechanized. The inspecting devices feed corrective information into the machine and thus relieve the operator of mental effort, decision-making, judgement and even the need to adjust the machine. By its very definition, the truly automatic machine needs no human assistance for its normal functioning. "Patrolling" becomes the main human contribution. The "operator", if he is still there, becomes a watchman, a monitor, a helper" (Bright, 1958: 188).

In support of Bright's findings, Faunce has found little difference between mechanized and automated jobs in the amount of time estimated by the workers that it would take 'a new man to learn their jobs' (Faunce, 1960: 371). Georges Freidmann has also noted: "In the chemical industry (automated),... the modernization of equipment has considerably lessened the time needed to train 'experienced' workers ... This is due particularly to ... more numerous and more sensitive measurings devices" (1961: 5-6)(see also Braverman, 1974: 203).

Another area of disagreement has to do with control of the pace of work. Blauner claims that in an automated plant, the worker is in control of his work (see also Shephered, 1971: 28). He illustrates this by his example of the "worker's soup" where a chemical operator explained how the workers often heat up a can of soup on a hot plate.

> "Suppose the soup is on the stove, ready to eat, just at the time that's officially scheduled for the operator's round of instrument readings, an activity that takes about thirty minutes. "You can eat the soup first and do the work later, or you can take the readings earlier than scheduled, in order to have the soup when it's hot", reported this operator. In other words, the nature of production work in an automated technology makes it possible for the employee to satisfy personal and social needs when he feels like it, because he can carry out his job tasks according to his own rhythm" (Blauner, 1964: 170).

In direct contradiction to Blauner's 'worker's soup', William Faunce, in a study of workers in an automobile plant, looked at change in job content that accompanied change from a mechanical to an automated plant. One of his conclusions was that "with the advent of automation, the long trend toward decreasing control of work pace by the industrial worker has almost rum full course ... Significantly fewer workers reported that they were able to work at their own speed on their automated jobs and significantly fewer indicated they were able to work ahead and take a break on these jobs" (Faunce, 1960: 371). Automated jobs require nearly constant attention to machine gauges as long as the equipment is operating (Faunce, 1960: 371). The consequences of worker's inattention could be very serious considering the high cost of automated machinery. The worker as a result is constantly, intensely involved in working with his equipment.

Even though physical mobility is not restricted in the automated job setting (Shepherd, 1971: 26-27), the opportunity for social interaction is low. As one worker put it "There are not so many workers around ... that's why it [the automated job] is more boring and lonesome"(Faunce, 1960: 373).

Job control is another area of controversial findings. Blauner has found that automation allows the worker a greater degree of choice of work methods than mechanized plants. "The worker has more freedom to determine techniques of doing his job. This results from the variety inherent in the work; the lack of time pressure, which allows experimentation and change; and the new situations for which solutions must be found. Even in such a relativly routine job as instrument-reading, much variation in the sequence of work is possible" (Blauner, 1964: 139).

In contrast to this viewpoint, Rinehart and Faunce have found automated jobs limit workers' control over their jobs. As Faunce observed, the monitor of dials "does not initiate processing operations, nor does he have any control of quantity and quality of output" (Faunce, 1968: 46). Rinehart also noted that "it is difficult to visualize individuals devising their own techniques for reading dials ..." (Rinehart, 1975: 135).

Blauner also contended that automatic technology "contains tendencies toward greater interest and involvement and toward great monotony and boredom" (Blauner, 1964: 157). The operator's job involves troubleshooting and reacting to malfunctioning equipment. When all is going well the job is monotonous and repetitive but when problems arise involvement, concentration and quick thinking are necessary.

Sussman has found that variety in most automated plants is restricted. As he notes a single operator now "sits at a console monitoring by television many meter readings which in less automated plants require two or three daily 30-minute 'rounds' of the plant" (Sussman, 1972: 43). Thus in the highly automated plants we find a rather immobile worker involved in repetitive monitoring of dials. However, in most automated operations the monitor still has to walk from dial to dial.

The basic characteristics of the automated job are, as yet, unclear. The skill required, the control over work pace, the control over work organization have resulted in contradictory findings. The only consistent findings arising from research dealing with automated technology are: that it encourages a strong relationship between man and machine, that it limits the opportunity to talk with others on the job, and that it encourages repetitive types of jobs. In some cases (the most automated), automated technology may limit physical mobility, and in others (the less automated), it encourages physical mobility.

Type of Technology and the Work Situation

In the previous section a description of manual, mechanized and automated types of technology was given. In this section these three types of technology will be compared with regard to eight attributes of work orientation: (1) time required to learn to use equipment on the job, (2) time spent operating equipment, (3) repetition, (4) physical mobility, (5) ability to talk, (6) control over work pace, (7) control over how work is organized and (8) job satisfaction. By changing the perspectives in this manner it will be possible to formulate eight relevant hypotheses, which later can be tested.

1. Time Required to Learn to Use Equipment on the Job

As noted in the previous section of this chapter, it is a point of controversy whether or not automated technology requires a long training period to learn to use the equipment on the job. In this thesis the position is maintained that automated technology requires a long training period because of the very complex nature of automated machinery. There is more agreement in the findings that mechanized technology usually requires little time to learn, as most of the skills are incorporated into the machinery. Manual technology also requires little time to learn the equipment used on the job, as this equipment is of a much more elementary nature and much more easily understood. From this review of the literature the following hypotheses is derived:

Hypothesis #1 - Workers that work with automated, mechanical and manual types of technology will have successively lower group means for perceived (3) time needed to learn equipment used.

2. Time Spent Operating Equipment

As shown earlier, the worker that deals with automated technology has been found to be constantly involved in monitoring equipment, as it requires

3. In what follows the responses to the questions raised are interpreted as the worker's perception rather than a statement of fact.

nearly constant attention. Likewise the worker that uses mechanized equipment will also be intensely involved with his equipment. Manual technology, as the name implies, depends largely on physical capabilities. As well, the worker will spend less time operating equipment on the job. From these findings the following hypothesis is formulated:

Hypothesis #2 – Workers that work with automated, mechanized and manual types of technology will have successively lower group means for perceived time spent operating equipment while on the job.

3. Repetition

A review of the literature has found that automated technology leads to a highly repetitive work environment. Likewise mechanized technology also makes for a good deal of repetitive work as machines have pre-set repetitive movements. Manual control over technology, however, is not mechanically controlled and is therefore much less repetitive. From the above findings the following hypothesis is developed.

Hypothesis #3 – Workers that work with automated, mechanical and manual types of technology will have successively lower group means for perceived repetition while operating equipment.

4. Physical Mobility

As discussed earlier, a review of the literature has found some authors claim that automation increases physical mobility while others claim that it limits physical mobility. This thesis will take the view that the latter is the case because of the constant attention required by the equipment which curtails physical mobility within a small radius. Mechanized technology also limits physical mobility to the vicinity of the immobile machinery. Manual technology, on the other hand, encourages physical mobility, since the worker deals with less equipment and is not tied to one particular machine. The hypothesis developed from these arguments is:

Hypothesis #4 - Workers that work with automated, mechanized and manual types of technology will have successively higher group means for perceived physical mobility while operating equipment.

5. Ability to Talk

The proceeding review of the literature has shown that automated technology limits the opportunity for workers to talk while working. Similarily mechanized technology has also been found to inhibit the possibility of talking. Manual workers on the other hand are less tied to any one machine and are more mobile. Consequently, this type of work situation generally encourages the possibility of workers to talk. We can therefore derive the following hypothesis:

Hypothesis #5 - Workers that work with automated, mechanized and manual types of technology will have successively higher group means for perceived ability to talk while working.

6. Control over Work Pace

Contradictory findings have been obtained by various researchers over the amount of control the worker that works with automated technology has over his work pace while operating equipment. This thesis will take the view that automation makes it necessary that the worker comply with the demands of the machine, thereby reducing the worker's control over his work pace. Mechanized technology has also been found to be paced by the cyclical nature of the machinery which curtails the worker's control over the work pace. Manual technology, on the other hand, promotes greater control over the work pace as the worker is less likely to be paced by the needs of the equipment. From these conclusions the hypothesis derived is:

Hypothesis #6 - Workers that work with automated, mechanized and manual types of technology will have successively higher group means for perceived control over work pace while operating equipment.

7. Control Over How Work is Organized

As discussed earlier, contradictory findings have been obtained by those who have looked at control over how work is organized within an automated technology. This paper will hold that automated technology will severely limit the worker's control over how his work is organized as control has been largely taken over by the demands of the machinery. This is also true of mechanized technology which has been found to curtail workers' control over how work is organized. In contrast, manual technology is much more dependent on the worker's initiative and judgement, hence encouraging self-control over how work is organized. We would therefore hypothesize that:

Hypothesis #7 - Workers that work with automated, mechanized and manual types of technology will have successively higher group means for perceived control over how their work is organized.

8. Job Satisfaction

Of special interest to many researchers is the area of job satisfaction and the factors that have an effect on this dependent variable. As we have yet to deal with this topic and because of its relative importance in industrial sociology, this section will combine a review of the different approaches used to measure workers' satisfaction and the associated problems of these approaches.

In order to measure workers' satisfaction with their work, job attitude surveys have been developed. The assumption underlying these surveys is that each work setting is different and that each set of circumstances is different. "Rejecting an a priori extreme position that workers either are or are not alienated one expects to find work situations where alienation is absent, as well as those where it is present" (Blauner, 1964: 4). This approach is based on the assumption that there exists "critically different types of work environments within modern industry. These diverse industrial environments result in large variations in the form and the intensity of alienation" (Blauner, 1964: 4).

To measure these diverse work environments, job attitude surveys use the verbal expression of a respondents evaluation of his job. This verbal evaluation is made operational by attitude items administered by interviews and/or questionnaires. These evaluations are of two types, those that attempt to measure alienation (see Blauner, 1964, Shepherd, 1971, Seeman, 1959) and those that attempt to measure the level of job satisfaction (see Woodward, 1964; Mueller, 1969; Robinson, 1958; Herzberg et al. 1957).

Robert Blauner has attempted to compile the results of a number of these job-attitude studies which have asked questions such as "Taking into consideration all the things about your job (work), how satisfied or dissatisfied are you with it?" The compiled results are as follows:

TABLE 2.1

Proportion of Dissatisfied Workers in Major Job Satisfaction Studies

Researchers	Composition of Study	Date	Dissatisfied Percent
Morse and Weiss	401 employed men	1955	20
Centers	811 men	1949	17
Palmer	517 labour force members	1957	10
Shister & Reynolds	800 manual workers	1949	12 and 21**
Hoppock	309 labour force members	1935	15
Kornhauser	324 employed persons	1952	11

** Two separate samples were used:

(from Blauner, Robert, "Work Satisfaction and Industrial Trends in Modern Society," in Galenson and Lipset, 1960: 340).

From 1946 to 1950, Robert Hoppock and Alan Robinson undertook to summarize the results of all published job satisfaction studies. "The total of percentages compiled over the past twenty years results in a median value of 13 percent for job dissatisfaction. Based on the Hoppock-Robinson reviews, the range of 13 - 21 percent has generally been reported in the literature as representing the approximate prevalence of job dissatisfaction" (Robinson, 1958: 670).

Robert Blauner has also attempted to find the number of workers who would choose their own line of work again, given the opportunity. He reported the following percentages with regard to blue-collar occupations:

TABLE 2.2

Percentage of Blue Collar Workers who would Choose the Same Work Again

Blue Collar Occupations		%
Skilled Printers	-	52
Paper Workers	-	52
Skilled Auto Workers	-	41
Skilled Steel Workers	-	41
Textile Workers	-	31
Unskilled Steel Workers	-	21
Unskilled Auto Workers	-	16

(Blauner, 1960: 343)

These findings indicate that those in unskilled occupations would be less likely to chose the same work again as compared to skilled occupations. However, these results are not in themselves conclusive, for they still do not answer the implicit issues of what it is about the work of a specific occupation that makes it more rewarding than the work of another occupation. Also, this approach has been criticized for being "fantasy" and "hypothetical dreaming" not taking into account real life situations and limitations.

Within these boundaries, the evidence from job attitude surveys is generally that: "Even under existing conditions, which are far from satisfactory, [most] workers like their jobs. Every survey of workers' attitudes which has been carried out, no matter in what industries, indicates that this is so" (Brown, J.C., 1954: 190-191).

There have, however, been many problems with both job satisfaction and alienation questionnaires. For example, although people may answer, "Yes, I am satisfied with my job," their exact meaning is still undetermined. There are many facets to the term job satisfaction. One man, who said he had a pretty good job, when asked to tell what made the job good, replied: "Don't get me wrong. I didn't say it is a good job. It's an O.K. job - about as good a job as a guy like me might expect. The foreman leaves me alone and it pays well. But I would never call it a good job. It doesn't amount to much, but it's not bad." Is this worker satisfied?

Robert Kahn has critized the direct question 'How satisfied are you with your work' because it strikes too closely at the respondent's self-esteem.

> "For most workers it is a choice between no work connection (usually with severe attendant economic penalties and a conspicuous lack of meaningful alternative activities) and a work connection which is burdened with negative qualities (routine, compulsory scheduling, dependency, etc.). In these circumstances, the individual has no difficulty with the choice; he chooses work, pronounces himself moderately satisfied, and tells us no more only if the questions become more searching. Then we learn that he can order jobs clearly in terms of their status or desireability, wants his son to be employed differently from himself, and, if given a choice, would seek a different occupation" (Kahn, R., 1972: 179).

Another criticism of job satisfaction statistics comes from the very term "job satisfaction" which according to some authors lacks adequate definition. Herzberg, Mausner and Snyderman have pointed out that "Most attempts at analysis agree that there are many facets to this term, and that job satisfaction is not a unidimensional attitude." Herzberg and his associates found that the factors that promoted job satisfaction were qualitatively different from those factors that promoted job dissatisfaction. (Herzberg et al., 1959) Herzberg found that the major factors contributing to job satisfaction were achievement, recognition, responsibility, advancement and the job itself. Factors responsible for job dissatisfaction were company policy and administration, supervision, salary, interpersonal relations and physical working conditions. From this simple breakdown, Herzberg shows that satisfaction is a result of what the workers actually do at work while dissatisfaction is a result of the environment or context in which work is performed. As Herzberg points out "the opposite of job satisfaction would not be job dissatisfaction but rather no job satisfaction; similarily, the opposite of job dissatisfaction is no dissatisfaction, not satisfaction with one's job" (Herzberg, 1955: 95). In general, Herzberg's analysis has not been incorporated into job satisfaction studies.

Within these shortcomings, several authors have attempted to asses the levels of job satisfaction associated with the various types of technology. Results from all studies generally show that the greatest job dissatisfaction is produced by mechanized technology.

> "Assembly-line work, in many instances, is like a signal revealing the present deficiencies of technology, wherever it causes the hand of man to perform largely subdivided operations which mechanization has been unable to conquer" (Friedmann Georges, 1954: 178).

The level of job satisfaction associated with craft technology found in the literature is much higher than with mechanized technology. This is due mainly to the craftsman's control over most aspects of his work. The level of job satisfaction associated with automated technology is generally more confusing. Robert Blauner has summarized his findings as follows:

> "In the early period, dominated by craft industry alienation is at its lowest level and the worker's freedom at a maximum. Freedom declines, and the curve of alienation rises sharply in the period of machine industry. The alienation curve continues upward to

> its highest point in the assembly-line industries of the 20th century .... The case of the continuous-process industries, particularly the chemical industry, shows that automation increases the worker's control over his work process and checks the further division of labour and growth of large factories. The result is meaningful work in a more cohesive, integrated industrial climate. The alienation curve begins to decline from its previous height as employees in automated industries gain a new dignity from responsibility and a sense of individual function - thus the inverted 'U' " (Blauner, 1964: 182).

In support of Blauner's thesis, Jon M. Shepherd has derived a curve-linear association between "phases in the man-machine relationship (craft, mechanized and automated) and each of five alienation scales (powerlessness, meaningless, normlessness, self-evaluative involvement and instrumental work orientation). With one exception, alienation was lower among craftsmen, reached a peak among assemblers, and declined again among monitors to a level below that of either assemblers or craftsmen " (Shepherd, 1971: 40).

Mueller et al. have also found that "workers with automated equipment tend to enjoy their work more often still than those with more traditional equipment " (Mueller et al. 1969: 34). Interestingly, this study found little difference between fixed mechanical levels of equipment operated (mechanized) and manual controlled equipment, and attitude towards the job as measured by whether the worker saw his job as enjoyable or drudgery (Mueller et al. 1969: 34).

The optimism of Blauner, Shepherd and Mueller concerning the benefits of automation have come under attack from several writers, among them William Faunce. In his study of an automobile plant which had recently moved from mechanical to automated technology, Faunce found both positive and negative attributes of automated production. Positive attributes included: greater worker responsibility, greater job importance, greater challenge for some of the workers, less material handling, less physical effort, and less fatigue.

Negative characteristics of automated jobs included: greater social isolation, compressed status hierarchy, greater alienation from actual work process, loss of control of work process and work pace, increased work tension and higher supervision levels.

In his study, Faunce found:

> "59 percent [of the respondents] reported being completely or well satisfied with automated jobs. On the other hand, in response to the question, "Would you rather work on automatic transfer machines as you do now, or on a "non-automated job?" approximately 72 percent of the respondents indicated that they preferred their present job" (Faunce, 1960: 374).

These results indicate a preference for automated jobs but as Faunce notes these findings 'should be interpreted with caution'. Faunce's data suggest that the structural changes which can be attributed to the change in production technology are sources of both satisfaction and dissatisfaction with jobs in the automated plant.

From the preceding review of the literature the following hypothesis has been derived:

Hypothesis #8 - Workers that work with mechanized, automated and manual types of technology will have successively higher group means for perceived job satisfaction.

Control Variables

Several variables that have been seen as potentially important by various authors will be introduced as control variables when assessing the relationship between blue-collar types of technology and their associated job characteristics. Included as control variables are occupation, sex, the size of plant, length with present employer, union membership, age, education and income.

1. Blue-Collar Occupation

Many writers have noted the significant differences found between various occupations and job satisfaction. These differences have a strong linear relationship with status. The importance of the role of occupation as a variable determining the nature of the job, as well as the level of job satisfaction will be noted.

It should however be recognized that a distinction is made in this thesis between 'occupation' and 'type of technology'. As noted earlier, several writers have used the occupation of 'craftsmen' as a type of technology. For our purposes, the term 'craftsmen' is used as one blue-collar occupation; the second blue-collar occupation being 'operator/labourer'. This distinction was found to be useful because the first socioeconomic occupational classification used in the United States divided manual workers into two classifications, craftsmen and labourers: "Craftsmen - the mechanics in various trades, whose admission into this category of skilled workers was thus dependent upon satisfying the traditional requirements of craft mastery. Labourers were all others; they were thus a residual class" (Braverman, 1974: 428).

In the 1930's, a revised analysis was undertaken which divided labourers into two parts. "Those who tended or operated machines, or attended mechanized processes, [were] called operatives. Labourers, still a residual category, now consisted of those nonfarm workers who were neither craftsmen nor machine operatives" (Braverman, 1974: 428).

It was simply by this reclassification, according to Braverman, that a distinction between semi-skilled and unskilled workers first came into being. This reclassification was not based on a study of occupational tasks, but "upon a simple mechanical criterion" (Braverman, 1974: 429). The assumption that a gap in skill exists between operatives and labourers has come under strong criticism from Braverman, 1974, Blauner, 1964, Fullan, 1971, Walker and Guest, 1952, Bright 1958 and Faunce, 1960, to name a few. The only valid distinction found in the literature is between craftsmen (skilled labour) and operators/labourers (semi-skilled, unskilled). These will be the two categories used in this analysis.

2. Sex

With the increased participation of women in the labour force and with the rise of the woman's liberation movement, many authors have attempted to analyze the different types of jobs related to sex. Ambert, for example, has noted that men consistently hold more prestigious jobs (Ambert, 1976: 86) and Shneider has found that in these more prestigious occupations, men, on the whole earn 55.25% more than females (Shneider, 1969: 495-496). Moreover, different occupations that women find themselves in generally require them to operate equipment more intensely. As Mueller et al. have found, 47% of women operate equipment almost constantly as compared to 40% for men (Mueller et al. 1969: 19). These authors go on to find that "men are more likely to report increased job satisfaction than women" (Mueller et al. 1969: 114).

3. The Size of the Plant

Mueller et al. have noted that automated equipment is found more frequently in larger plants (Mueller et al., 1969: 30-31). Blauner has also found that increasing the size of a plant reduces worker's identification with his work (Blauner, 1964: 177). The worker in a large factory usually is unable to see his actual contribution in the entire process. In this situation the worker feels unimportant and overlooked, which will in turn affect his attitude towards his job. We would therefore expect to find a strong relationship between the size of the plant and job satisfaction.

4. Length with Present Employer

The length of time a worker has worked for one employer generally affects his attitude towards his job. The data to be used in this study was undertaken during a time of economic prosperity (1962-1967), where it was relatively easy for people to change jobs in the hope of upgrading themselves. Mueller et al. have found that during this period those workers who have undergone a job change have generally increased their job satisfaction (Mueller et al., 1969: 111).

5. Union Membership

There is some indication that job conditions correlate with workers' union activity. Communication of problems between workers and management usually take place via unions and management. Hence we would expect to see a negative relationship between job satisfaction and union membership. This variable will therefore be controlled when assessing the effects of technology on job satisfaction.

6. Age

It has been found that there are more younger than older workers who operate equipment. In Mueller et al.'s study, 52% of those under age 25 operate equipment as compared to 38% for those 55 years or older (Mueller et al.,1969: 26). Similarily, Mueller also found that older workers are associated with manually controlled equipment while younger workers are more likely involved with fixed mechanical or numerical, tape, computer, or logically controlled equipment. This resulted in generally more satisfied younger workers and less satisfied older workers (Mueller et al.,1969: 113). However, reports of less job satisfaction occurred with the greatest frequency amongst the youngest and oldest workers (Mueller et al.,1969: 114).

7. Education

Mueller et al. have found that formal education is positively related to increased automation level of equipment employed (Mueller et al. 1969: 162). These authors have also found that increasing education is directly related to job satisfaction (Mueller et al. 1969: 113).

8. Income

Mueller et al. have found that "income change does indeed appear as the single most important determinant of job satisfaction, with a correlation coefficient of .30" (Mueller et al. 1969: 117). It was also found that income decreases are even more important in relation to job dissatisfaction (Mueller et al. 1969: 113-114). These authors have also looked at 'automation level' and 'income'. The highest paid workers, as a group, are those that work with numerical tape, computer or other logical control, with a median income of $8,200. They are followed by those that work with manually controlled equipment having a median income of $5,600, and with those that work with fixed mechanically controlled equipment having a median income of $5,300 (Mueller et al. 1969: 78). As Dubin states "income remains the all-important means for satisfying human wants and needs. Income from wages and salaries is the major incentive to work" (Dubin, 1958: 241).

All of the above variables have been considered important in the study of the worker and his job satisfaction. Each of these variables will be considered as potential control variables when assessing the effects of types of technology on the workers' perceived job characteristics and job satisfaction.

Summary

To summarize, this chapter has dealt with the various classificatory schemes of technology. Shortcomings of these methods have been illustrated and a slightly different typology has been put forward to be used in this thesis. In addition a review of the findings of previous studies has been undertaken. From these findings seven hypotheses have been derived which have attempted to link types of technology and their job characteristics. An eighth hypothesis dealing with types of technology and job satisfaction has also been developed after a more thorough analysis of the literature on this subject.

Several authors have dealt with other variables that have been deemed important. These variables have been found significant in accounting for variations in the employment setting, therefore they will be introduced in the following analysis as control variables.

CHAPTER III

METHODOLOGY

The following chapter is concerned with the methods used to test the hypotheses that have been derived in Chapter II. To begin with, a description of the data to be used will be undertaken. Following this, independent, dependent and control variables will be operationalized from available material. Finally a brief description of the statistical methods will be given.

Data

Data collected in 1967 by the Institute for Social Research at the University of Michigan will be used to test the hypotheses presented in the previous section. Some of the findings derived from this data set were published in Technological Advance in an Expanding Economy by Mueller, Hybels, Schmiedeskamp, Sonquist, Staelin. The prime focii for these researchers were to study the effect of machine change on (1) the economic aspects of the work force; (2) the levels of job satisfaction and contentment; and (3) the level of education and training.

The use of this data set proved to be useful because of the large sample size of 2,662 workers. Area probability sampling procedures were used in selecting respondents and interviews then took place in the respondents' homes. The representative nature of this sample was assessed by comparing three basic sample characteristics with corresponding estimates from the Current Population Survey of the U.S. Bureau of Census (see Mueller et al., 1969: 237-239). This comparison revealed that the age distributions between the two samples were quite similar. Education and sex were not, however, as closely associated, but ~~average~~ differences did not exceed 5 percent. Those chosen were, therefore, considered as a representative sample of the American labour force.

For this thesis, a sub-population of 962 blue-collar workers was obtained.[4] It was felt that this sample size was large enough to fill all the categories in order to make the calculations necessary for this thesis.

Problems Associated with Using Secondary Data

The use of secondary data sets limitations on the researcher in terms of an already existing data set. The lack of input in the development of a questionnaire limits the scope of enquiry of secondary analyses as was especially true in this study when it was found that skill level could not be obtained for the three types of technology.

A second problem associated with using secondary data is the inability to judge the rigor with which the initial survey was undertaken. This is especially true of interviewing and coding procedures. Some problems in understanding the coding procedure were also encountered.

Within these limitations it was still possible to develop a number of concerns that were thought to be important. Concerns that could not be adequately analyzed will be dealt with in the section on suggestions for future research.

Operationalization of Variables

1. Independent Variable : Type of Technology

Woodward, Blauner, Fullan, and Faunce start their analysis with the assumption that the workers in a given firm or industry are representative of a particular type of technology. This approach makes no attempt to differentiate the many types of technology to be found within each of these firms or industries.

A main difference between this study and those described above is the

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4. For a further analysis of the sub-category used see Appendix IV.

method used to classify workers according to types of technology. In order to establish a link between the individual worker and the type of technology he encounters on the job, workers are not classified according to a particular industry, but with regard to the varying degrees of control the worker has over the work process. As mentioned earlier Mueller et al. have used control as the basis for developing three categories of worker - machine relationships. These categories are interpreted for this study as 'types of technology'.

These three levels of control (manual, fixed mechanical and logical) are readily available in the form of an 'automation scale' (Mueller et al., 1969: 241-246). Coding for this scale was undertaken by graduate engineering students obtained by the Survey Research Centre. The type of machinery the employees worked with, and the type of control the worker has over this machinery were taken into consideration during coding. Each worker was then categorized according to six automation levels: (1) operator powered and controlled (2) powered single-system, manual control (3) powered multi-system, manual main control (4) fixed mechanical control (5) other logical control (6) numerical, tape or computer control. Subsequently this scale was reduced to three categories by Mueller et al. These are:

(1) Manual control which includes

  (a) operator powered or powered single-system and

  (b) powered multi-system.

(2) Fixed mechanical control

(3) Numerical, tape, computer or other logical control.

The most elementary form of control is <u>manual control</u> of equipment which is either powered by the operator or powered by machinery (Mueller et al., 1969: 242). No matter how the equipment is powered the control lies with the operator.

The second category of control is called <u>fixed mechanical control</u> (Mueller et al., 1969: 242). In this category a fixed operation or operations are set up in advance by the design of the equipment. These operations are repeated, producing identical products. Although the worker may have control over starting and stopping the operations he has lost control over the manner of operation, for this is built into the machine itself. This category includes a large variety of machines, among them much of the mass production and assembly-line equipment which best illustrates the lack of control the worker has over his work.

The third category may be called <u>logical control</u> (Mueller et al., 1969: 243). Equipment characterized by logical control is capable of having its operations programmed by the equipment itself. That is, the machine can use sensory units to pick up necessary data about the material to be processed. Employing feedback techniques, the machine is able to adjust its operation and/or modifies the sequence of available operations. Control of the actual operations in this category is by the machines. The worker can start or stop the machine but during the operation, the worker is only involved in monitoring the equipment and materials. This type of work environment is to be found where the mechanization of production and materials has reached the point where process operators neither see the product nor work on it directly with their hands. Instead they monitor the automatic control dials, inspect machinery, adjust valves, and record the data that describe the operations of the automated system.

The review of the literature established three types of technology; manual, mechanized and automated. To operationalize these classifications using the condensed automation scale described above is fairly straightforward. By eliminating the distinction between (1a) operator powered or powered single system and (1b) powered multi-system manual control, it will be possible to form one category: manual control of technology. There exists equivalence between (2) fixed mechanical control and mechanized technology. This is also true of (3) numerical, tape, computer or other logical control and automated technology. Therefore the three categories of the independent variable, type of technology,[5] will be:

1. Manual Control Technology - This type of technology will be operationalized by using the categories (1) operator powered and controlled (2) powered single system, manual control (3) powered multi-system, manual control.

2. Mechanized Technology or Fixed Mechanical Control. This will be operationalized from the (4) Fixed Mechanical Control level of the Automation Scale.

3. Automated Technology - This category will be operationalized by including
   (5) other logical control
   (6) numerical, tape or computer control as well as all those who fall into (4) fixed mechanical control but operate or help to run automatic equipment.

II Dependent Variables

The choice of dependent variables has been limited by the questions available in the primary study. The following variables of workers' perceived attitudes towards their work situation and towards job satisfaction have been operationalized below.

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5. For further elaboration of the questionnaire and coding categories see Appendix III.

Dependent Variables	Indicator of Perceived Attitudes[6]
1. Time Needed to Learn Equipment Used	Thinking now about just the equipment you use on your job, how long would it take someone with the same general education and training as you to learn to work properly with this equipment?
2. Time Spent Operating Equipment while on the Job	Do you use at least one piece or another of equipment some of the time, or almost constantly.
3. Degree of Repetition	Degree of repetition during R's operation of this equipment (and during set-up if that is a significant part of R's job).
4. Physical Mobility	Respondent's mobility while operating this equipment.
5. Ability to Talk	Do you have much chance to talk to other people during the time you are working?
6. Control over Work Pace	Control over respondent's work pace while operating or helping to run equipment during its normal operation.
7. Control over how Work is Organized	In some jobs how your work is organized depends mostly on you, yourself. In others, its pretty much determined by the equipment you work with, a production line, or by a number of people who have to work together. How is it with your job?
8. Job Satisfaction	On the whole do you feel that work on your present job is drudgery or is it all right or do you enjoy your work?

III Control Variables

For the purpose of this study eight potentially important variables (covariates) will be controlled when assessing the relationship between blue-collar technology and the workers' perceived attitude toward their work situation. These variables include:

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6. For further elaboration of the questionnaire and coding categories see Appendix III.

Control Variable	Indicator of Control Variable[7]
1. Occupation	Occupation of respondent
2. Sex	Sex of respondent
3. Size of Plant	About how many people are employed by your company or employer at the location where you work?
4. Length with Present Employer	How long have you worked with your present employer?
5. Union Membership	Is there some sort of union or professional society or association for people in your line of work? Do you belong to it?
6. Age	How old are you?
7. Education	Education of respondent
8. Income	Can you tell me about how much money you (R) made on your own main job last year?

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7. For further elaboration of the questionnaire and coding categories see Appendix III.

Statistical Analysis

The statistical method used in this thesis to examine the interrelationship between the independent and dependent variables is Multiple Classification Analysis (MCA). This method is useful as it gives easily interpretable tables of the means for all categories looked at. MCA can also control for the effects of other variables while showing how each predictor variable relates to the dependent variable (see Andrews, Morgan, Sonquist, Klem, 1973)

This statistical analysis has been undertaken with the use of the Statistical Package for the Social Sciences (SPSS). The Multiple Classification Analysis in SPSS is, however, limited in that only five covariates (control variables) are able to be adjusted for at one time. In order to overcome this problem the F ratio obtained from a Multiple Regression Analysis is used to eliminate the least important control variables before undertaking the Multiple Classification Analysis.

Possible interaction effects between the factors and the covariates is not examined in this analysis because Multiple Classification does not provide for this proceedure. Multiple Regression can look at interaction effects only with a great deal of effort. In the statistical proceedures that follow interaction effects between factors will be looked at when there are several of them.

The results obtained will be assessed according to two criteria, the first,that a statistical significance level of .05 or greater is considered acceptable, and secondly, that a minimum limitation for the fluctuation between the highest and lowest categories of 10% is considered meaningful. If both of these conditions are met the results will be considered as meaningfully supporting the hypothesis.

Summary

Chapter III has dealt with the methodology that is to be used in this thesis. We began with a short description of the secondary data to be used in this study, followed by a section on some problems associated with secondary data analysis. The next section dealt with the operationalization of the employed variables. In the fourth section the statistical procedures to be used were described briefly and a basis for supporting or rejecting the hypotheses was established.

CHAPTER IV

FINDINGS

In Chapter II, eight major hypotheses were derived from a review of the literature. In Chapter III the indicators used for testing these hypotheses were presented. In this chapter the results of the statistical analysis described previously will be presented in the form of Multiple Classification Analysis Tables. Then the hypotheses will be accepted or rejected according to the criteria mentioned in Chapter III.

1. Time Needed to Learn Equipment Used on the Job

The first hypothesis is:

> Workers that work with automated, mechanized and manual types of technology will have successively lower group means for perceived time needed to learn equipment used.

The results of a Multiple Classification Analysis (MCA) are given in Table 4.1. 'Type of technology' is found to be fairly strongly associated with the workers' perceived time needed to learn the equipment used. The relationship is in the direction predicted by the hypothesis, with workers that deal with manual technology perceiving their equipment as requiring less time to learn than those that deal with mechanized equipment. Likewise, workers that deal with mechanized technology perceive their equipment as requiring less time to learn than those that deal with automated equipment. When the effects of 'occupation' are controlled for, as in column 2, the differences become more accentuated, with a beta of .16 as compared to an eta (unadjusted) of .13. When controlling for the 'size of the plant', 'length with present employer', 'union membership', 'income' and 'sex', the relationship is slightly affected with a beta for this variable of .15 (significant

In general the differences between the manual, fixed mechanical, and automated categories remain relatively stable when unadjusted or adjusted by all the control variables.

The results in table 4.1 conform to the direction specified in hypothesis #1 and reach the established criteria for statistical significance and meaningfulness. Hypothesis #1 is, therefore, accepted.

TABLE 4.1

Workers' Perceived Time Needed to Learn Equipment Used by 'Type of Technology' (Independent Variable), Adjusted for the Covariates 'Occupation',[1] 'Size of Plant', 'Length with Present Employer', 'Union Membership', 'Income' and 'Sex'.[2]

Type of Technology	N[3]	Unadjusted Mean	Eta	Adjusted For 'Occupation' Mean	Adjusted For 'Occupation' Beta	Adjusted for All Covariates Mean	Adjusted for All Covariates Beta
Manual	278	5.29		5.21		5.24	
Fixed Mechanical	181	5.48		5.53		5.53	
Automated	100	6.33	0.13	6.46	0.16	6.41	0.15
Grand Mean = 5.54		Multiple R Squared			0.036		0.078
(For the Dependent Variable)		Multiple R			0.191		0.280

Significant at the .001 level

1. For an analysis using 'occupation' as an independent variable see Appendix II.

2. The covariates in all of the following tables have been limited to the most important. For further elaboration of the process used to derive these variables see Appendix I.

3. Responses that were not available were eliminated in all of the following tables.

From the results, it appears that technology plays a role in determining the time required to learn the equipment used on the job. As machinery increases in complexity, the time required to learn to operate it also increases. The notion that manual workers require less training appears to be supported by the results. This, however, does not necessarily mean that manual control requires less skill. The worker in this category is likely to be directly involved in controlling and guiding any equipment he does use. In this situation the machinery may be simple to learn, but the overall skill required to effectively control the equipment may be much more complex.

Even though mechanized jobs require more time to learn the use of their equipment used than do manual jobs, this does not necessarily indicate the level of on-going skills required once the equipment has been mastered. A question pertaining to the on-going skill requirements was unfortunately not asked in this survey. From these results we are able to conclude that manual workers require the least amount of time to learn the equipment used on the job. Workers that deal with mechanized technology require somewhat more time to learn their equipment, but the difference between these workers and manual workers are not meaningful. Workers that work with automated technology do require more time to learn to operate their equipment than mechanized technology and these differences are found to be meaningful. The hypotheses is, therefore, accepted.

Another variable which is found to have some effect on the dependent variable is 'occupation' (see Appendix II). The two categores for 'occupations', craftsmen and operator/labourer are found to have meaningful differences between group means when unadjusted and adjusted for 'type of technology'. When all of the covariates mentioned in Table 4.1 are adjusted for, the differences, however, fail to reach a meaningful level. The finding that craftsmen work with equipment which requires more time to learn than do operators/labourers is meaningful only until all the covariates are introduced.

These findings correspond with the earlier prediction that there is a distinction between the categories of 'manual technology' and 'craftsmen' with regard to the equipment used. Whereas the manual worker requires little time to learn to use the equipment on his job, the craftsman generally requires more time.

Besides 'occupation', the only covariate with any substantial effect on the dependent variable is 'income'. (see Appendix II) Income increases with the time needed to learn the equipment used. Of the total variation of the dependent variable income explains 1.8% (significant at the .001 level). One possible explanation of these results may be the need for a company to maintain enough of an incentive to keep the more highly trained worker from moving on. A firm has invested greater time in training this worker to do a certain job. Retraining a new worker would cost the company considerable time and money. By increasing the workers pay, it is less likely that he will look elsewhere for work.

2. Time Spent Operating Equipment

The second hypothesis is:

> Workers that work with automated, mechanized and manual types of technology will have successively lower group means for perceived time spent operating equipment while on the job.

The results presented in Table 4.2 are in the direction as predicted in hypothesis #2. Manual workers are less intensely involved in operating equipment than are those workers that deal with mechanized technology. It

TABLE 4.2

Workers' Perceived Time Spent Operating Equipment While on the Job by 'Type of Technology' (Independent Variable) Adjusted for the Covariates 'Occupation',[1] 'Size of Plant', 'Length with Present Employer', 'Education', 'Income' and 'Sex'.

Type of Technology	N	Unadjusted Mean	Eta	Adjusted for 'Occupation' Mean	Adjusted for 'Occupation' Beta	Adjusted for All Covariates Mean	Adjusted for All Covariates Beta
1. Manual	282	2.44		2.45		2.46	
2. Fixed Mechanical	190	2.56		2.56		2.55	
3. Automated	98	2.83	.20	2.81	.18	2.81	.18
Grand Mean = 2.55			Multiple R Squared		.049		.064
(For the Dependent Variable)			Multiple R		.222		.254

Significant at the .001 level or better

1. For an analysis using 'occupation' as an independent variable see Appendix II.

should be noted that the difference however, fails to reach a meaningful level. Workers that deal with mechanized technology are less intensely involved in operating equipment than are automated workers. This difference, however, does reach a meaningful level. The relationships between the three variables remains quite stable when controlling for 'occupation' (as in column 2) and then controlling for all the covariates (as in column 3). Totally, 'type of technology' has an eta of .20 which explains 4% of the total variation of the dependent variable (significant at the .001 level).

Manual workers, as the name implies, use their hands more than they do equipment. Automated jobs by contrast, appear to encourage the highest level of interaction with machinery. This is partially due to the longer time required to learn the automated equipment as shown in hypothesis #1. This generally leads to more specialization and greater division of labour which in turn results in the worker spending a larger amount of time operating equipment. The manual worker, in contrast, requires less time to learn to use equipment and is less likely to be involved with equipment at all.

The variable 'occupation' was also examined as an independent variable (see Appendix II). Although not meaningful, it is found that operators/labourers spent more time operating equipment on the job than do craftsmen. This variable, however, only has an eta of .13 which explains 1.69% of the total variation of the dependent variable (significant at the .05 level).

The total variation of the dependent variable that is explained by 'type of technology' when all the control variables mentioned above are adjusted for is 6.4%. When only 'occupation' is controlled for, this figure is reduced to 4.9% of the explained variation.

In conclusion we could say that the results for the dependent variable 'time spent operating equipment' are consistent with hypothesis #2; that is the results are in the same direction as the hypothesis, they reach a significance level beyond our requirements of .05 and the differences between the highest and lowest categories are great enough to be considered meaningful.

3. <u>Repetition</u>

The third hypothesis is:

> Workers that work with automated, mechanical and manual types of technology will have successively lower means for perceived repetition while operating equipment.

As can be seen from Table 4.3 there are substantial differences between group means for the various 'types of technology' and perceived repetition. This can be seen in the fact that this relationship has an eta of .45 (statistically significant at the .001 level).

Thus the proportion of the total variation of the dependent variable explained by 'type of technology' is the eta squared which equals 20%. Manual workers appear to have the least repetitive jobs, followed by fixed mechanical and then automated jobs. It appears as though fixed mechanical jobs are highly repetitive but not nearly as repetitive as automated jobs.

In the unadjusted column, the differences between all three 'types of technology' are meaningful. These differences remain meaningful when adjusting for 'occupation' and 'sex' (column 2) and when adjusting for all the covariates (column 3). The differences between categories contracts somewhat from column 1 to column 2, because of the importance of the covariates 'occupation' and 'sex'. Little change is seen however, between column 2 and column 3 where all the covariates are controlled for. This would indicate that the covariates 'size of plant', 'union membership' 'age' and 'income' have little effect on the dependent variable.

One possible explanation for the differences in the amount of repetition associated with each type of technology may be due to the effects of the machinery used on the job. Usually a machine is based on a cyclical pattern, proceeding through a number of steps and starting over again, usually in a fixed amount of time. Repetition when dealing with this type of equipment is inevitable.

As compared to the other types of technology, manual workers are much less intensely involved in using any equipment on the job. Because of this we would expect a greater diversity of activities and less repetitive types of work.

In mechanized technology, the worker is more intensely involved in the use of machinery which generally promotes a more repetitive work environment. The worker usually has to start the machines, feed it material, watch it proceed through its cycle, remove the completed product and begin the process over again.

Whether automation promotes repetition has been a point of controversy. Those that hold the point of view that automation reduces the routine of the factory see the worker in this work situation as having an increased number of work activities that he is involved in. This is due to the greater number of machines he is responsible for and the greater complexity of these machines. The opposing view argues that monitoring a number of machines in an automated factory is a tightly-scheduled highly-repetitive activity. The second viewpoint appears to be consistent with the results obtained in this study.

When analyzed as an independent variable, 'occupation' was found to be strongly associated with repetition. After controlling for 'type of technology', 'sex', 'size of plant', 'union membership', 'age', and 'income' a beta of .33 was found. Craftsmen appear to have considerably less repetitive jobs than operators/labourers. This can be explained by the limited division of labour usually associated with craft technology. By working on

TABLE 4.3

Workers' Perceived Degree of Repetition While Operating Equipment by 'Type of Technology' (Independent Variable), Adjusting for the Covariates 'Occupation',[1] 'Sex', 'Size of Plant', 'Union Membership', 'Age' and 'Income'.

Type of Technology	N[2]	Unadjusted Mean	Eta	Adjusted for For 'Occupation' and 'Sex' Mean	Adjusted for For 'Occupation' and 'Sex' Beta	Adjusted for All Covariates Mean	Adjusted for All Covariates Beta
1. Manual	117	2.45		2.86		2.88	
2. Fixed Mechanical	86	4.36		4.04		4.04	
3. Automatic	47	5.92	.45	5.49	.33	5.43	.32

Grand Mean = 3.76	Multiple R Squared	.461	.472
(For the Dependent Variable)	Multiple R	.679	.687

Significant at the .001 level or better

1. For an analysis using 'occupation' and 'sex' as independent variables see Appendix II.

2. Those self-employed and those who do not use equipment intensely were eliminated.

a larger portion of the finished product the repetitive nature of this type of work is reduced.

'Sex' was also analyzed as an independent variable in this case, because of its high correlation with the dependent variable (see Appendix II). It was found that females are more likely to have repetitive types of jobs than males. When adjusting for independents and covariates the group means between males and females differed 2.29 from a grand mean of 3.76 with a beta of .29, (significant at the .001 level). This difference can be attributed to the fact that women generally hold different types of jobs than men. These jobs appear to be more directly related to working with equipment (see Mueller et al. 1969: 19) and hence repetition is more likely in this work situation.

In conclusion, the results strongly support hypothesis #3, 'type of technology' explaining 20% of the variable 'repetition'. The total variation explained by 'type of technology', 'occupation' and 'sex' as seen by the multiple R squared is 46.1%. When adding the control variables 'size of plant', 'union membership', 'age', and 'income', the explained variation only rises to 47.2%. These findings indicate that these control variables are relatively unimportant as determinants of repetition.

4. Physical Mobility

The fourth hypothesis is:

> Workers that work with automated, mechanized and manual types of technology will have successively higher group means for perceived physical mobility while operating equipment.

As can be seen in Table 4.4 the only meaningful effect on perceived physical mobility is 'type of technology', which has an eta of .35 (significant at the .001 level. When the eta is squared this reveals that 12.25% of the total variation of the dependent variable is explained by 'type of technology'. As predicted in the fourth hypothesis, manual workers perceive greater mobility while fixed mechanical and automated workers are more likely to work at single work stations. The difference in means is .67 or a 44% variation between means for the manual and automated categories when adjusted for 'occupation', 'size of plant', 'length with present employer', 'union membership', 'income' and 'sex'. Adjusting for the covariates listed above, had no meaningful effect as can be seen by the relative stability found between the unadjusted and two adjusted columns.

The differences in group means between the 'types of technologies' for perceived physical mobility can be accounted for in many ways. One explanation is that manual workers, as was shown earlier, are less intensely involved with using machinery, which limits the worker's mobility. Also, the manual worker generally works on a greater number of tasks or a greater portion of a product. These characteristics tend to encourage a work environment with a good deal of physical mobility.

From Table 4.4 it is clear that there is a meaningful distinction for perceived physical mobility between manual and mechanical workers. The worker who deals with mechanized technology usually is involved with relatively large, immobile machinery, as found in most factories today. The mechanized factories have been the target of time and motion studies which have analyzed the worker's physical activities in an attempt to limit his motions in order to increase efficiency (see Frederick Taylor, 1947). In this way management has attempted to extend the logic of machinery to the human operators. In this work situation the worker is very likely to be physically limited to one geographical place doing a very few number of tasks and motions.

To some authors automated technology encourages physical mobility, to others it limits physical mobility. The optimistic viewpoint is derived

TABLE 4.4

Workers' Perceived Physical Mobility While Operating Equipment by 'Type of Technology' (Independent Variable), Adjusting for the Covariates 'Occupation', 'Size of Plant', 'Length with Present Employer', 'Union Membership', 'Income' and 'Sex'.

Type of Technology	N[1]	Unadjusted Mean	Eta	Adjusted for 'Occupation' Mean	Adjusted for 'Occupation' Beta	Adjusted for All Covariates Mean	Adjusted for All Covariates Beta
1. Manual	114	1.84		1.86		1.85	
2. Fixed Mechanical	85	1.27		1.25		1.25	
3. Automatic	45	1.20	0.35	1.17	0.38	1.18	0.37

Grand Mean = 1.52	Multiple R Squared	0.132	0.165
(For the Dependent Variable)	Multiple R	0.364	0.406

Significant at the .001 level or better

1. Those self-employed were eliminated.

from a perspective that the worker has to make rounds in order to monitor all the equipment he is responsible for. The opposing viewpoint sees the operator sitting at a console monitoring, by television, many meters. The results from this study confirm the latter view in that workers in plants are the most physically immobile of the three groups. The differences between the mechanical and automated categories, however, fail to reach a meaningful level although there is a large difference between the group means for automated and manual technology as well as mechanized and manual technology.

It should be noted as well that none of the introduced covariates looked at proved to be statistically significant at the .05 level, except for 8union membership' which proved to be only weakly related to physical mobility. This can clearly be seen by dividing the sum of squares for 'union membership' by the total sum of squares. As a result, 'union membership' explains 2.56% of the total variation of the dependent variable (at the .008 significant level). Union members or members of work organizations appear to have greater perceived physical mobility than do non-members.

In conclusion, we find that 'types of technology' have meaningful differences for perceived physical mobility. The results confirm the hypothesis: workers that work with automated, mechanized and manual types of technology have successively higher group means for perceived physical mobility while operating equipment.

5. Ability to Talk

The fifth hypothesis is:

> Workers that work with automated, mechanized and manual types of technology will have successively higher group means for perceived ability to talk while working.

The findings presented in Table 4.5, although very weak, are in the directed predicted by the hypothesis. Manual workers perceive a slightly greater ability to talk while working. Workers that work with automated technology are slightly less able to talk than those who work with mechanized technology, although none of the differences prove to be meaningful. When adjusted for 'occupation', 'length with present employer', 'union membership', 'age', 'education' and 'income' the relationship nearly disappears with a beta of only .03. Also the variable 'type of technology' fails to reach the .05 significance level and was considered statistically insignificant.

Although slight, these differences coincide with the notion that increasing automation interferes with the ability to communicate. This is due to several factors including the workers greater interaction with machinery, the more noise usually produced by this machinery, the physical isolation necessitated by the distances between machinery, the lack of physical mobility and the greater repetition associated with increasing automation.

Why these relationships are not stronger may be explained in part by a two-way interaction between 'type of technology' and 'occupation' that was found in this analysis. This interaction accounted for 1.48% of the total variation of the dependent variable (at the .009 significant level). It should be noted that this interaction renders the figures in Table 4.5 problematic to some extent as some of the variation has been absorbed by the variable 'occupation'.

This may be why 'occupation' appears to be somewhat more meaningful than 'type of technology' when adjusted for independents and covariates. This variable has a beta of .20 which is significant beyond the .001 level. (see Appendix II) Craftsmen are able to talk more frequently while working than do operators/labourers. This is partially explained by the need for

TABLE 4.5

Workers' Perceived Ability to Talk While Working by 'Type of Technology' (Independent Variable), Adjusting for the Covariates 'Occupation',[1] 'Length with Present Employer', 'Union Membership', 'Age', 'Education', and 'Income'.

Type of Technology	N	Unadjusted Mean	Eta	Adjusted for 'Occupation' Mean	Adjusted for 'Occupation' Beta	Adjusted for All Covariates Mean	Adjusted for All Covariates Beta
1. Manual	291	2.57		2.54		2.53	
2. Fixed Mechanical	196	2.47		2.49		2.51	
3. Automatic	98	2.42	0.08	2.46	0.04	2.46	0.03
Grand Mean = 2.51		Multiple R Squared			0.038		0.093
(For Dependent Variable)		Multiple R			0.196		0.306

1. For an analysis using 'Occupation' as an independent variable see Appendix II.

the craftsman to deal with less machinery which in turn increases physical mobility. In this work situation, the craftsman also finds talking an important aspect of the job.

Of all the control variables only 'age' appears important, explaining 4.6% of the total variation of the dependent variable (at a significance level of .001). This relationship is of a negative nature which means that younger workers perceive greater ability to talk on the job than do older workers.

In conclusion, we could say that the results found in Table 4.5 are in the direction predicted by hypothesis #5. These results are, however, too weak to support the hypothesis. The two-way interaction between 'type of technology' and 'occupation' makes the interpretation of the results problematic. More important in explaining ability to talk are the variables 'occupation' and 'age'. Hypothesis #5, therefore, is rejected.

6. Control Over the Work Pace

The sixth hypothesis is:

> Workers that work with automated, mechanized and manual types of technology will have successively higher group means for perceived control over the work pace while operating equipment.

From Table 4.6 those who operate manual equipment have the greatest perceived control over work pace, while those who work with automated technology have the least perceived control over their work pace. These results support the hypothesis presented above. The differences between the manual and mechanized categories is meaningful when unadjusted. When adjusted for 'occupation' and 'sex' the differences between these two categories diminishes and fails to reach the 10% criterian for meaningfulness. The differences between mechanical and automated technologies remain meaningful in all three columns. In general, the differences for all three categories

TABLE 4.6

Workers' Perceived Control Over Work Pace While Operating Equipment by 'Type of Technology' (Independent Variable), Adjusting for the Covariates 'Occupation',[1] 'Sex',[1] 'Size of Plant', 'Length with Present Employer', 'Union Membership', and 'Age'.

Type of Technology	N[2]	Unadjusted Means	Eta	Adjusted for 'Occupation' and 'Sex' Mean	Adjusted for 'Occupation' and 'Sex' Beta	Adjusted for All Covariates Mean	Adjusted for All Covariates Beta
1. Manual	121	3.81		3.72		3.71	
2. Fixed Mechanical	83	3.45		3.54		3.54	
3. Automatic	48	2.80	.39	2.87	.32	2.89	.31
Grand Mean = 3.50		Multiple R Squared		.266		.75	
(For the Dependent Variable)		Multiple R		.516		.525	

Significant at the .001 level or better

1. For an analysis using 'Occupation' and 'Sex' as independent variables see Appendix II.

2. If respondents were self-employed they were eliminated.

decrease when 'occupation' and 'sex' are controlled but remain stable when all the covariates are adjusted. Combined 'type of technology' has an eta of .39 which accounts for 15.21% of the total variations of the dependent variable. This reduces to a beta of .32 when adjusting for 'occupation' and 'sex' and a beta of .31 when adjusting for all covariates.

As mentioned earlier, most machinery is usually based on a cyclical pattern. If the worker is involved in working with this machinery - as in fixed mechanical control, the machine will determine the work pace. In automated technology, similarily, the expensive equipment and operations entail a high level of responsibility to punctually inspect and monitor the equipment. Control over the work pace is taken over by the demands of the machine. The worker in this work situation loses his choice over work pace. These results contradict Blauner's findings that automation allows the worker discretion over when to 'make the rounds' and when to relax. The findings presented above endorse the idea that automation reduces the discretion over work rhythms because decision when to work, once made by man, have now been taken over by the machine and its requirements.

It was also found that 'occupation' and 'sex' are highly correlated to the control over the work pace. Both were therefore looked at as independent variables. It was found that craftsmen have greater control over their work pace, than do operators/labourers. (see Appendix II) The beta for this relationship is .18 (at the .001 significance level), after controlling for 'type of technology', 'sex','size of plant', 'length with present employer', 'union membership' and 'age'. These results can be explained by the nature of the craftsman's job which requires a good deal of freedom to create a more unique product. Operators/labourers, in general, are more intensely involved with machinery than craftsmen. This work situation limits the control the worker has over his work pace.

'Sex', as an independent variable, when controlled by all the variables listed above, had a beta of .24 (at the .001 significance level). Generally, males have greater control over their work pace than do females. This finding can be accounted for by the greater percentage of females that work with equipment on the job.

Together, the three independent variables 'type of technology', 'occupation' and 'sex' account for 10.24% of the total variation of the dependent variables - control over work pace. When adjusting for the control variables a decrease to 9.61% can be observed which suggests that little importance is to be found in any of the control variables.

A slight two-way interaction between 'type of technology' and 'sex' accounted for 2.2% of the total variation of the dependent variable (at the .024 significance level). This should be noted, as this makes the results somewhat problematic.

In conclusion, the data supports the hypothesis that workers who work with automated, mechanized and manual types of technology will successively have higher group mean for perceived control over their work pace while operating equipment. Craftsmen, as well, have meaningfully higher control over their work pace then do operators/labourers. Also, males perceive greater control over their work pace than do females.

7. Control Over How Work is Organized

The seventh hypothesis is:

> Workers that work with automated, mechanized and manual types of technology will have successively higher group means for perceived control over how their work is organized.

As was found with the variable 'control over work pace', manual workers also have the greatest perceived control over how their work is organized. Workers that deal with fixed mechanical technology have less control over how their work is organized than do manual workers but greater control than do workers that work with automated technology. As can be seen from Table 4.7 'type of technology' has an eta of .14 (at the .144 significant level). It should, however, be noted that adjusting for 'occupation' and 'sex' reduces the deviation with a beta of only .08. The beta remains the same when adjustments for all covariates are included. Although the deviations for the 'type of technology' are in the direction predicted by hypothesis #8, the differences are too weak to prove meaningful.

What proves to be more important for this variable is 'occupation' which has a beta value when adjusted by independents and covariates of .20 (at the .001 significance level). (see Appendix II). This analysis proves to be meaningful with craftsmen having higher levels of control over how their work is organized than do operators/labourers. One explanation is the greater skill and responsibility the individual craftsman needs to deal with a variety of problems which daily confronts him. The craftsman also requires a great deal of freedom in order to maintain a high standard of quality.

'Sex' also proves to be of some importance in determining control over how work is organized with males having greater perceived control over how their work is organized than do females. Initially, the unadjusted differences between group means has an eta of .24 which is reduced to .13 (at the .001 significance level) when controlling for both independents and covariates. Once again this may result of the different occupations women generally find themselves in. Also the lower status occupations that women are forced into result in a situation where decisions as to how the work is organized are made by their bosses, who are usually men.

Combined the independent variables 'type of technology', 'occupation' and 'sex' explain 11.3% of the total variation of the dependent variable

TABLE 4.7

Workers' Perceived Control Over How Their Work is Organized by the 'Type of Technology' (Independent Variable), Adjusting for the Covariates 'Occupation',[1] 'Sex',[1] 'Size of Plant', 'Union Membership', 'Education', and 'Income'.

Type of Technology	N	Unadjusted Mean	Eta	Adjusted for 'Occupation' and 'Sex' Mean	Adjusted for 'Occupation' and 'Sex' Beta	Adjusted for All Covariates Mean	Adjusted for All Covariates Beta
1. Manual	273	4.58		4.45		4.44	
2. Fixed Mechanical	180	4.33		4.45		4.45	
3. Automatic	87	3.92	0.14	4.09	0.08	4.11	0.08
Grand Mean = 4.39		Multiple R Squared		0.113		0.124	
(For the Dependent Variable)		Multiple R		0.337		0.353	

1. For an analysis using 'Occupation' and 'Sex' as independent variables see Appendix II.

(see multiple R squared). When controlling for 'size of plant', 'union membership', 'education' and 'income', the explained variation increases only 1.1% to 12.4%.

To summarize, although the results are in the direction predicted, the magnitude of the differences as well as the statistical level are insufficient to meaningfully support hypothesis #8. However, it was found that the variables 'occupation' and 'sex', when used as independent variables, are meaningful in explaining some of the deviations found in the dependent variable.

8. Job Satisfaction

The eighth hypothesis is:

> Workers that work with mechanized, automated and manual types of technology will have successively higher group means for perceived job satisfaction.

From Table 4.8 it can be concluded that those that work with manual technology enjoy their job the most. Contrary to hypothesis #8, workers that work with fixed mechanical technology are slightly happier with their jobs than those that work with automated technology. The difference in means between manual and automatic categories is .65 or a 7.4% variation when adjusted for by all covariates (column 3). 'Type of technology' has an eta of .12 which explains 1.44% of the total variation of the dependent variable (at the .045 significance level). This deviation is only slightly affected when adjusting for 'occupation' and 'sex' (column 2), as well as when adjusting for all covariates (column 3).

The results in Table 4.8 are contradictory to hypothesis #8. This hypothesis has been derived from a review of the writings of such authors as Blauner, Mueller et al., and Shepherd, who have found that workers that work with automated technology have greater perceived job satisfaction than

TABLE 4.8

Worers' Perceived Job Satisfaction by 'Type of Technology' (Independent Variable), Adjusting for the Covariates 'Occupation',[1] 'Sex',[1] 'Size of Plant', 'Length with Present Employer', 'Age', and 'Education'.

Type of Technology	N	Unadjusted Mean	Eta	Adjusted for 'Occupation' and 'Sex' Mean	Beta	Adjusted for All Covariates Mean	Beta
1. Manual	294	8.91		8.88		8.89	
2. Fixed Mechanical	198	8.59		8.59		8.59	
3. Automatic	99	8.18	.12	8.25	0.10	8.24	.11

Grand Mean = 8.68	Multiple R Squared	0.037	0.041
(For the Dependent Variable)	Multiple R	0.194	0.203

Significant at the .05 level or better

1. For an analysis using 'Occupation' and 'Sex' as independent variables see Appendix II.

do those that work with mechanized technology and 2) workers that work with manual technology have greater perceived job satisfaction than those that work with mechanized technology.

The results, as presented in Table 4.8, support the former findings of these authors but contradict the latter findings. The notion that automation will result in greater job satisfaction than mechanization is based on the belief that there are more challenging jobs found in automated work settings than are available in mechanized work settings. The most articulate spokesman of this viewpoint is Robert Blauner (1964) who sees automation as increasing the worker's skill requirements, increasing his chances for promotion, increasing responsibility, increasing control over work pace, increasing physical mobility and, increasing control over how work is organized. Blauner concludes that alienation is highest in mechanized technology and decreases in automated technology.

This study's finding that automated technology results in lower perceived job satisfaction than mechanized technology is supported by the previous results that increasing automation (from manual, through mechanized to automated technology) increases the time spent operating equipment, (hypothesis 2), increases repetition, (hypothesis 3), reduces physical mobility, (hypothesis 4), reduces the ability to talk on the job, (hypothesis 5), reduces the worker's control over the work pace, (hypothesis 6), and reduces the control the worker has over how his work is organized, (hypothesis 7). These results indicate that social structural changes which can be attributed to increasing automation are sources of job dissatisfaction. Part of the explanation can be found in the lack of control over how the work is organized, as well as the lack of control over the work pace which contribute to a sense of powerlessness, forcing the worker to comply with the demands of the machine. In the less automated types of technology the worker controls the machine and his work pace, providing a greater feeling that it is the worker who is actually producing the product. This feeling is absent in the automated plant where the worker feels that it is the machine which produces the product not the worker.

The results in this study are at odds with Mueller et al's. findings that increasing automation increases job satisfaction. These authors' results are obtained using the same data as are used in this thesis but include the entire sample of 2,662 individuals, which is supposedly a representative sample of the total American labour force. Mueller at al. have found that 91% of workers that work with the most automated equipment find their job enjoyable. In fixed mechanical category 78% found their job enjoyable, while 75.5% in the manual control category reported their job to be enjoyable (Mueller et al., 1969: 34).

One main reason for the differences between Mueller's findings and the findings of this study, which are in the opposite direction for perceived job satisfaction, is the sample used. The sample for this study included a sub-sample of only blue-collar workers. The effect of technology on white-collar workers may be totally different than for blue-collar workers. This may be due to the increased status of working with the most advanced levels of automation. As well, disdain for physical labour is a trait generally associated with white-collar workers. This conclusion was supported by Shepherd (1971) who studied alienation among blue and white-collar workers. For white-collar workers, he concluded that "Except for powerlessness, computer operators (automated technology) tended to be less alienated than workers in either the non-mechanized or the mechanized man-machine relationship" (Shepherd, 1971: 109). He goes on to elaborate that a curvilinear relationship between the phases in the man-machine relationship and alienation appeared for white-collar workers. Although these results are beyond the scope of this thesis, it would be interesting for future research to compare the effects of technology on blue-collar and white-collar workers.

'Occupation' is essential in determining job satisfaction. Craftsmen respond with much more positive attitudes towards their jobs than do operators/labourers. When the variable 'occupation' is looked at as an independent variable, it has an eta of .15 (see Appendix II). This finding seems to support the previous results, namely that craftsmen spend less time operating equipment, have less repetitive jobs, have greater ability to talk on the job, have greater control over their work pace, and greater control over how their work is organized than do operators/labourers.

The variable 'sex', when used as an independent variable, has an eta of .001. This variable, however, becomes more important when adjusted for 'type of technology' and 'occupation', with a beta of .08. This increases to .09 when all the covariates are adjusted for. In general, males are slightly less satisfied with their jobs than are females. This is unexpected as the previous results have found that males have significantly less repetitive jobs than females, greater control over their work pace and greater control over how their work is organized. The discrepancies between these results seem to indicate a difference in the expectations between sexes of what is considered a satisfactory work environment. This discrepancy may be due to differences in socialization where the woman often considers her job as temporary and as supplementary to her husband's. General acceptance by women of jobs that offer less control than their males co-workers under these conditions is therefore understandable.

Combined 'types of technology', 'occupation', and 'sex' explain 3.7% of the total variation of the dependent variable 'job satisfaction' (see multiple R squared). When the covariates are added, the variation explained only increases to 4.1%, indicating relatively little importance to be found among these variables. In general, hypothesis #8 has been rejected because the results are not meaningful. Some evidence is found however, to support a revised hypothesis which would suggest that workers in manual, mechanized and automated technologies have successively lower group means for perceived job satisfaction.

Two further tables were obtained to determine the effect that 'type of technology' has on the workers' attitudes toward their equipment and toward automation in general. Although no hypotheses were formulated, it was felt that these two tables add some additional light on how 'type of technology' affect work attitudes.

From Table 4.9, it can be concluded that workers that deal with manual types of technology like the equipment they work with slightly more than those who work with fixed mechanical and automated types of technology. However, no meaningful differences are found between the mechanical and automated categories. When adjusted for 'occupation', 'size of plant', 'length with present employer', 'union membership', 'education' and 'income', it is found that 'type of technology' has a beta of .12 (at the .011 significance level).

In Table 4.10, those workers that work with fixed mechanical technology dislike automation moreso than either manual or automatic categories. These results are, however, statistically insignificant. Similarily, operators/labourers appear to have greater dislike for automation than do craftsmen. This relationship is also statistically insignificant.

Together, 'type of technology' and 'occupation' explain .8% of the total variation of the dependent variable. Adding the control variables 'size of plant', 'union membership', 'age', 'education' and 'income' the total explained variation increases to 3.7% of the dependent variable - dislike of automation.

TABLE 4.9

Workers' Perceived Dislike of Equipment Worked With by 'Type of Technology', (Independent Variable), Controlling for the Covariates 'Occupation', 'Size of Plant', 'Length with Present Employer', 'Union Membership', 'Education', and 'Income'.

Type of Technology	N	Unadjusted Mean	Eta	Adjusted for 'Occupation' Mean	Adjusted for 'Occupation' Beta	Adjusted for All Covariates Mean	Adjusted for All Covariates Beta
1. Manual	277	.96		.97		.99	
2. Fixed Mechanical	184	1.38		1.37		1.36	
3. Automatic	92	1.39	.14	1.36	.13	1.34	.12
Grand Mean = 1.17		Multiple R Squared		.022		.036	
(For the Dependent Variable)		Multiple R		.150		.191	

Significant at the .01 level or better.

TABLE 4.10

Workers' Perceived Dislike of Automation by 'Type of Technology' (Independent Variable), Controlling for the Covariates 'Occupation', 'Size of Plant', 'Union Membership', 'Age', 'Education', and 'Income'.

Type of Technology	N	Unadjusted Mean	Eta	Adjusted for 'Occupation' Mean	Adjusted for 'Occupation' Beta	Adjusted for All Covariates Mean	Adjusted for All Covariates Beta
1. Manual	279	-0.05		-0.03		-0.02	
2. Fixed Mechanical	191	0.08		0.07		0.06	
3. Automatic	95	-0.01	.04	-0.04	.04	-0.05	.03

Grand Mean = 2.79	Multiple R Squared	0.008	0.037
(For the Dependent Variable)	Multiple R	0.092	0.191

It was also found that as education increases respondents had a more positive attitude towards automation. 'Education' explained .7% of the total variation found in the dependent variable (at the .044 significance level). These results are consistent with Mueller et al's. finding that education is directly related to the level of machinery dealt with (Mueller et al., 1969: 161-162) and that "attitudes towards automation grow much more favourable with increases in formal education" (Mueller et al., 1969: 170). This may be due to the fear that automation may take over the job of the less educated worker, while those that work with the highest levels of technology generally feel indispensable for the smooth operation of equipment.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

The purpose of this thesis was to examine the effects of technology on the worker's perceived work situation and the attitudes of the worker to this work situation.

From a review of the literature undertaken in Chapter II, three 'types of technology' were established based on varying control over the machinery used on the job. The categories derived were manual, mechanical and automated.

A review of the writings of various authors has emphasized several areas of importance to the worker in assessing the quality of his job. Due to the constraints of using secondary data, this thesis was limited to looking at only eight aspects of the work situation. These eight dependent variables included: 'time needed to learn equipment used', 'time spent operating equipment', 'repetition', 'physical mobility', 'ability to talk on the job', 'control over the work pace', 'control over how the work is organized' and 'job satisfaction'. All eight job characteristics were related to the three types of technology - manual, mechanical and automated. From this analysis eight hypotheses were derived which ranked the three types of technologies according to the eight job characteristics.

Chapter II concluded with the listing of seven other potentially important variables that have also been considered relevant in the study of technology or job satisfaction. Once again these control variables were limited to the available data. These variables included: 'occupation', 'sex', 'size of plant', 'length with present employer', 'union membership', 'age' and 'income'.

In Chapter III the three categories of the independent variable - 'type of technology', the eight dependent variables and the seven control variables were operationalized from the available data.

The third chapter also established the statistical methods and criteria for assessing statistical significance and meaningfulness.

The fourth chapter presented the results of the statistical manipulations. It was found that increasing levels of automation - from manual to mechanical to automated technology had the effect on the worker's perceived attitudes of:

1. increasing the time required to learn the equipment used
2. increasing the time spent operating equipment
3. increasing repetition
4. decreasing physical mobility
5. decreasing the ability to talk on the job
6. decreasing the control over the work pace
7. decreasing the control over how the work is organized
8. decreasing job satisfaction.

All of the above results are in the same direction as predicted by the hypotheses, except for the final result (8). It was predicted from a review of the literature that mechanized, automated and manual types of technology would successively have higher group means for perceived job satisfaction. However the results from this study suggest that increasing automation will result in decreasing job satisfaction.

Of the seven hypotheses that were supported by the findings with regard to direction, only five of these met the criterion for a significance level greater than .05 and a meaningfulness criterion of 10% differences between the two extreme categories. The five hypotheses that met all the criterion for acceptance are:

1. Workers that work with automated, mechanized and manual types of technology will successively have lower group means for perceived time needed to learn the equipment used.

2. Workers that work with automated, mechanized and manual types of technology will successively have lower group means for perceived time spent operating equipment on the job.

3. Workers that work with automated, mechanized and manual types of technology will successively have lower group means for perceived repetition on the job.

4. Workers that work with automated, mechanized and manual types of technology will successively have higher group means for perceived physical mobility on the job.

5. Workers that work with automated, mechanized and manual types of technology will successively have higher group means for perceived control over the work pace.

Conclusions

Overall, the belief that technology plays a major role in affecting the work situation has been supported in this thesis. Five of the eight hypotheses were found not only to be statistically significant, but were also found to have meaningful differences between 'types of technology'.

From the results of this thesis, the characteristics of manually controlled technology tend to encourage job satisfaction. Manual workers spend less time operating equipment and as a result have less repetitive jobs, greater physical mobility and greater opportunity to talk on the job. They also have greater control over their work pace and more control over how their work is organized as they are not compelled by the machinery they operate to perform specified tasks in specified ways at specified times.

Workers that work with mechanized types of machines are not as satisfied with their jobs as the manual workers. Not only is this finding supported by the direct question "On the whole do you feel that work on your present job is drudgery or do you enjoy it?" but also indirectly by the results of the questions having to do with the job situation. Workers in mechanized technology interact much more frequently with equipment on their job, and have much more repetitive jobs. Since their physical mobility is restricted to the vicinity of the machinery, social interaction is limited. The worker in this work situation has little control over his work pace or how his work is organized as the machinery he deals with has incorporated these into its design.

Workers in automated technology have been found to be least satisfied with their jobs when asked the direct question "On the whole do you feel that work on your present job is drudgery or do you enjoy it?" This conclusion has been supported by the other results which have found that these workers require considerably more time to learn the equipment used on the job. This in turn leads to the highest level of interaction with technology as this group spends the most time operating equipment. As a result, these jobs are characterized by a great deal of repetition. Physical mobility is also greatly limited and the ability to talk on the job is curtailed. As opposed to several writers, this study has found that automated jobs offer the worker the least control over the work pace and the least control over how his work is organized. This is due to the automated machinery that require periodic monitoring. As Rinehart has noted there is only one way to read a dial and this must be done repeatedly at specific times of the day.

The findings of this thesis uphold the contention that increasing automation decreases job satisfaction. The process of absorbing the physical work of men into mechanical actions of machinery may decrease the physical hardships encountered by the worker on the job but this process in turn leaves the worker uninvolved - a mere spectator in the process of production. The worker in this work situation faces little challenge or opportunity for self-expression. Gratification in such a work situation becomes difficult if not impossible.

The most important control variable that has been used in this analysis has been '<u>occupation</u>'. The results indicate that craftsmen have a much better work environment and greater job satisfaction than do operators/ labourers in all of the analyses that were undertaken using 'occupation' as an independent variable (see Appendix <u>II</u>). The conclusions suggest that in comparison to operators/labourers, craftsmen have work situations that promote:

1. greater time to learn the equipment used on the job
2. less time spent operating equipment
3. less repetitive work
4. greater opportunity to talk on the job
5. greater control over the work pace
6. greater control over how work is organized
7. greater job satisfaction.

With the exception of 'time required to learn equipment used', the notion that manual control of technology promotes similar job characteristics to the 'occupation' of craftsmen has been supported by this thesis. It should be noted however, that these similarities exist in spite of the lack of any overlap in categories.

It was shown that occupations do not necessarily lead to any one type of technology which could account for the similarities between manual workers and craftsmen. One possible explanation for these similarities could be that the less time spent operating equipment, a characteristic of both manual workers and craftsmen, encourages the same job characteristics. This notion is consistent with the belief that increasing use of machinery curtails job satisfaction and lends support to the argument that the machinery itself is a prime determinant of a job's characteristics.

'Sex' was also found to be an important control variable in determining the characteristics of the job encountered. The results, although weak, found women slightly more satisfied with their jobs than men (see Appendix II). This notion conflicts with the findings that in comparison to men, women are in jobs that encourage greater repetition, less control over the work pace, and less control over how work is organized. This discrepancy may be explained by the notion that women have been socialized to expect less from work and are satisfied even though their work situations are not generally as good as men's.

Limitations of the Thesis

There are a number of limitations to the present study which should be brought to the reader's attention. This study was a secondary analysis of data collected in a survey questionnaire administered to a supposedly representative sample of the American labour force (see Mueller et al., 1969: 231).

Several major limitations are associated with the use of secondary data (see Chapter III). These include the inability to control the quality and purposes of the initial research design. This places constraints on the quality and purposes of this thesis. An example of these limitations was encountered with the inability to determine the skill levels associated with the three types of technology.

A final problem associated with using secondary data is the inability to make finer distinctions than provided for by the coding procedure. As mentioned earlier, categories for 'types of technology' were established from the code book which created an 'Automation Scale. Therefore, a clearer distinction within any one of these categories was not possible.

In general, the limitations, associated with the use of secondary data, are imposed by the initial researchers' choice of questions and how answers are coded. These choices had the effect of limiting what could be examined in this thesis.

Suggestions for Future Research

This thesis has defined types of technology according to control the worker has over his equipment. It is felt that this approach produces a much more accurate analysis of the effects technology has on the worker, than has previously been available. Further development of this methodology is necessary not only in confirming or rejecting the results of this thesis, but also to clarify the classifications and the methods used in coding 'types of technology'.

One classification that seems to be of some importance in the literature is between limited automatic processes and totally automatic processes. By subdividing 'types of technology' into smaller sub-categories it may be possible to determine whether meaningful differences within these sub-categories can be found.

One of the main reasons for the low level of association for many of the relationships in this study may be due to the reference group analyzed. By limiting this studies' perspective to only blue-collar workers we may in fact be eliminating the greatest differences to be found: differences between blue-collar and white-collar technology. Future research should go beyond the scope of blue-collar technology in an attempt to assess the total impact of technology on the worker.

The approach used in this thesis, of looking at the worker's direct control over his equipment makes it possible for future research to overcome the problems of over-generalization found in the literature. As mentioned earlier most studies have used occupations, industries or entire plants as classifications to derive 'types of technology'. The variety found within each of these classifications makes generalization based on this approach questionable. Blauner, to cite one example, has used industries as representative of various types of technology. Using this approach he has found that automation reduces alienation from work. The findings of this study contradict Blauner's, and generally find that automation in fact decreases job satisfaction.

It would also be of some interest to use the above approach developed in this thesis in a longitudinal study where workers changed types of technology over time. It may be that the distinctions between short term and long term effects are of great importance in understanding how technology affects the worker. It may be found that the results of this thesis would differ from a longitudinal study.

In a more general context it should be noted that not only does technology relate to the man-machine relationship, but also to the social relations established at work. How technology affects the structure of worker relations and, also, how technology affects worker-employer relations are areas of great importance.

Due to the use of secondary data, the number of variables examined in this thesis has been limited. In future studies, it would be of interest to take into consideration the effects of types of technology on such factors as: 1) the division of labour 2) worker control over the quality of the product 3) skill level 4) worker attitude towards the company. Other control variables that were considered important but were unavailable include: 1) the physical environment (noise, safety, cleanliness) 2) ethnicity.

It is felt that several issues need to be explored further. These include:

1. the types of technology associated with occupations and how the two factors interrelate

2. the differences in the effects types of technology have on blue-collar and white-collar workers

3. the ways in which the sexes differ in the types of technology they work with and how this affects job satisfaction.

In conclusion, social scientists are increasingly aware of the role that technology plays in determining work situations. Automation, as the most recent technological extension, has yet to be fully understood. Therefore, the findings from this study that increasing automation decreases job satisfaction requires further substantiation. It is felt that by using the methodological approach developed in this thesis, more conclusive evidence can be achieved.

APPENDICES

APPENDIX I

Multiple Regression for all Dependent Variables by all Control Variables

The first step in the statistical analysis was reducing the eight control variables to the six most important for each dependent variable. This was done using the 'F' ratio for one degree of Freedom obtained in Multiple Regression.

Control Variables	Time to Learn Equip. used.	Time Spent Per.Equip.	Repetition	Physical Mobility	Ability to Talk	Control over Work Pace	Control over how Work is Organized	Job Satis-faction
Occupation	1.430	.153	.756	2.342	.835	.537	4.031	.104
Sex	1.926	3.521	13.930	10.060	.072*	9.015	1.237	2.733
Size of Plant	3.292	5.109	.384	.339	.002*	.299	.679	.299
Length with Present Employer	2.245	1.062	.003*	.343	.670	.581	.000*	.801
Union Membership	4.910	.008*	.042	6.118	.192	.315	.168	.039*
Age	1.311*	.011*	.125	.017*	1.929	.078	.071*	.429
Education	.965*	.428	.008*	.082*	1.193	.000*	.367	.951
Income	4.646	14.482	.264	2.638	.590	.037*	3.430	.028*

*Eliminated

APPENDIX II

Multiple Classification Analysis Tables for All Dependent Variables Using 'Occupation' and/or 'Sex' as Independent Variables

1. Workers' Perceived Time Needed to Learn Equipment Used by 'Occupation' Controlling for 'Types of Technology', 'Size of Plant', 'Length with Present Employer', 'Union Membership', 'Income' and 'Sex'.

Occupation	N	Unadjusted Mean	Eta	Adjusted for Type of Technology Mean	Adjusted for Type of Technology Beta	Adjusted for All Covariates Mean	Adjusted for All Covariates Beta
Craftsman	249	5.91		6.00		5.74	
Operator/ Labourer	311	5.24	.11	5.17	.14	5.38	.06
Grand Mean = 5.54		Multiple R Squared			.036		.078
		Multiple R			.191		.280

Significant at the .001 level or better

2. Workers' Perceived Time Spent Operating Equipment While on the Job by 'Occupation', Controlling for 'Type of Technology', 'Size of Plant', 'Length with Present Employer', 'Education', 'Income' and 'Sex'.

Occupation	N	Unadjusted Mean	Eta	Adjusted for Type of Technology Mean	Adjusted for Type of Technology Beta	Adjusted for All Covariates Mean	Adjusted for All Covariates Beta
Craftsman	256	2.45		2.48		2.46	
Operator/ Labourer	314	2.63	.13	2.61	.09	2.63	.12
Grand Mean = 2.55		Multiple R Squared			.049		.064
		Multiple R			.222		.254

Significant at the .05 level or better

3. Workers' Perceived Degree of Repetition While Operating Equipment by 'Occupation' and 'Sex', Controlling for 'Type of Technology' 'Size of Plant', 'Union Membership', 'Age' and 'Income'.

Occupation	N	Unadjusted Mean	Eta	Adjusted for Independents and Type of Technology Mean	Adjusted for Independents and Type of Technology Beta	Adjusted for Independents and Covariates Mean	Adjusted for Independents and Covariates Beta
Craftsman	105	1.93		2.54		2.61	
Operator/ Labourer	145	5.09	.52	4.64	.35	4.59	.33
Sex							
Male	206	3.14		3.37		3.36	
Female	44	6.69	.45	5.60	.29	5.65	.29
Grand Mean = 3.76		Multiple R Squared			.461		.472
		Multiple R			.679		.687

Significant at the .001 level or better

4. Workers' Perceived Ability to Talk While Working by 'Occupation', Controlling for 'Type of Technology', 'Length with Present Employer', 'Union Membership', 'Age', 'Education' and 'Income'.

Occupation	N	Unadjusted Mean	Eta	Adjusted for Type of Technology Mean	Adjusted for Type of Technology Beta	Adjusted for All Covariates Mean	Adjusted for All Covariates Beta
Craftsman	263	2.68		2.67		2.68	
Operator/ Labourer	322	2.37	.19	2.38	.18	2.37	.20
Grand Mean = 2.51		Multiple R Squared			.038		.093
		Multiple R			.196		.306

Significant at the .001 level or better

5. Workers' Perceived Control Over Work Pace While Operating Equipment by 'Occupation' and 'Sex', Controlling for 'Type of Technology', 'Size of Plant', 'Length with Present Employer', 'Union Membership', and 'Age'.

Occupation	N	Unadjusted Mean	Eta	Adjusted for Independents and Type of Technology Mean	Beta	Adjusted for Independents and Covariates Mean	Beta
Craftsman	101	3.90		3.74		3.72	
Operator/ Labourer	151	3.24	.33	3.34	.20	3.35	.18
Sex							
Male	204	3.66		3.61		3.61	
Female	48	2.82	.34	3.03	.23	3.01	.24
Grand Mean = 3.50		Multiple R Squared			.266		.275
		Multiple R			.516		.525

Significant at the .001 level or better

6. Workers' Perceived Control Over How Their Work is Organized by 'Occupation' and 'Sex', Controlling for 'Type of Technology', 'Size of Plant', 'Union Membership', 'Education' and 'Income'.

Occupation	N	Unadjusted Mean	Eta	Adjusted for Independents and Type of Technology Mean	Beta	Adjusted for Independents and Covariates Mean	Beta
Craftsman	243	4.91		4.80		4.75	
Operator/ Labourer	297	3.96	.29	4.06	.23	4.09	.20
Sex							
Male	443	4.57		4.51		4.49	
Female	97	3.56	.24	3.86	.15	3.94	.20
Grand Mean = 4.39		Multiple R Squared			.113		.124
		Multiple R			.337		.353

Significant at the .001 level or better

7. Workers' Perceived Job Satisfaction by 'Occupation' and 'Sex' Controlling for 'Type of Technology', 'Size of Plant', 'Length with Present Employer', 'Age', and 'Education'.

Occupation*	N	Unadjusted Mean	Eta	Adjusted for Independent and Type of Technology Mean	Adjusted for Independent and Type of Technology Beta	Adjusted for Independents and Covariates Mean	Adjusted for Independents and Covariates Beta
Craftsman	263	9.07		9.09		9.07	
Operator/ Labourer	328	8.37	.15	8.35	.16	8.37	.15
Sex							
Male	479	8.68		8.59		8.59	
Female	112	8.67	.00	9.04	.08	9.08	.09
Grand Mean = 8.68		Multiple R Squared			.037		.041
		Multiple R			.194		.203

* Significant at the .001 level or better

APPENDIX III

ABBREVIATED QUESTIONNAIRE

Independent Variable

1. Automation Level

    1. Operator powered and controlled; powered single system, manual control; powered multi-system, manual control
    2. Fixed mechanical control
    3. Numerical tape or computer control; other logical control; those in fixed mechanical control who operate or help run automatic equipment.

Dependent Variables

2. Thinking now about just the equipment you use on your job, how long would it take someone with the same general education and training as you to learn to work properly with this equipment?

    1. Anyone with similar general training or occupation already knows how
    2. Matter of minutes
    3. Hours
    4. Days
    5. One to two weeks
    6. Three weeks to one month
    7. Two to four months
    8. Five to seven months
    9. Eight to eleven months
    10. One year or more; always keep learning more.

3. Thinking now of all the equipment that you operate or help to run on your job, do you use at least one piece or another of this equipment?:

    1. Very little
    2. Some of the time
    3. Almost constantly: Some of the equipment is used almost constantly.

4. Degree of repetition during R's operation of equipment.

    1. R does not perform the same task repetitively
    2. R performs a specific taske repetitively, but the repetitions are sufficiently different so that he cannot be said to be doing the same thing

3. R does the same thing with variations
4. R does several tasks, each of which separately would be coded 5,6,7
5. R does same thing but with both occasional interruption and minor variation
6. R does same thing without interruption but with minor variations
7. R does same thing without variation except upon the occasional occurrance of some event (e.g. breakdown)
8. R continually observes, monitors or machine tends this piece of equipment
9. R does same thing time after time without variation or interruption.

5. R's mobility while operating equipment

   1. R works at a single work station
   2. R works at a single work station with some evidence that he cannot leave his station without finding a replacement
   3. Equipment is mobile in the sense that R moves about while using it
   4. Equipment is used to enhance R's mobility

6. Do you have much chance to talk to other people during the time you are working, or does your location or the kind of work you do keep you from talking with others while you work?

   1. Can't talk
   2. Sometimes can't talk
   3. Can talk; talking is part of the job.

7. Control over R's work pace while operating or helping to run equipment during its normal operation.

   1. Machine paced
   2. Paced by other pieces of equipment not controlled by R or his work group (e.g. production line)
   3. Not paced at all; R "machine tends" equipment
   4. Paced by R (i.e., R controls pace of machine rather than vice-versa)

8. In some jobs, how your work is organized depends mostly on you, yourself. In others, its pretty much determined by the equipment you work with, a production line, or by a number of people who have to work together. How is it with your job?

   1. Determined by equipment
   2. Determined by production line, production process
   3. Determined by flow of work to be done (orders, weather)

4. Determined by boss, supervisor
5. Determined by a group of people
6. Organized by R

9. On the whole, do you feel that the work on your present job is drudgery or is it alright, or do you enjoy your work?

   1. Drudgery
   2. Negative response, not codable as drudgery
   3. Drudgery on part of the job on under some conditions
   4. Drudgery, but job is O.K., all right
   5. Drudgery on part of the job or under some conditions, but R enjoys his job
   6. Drudgery, but R enjoys it
   7. O.K., all right, neutral response
   8. Positive response, not codable as drudgery
   9. Enjoy, with qualifications
   10. Enjoy it.

Control Variables

10. Occupation of Respondent

    1. Craftsman
    2. Operator/Labourer

11. Sex of Respondent

    1. Male
    2. Female

12. About how many people are employed by your company or employer at the location where you work.

    1. 3 - 9
    2. 10 - 49
    3. 50 - 99
    4. 100 - 499
    5. 500 - 999
    6. 1000 - 1999
    7. 2000 - 4999
    8. 5000 and over.

13. How long have you worked for your present employer?

    1. 6 months or less
    2. 7 - 12 months
    3. 13 - 18 months
    4. 2 years
    5. 3 years
    6. 4 - 5 years

7. 6 - 7 years
8. 8 - 10 years
9. 11 or more years.

14. Is there some sort of union or professional society or association that you belong to?

1. Yes
2. No.

15. How old are you?

1. XX Code number of years

16. Education of R

1. 0 - 8 grades
2. Some high school - no degree
3. Some high school - no degree - some vocational training (at least 3 months)
4. High school degree
5. High school degree and vocational training of at least 3 months
6. Some college - no degree
7. B.A. degree
8. Graduate training.

17. Can you tell me how much money you (R) made on your main job last year?

I mean before taxes or any deductions.

0. under - 2,000
1. 2,000 - 2,999
2. 3,000 - 3,999
3. 4,000 - 4,999
4. 5,000 - 5,999
5. 6,000 - 7,497
6. 7,500 - 9,999
7. 10,000 - 14,999
8. 15,000 - 24,999
9. 25,000 and over.

18. Select if

1. White -collar, no equipment
2. White-collar, equipment
3. Blue-collar, no equipment
4. Blue-collar, equipment.

APPENDIX IV

Selection of Sub-Population and Sampling Representativeness

In this thesis a sub-population of 966 blue-collar workers working with equipment was selected. This sub-population was obtained by selecting those respondents that fell into the category: blue-collar workers that work with equipment (see Appendix III, question 18).

In order to assess the representativeness of this sub-population of the entire American labour force, it would have been desireable to obtain a comparison of the essential variables of either 'industry' or 'occupation'. Neither, however, was obtainable from the secondary data. It was possible, however, to obtain a comparison of the following variables: 'age', and 'sex'. Although these variables were considered of secondary importance, they added limited basis for comparison. Mueller et al. considered a comparison of their 2,662 respondents with regard to 'age', 'sex' and 'education' as representative of the America labour force. (Mueller et al., 1969: 237-239). The comparison of both Mueller's sample and the blue-collar sub-population employed in this thesis with the American Census estimates for age and sex are presented in the tables below.

TABLE 1

Percentage Distribution of Labour Force By Age, 1967

Age Group	Blue-Collar Sub-Population	Survey Research Center[1]	1967 Census Estimate[1]
Under age 25	15.1	13.1	16.5
25-34	22.8	21.5	20.2
35-44	23.8	24.3	22.9
45-54	22.6	23.1	21.9
55-64	13.1	14.8	14.5
Age 65 or older	2.6	3.2	4.0
Total	100	100	100

1. Mueller et al., 1969, 237.

TABLE 2

Percentage Distribution of Labour Force By Sex, 1967

Sex	Blue -Collar Sub-Population	Survey Research Center[2]	1967 Census Estimate[2]
Male	77.8	67.7	63.7
Female	22.2	32.3	36.3
Total	100	100	100

2. Mueller et al., 1969, 238.

Column 1 in Table 1 presents the blue-collar population used in this thesis. It is considered as not departing significantly from the census estimates with regard to age. Sex, however, as presented in column 1 in table 2 shows a different frequency distribution as compared with column 3;

males being over-represented in this thesis as in either the original study or the census estimate. The discrepancy may be explained by the fact that men generally are found more frequently in blue-collar jobs than are women. Furthermore, the affects of any possible discrepancy are overcome as sex is controlled for in this study.

APPENDIX V

'Occupation' by 'Type of Technology' for Blue-Collar Workers

Type of Technology	Occupation: Craftsmen	Operators/ Labourers	Others	Row Total
Manual	172	143	187	502
Fixed Mechanical	82	134	102	318
Automated	31	75	15	121
Others	2	13	6	21
Column Total	287	365	310	962

APPENDIX V1

Correlation Coefficients for all Dependent Variables by all Dependent Variables

	Time to Learn Equipment	Time Spent Operating Equipment	Repetition	Physical Mobility	Ability To Talk	Control Over Work Pace	Control Over How Work is Organized	Job Satis-faction
Time to Learn Equipment		-.20848	.08357	.19968	.05946	-.00547	.12452	.08207
Time Spent Operating Equipment	-.20848		.03591	.02870	.07915	.8069	.01744	.05422
Repetition	.08357	.03591		.03009	.18754	.37918	-.14483	.19441
Physical Mobility	.19968	.02870	-.03009		-.04607	-.01056	.05540	-.08418
Ability To Talk	.5946	.07915	.18754	-.04607		.03173	.06592	-.00806
Control Over Work Pace	-.00547	.08069	.37918	-.01056	.03173		-.03244	.09473
Control Over How Work is Organized	.12452	.01744	-.14483	.05540	.06592	-.03244		.09205
Job Satis-faction	.08207	.05422	.19441	-.08418	-.00806	.09473	.09205	

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