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WORK, WORK, WORK: IMPACTS OF ... OFFICE AUTOMATION ON WORK, WORKERS AND WORKPLACES

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1 BACKGROUND

This research builds upon the Office Communications Systems Programme (OCS) field trial, which was established by the Federal Government in 1980 as a joint initiative of the Minister of Communications, the President of the Treasury Board and the Minister of Regional Industrial Expansion. The $12 million programme, which ended March 31, 1985, was administered by the OCS Programme Office in the Department of Communications and had the following objectives:

1. The production of system design and functional product specifications to which Canadian industry could respond with product-line systems and subsystems that could meet the needs identified;

2. Experimentation with partial or full office automation systems, testing the functionality of these systems in terms of their impact on productivity, organizational adjustments, user acceptance, overall effectiveness and improved delivery of departmental services;

3. The development and application of general office systems methodology to aid prospective users and industry in defining, planning and implementing integrated office information systems;

4. The provision of test beds in which research and analysis could be undertaken on the economic, social and behavioural aspects of office automation.

To meet these objectives the OCS Programme supported field trials of Canadian office communications systems technology in federal government departments. The first phase of the OCS Programme, from late 1980 to early 1982, involved performing basic research and planning for the various field trials. The second phase, from early 1982 through early 1985, involved supporting field trials in five federal government departments.

Integral to all of the field trials was an impact assessment component that was designed to measure the impact of the introduction of this technology on the workplace. In general the impact assessment activity addressed the following issues: system performance; user acceptance; human/social impacts; organizational impacts; and productivity. The present research was conducted as a follow-up to one of these field trials, and was designed to examine the extent to which the changes which were observed at the end of the field trial would remain in effect one year later.

The OCS implementation project under discussion included 70 work-stations linked by a Local Area Network (LAN). Each workstation consisted of a monitor, a bilingual keyboard, and expansion chassis. Two file server units which act as network controllers, each

containing 137 million characters of storage, or the equivalent of 200,000 document pages, were installed. The 70 stations, which could accommodate up to 100 users, provided a combination of off-the-shelf and custom designed software. The available functions were in four general areas: document creation, document storage, document transmission and other functions. Document creation included text processing and an electronic spreadsheet; document storage included personal space management and archiving; and document transmission consisted of electronic messaging. Other functions included a calendar, personal computing, problem reporting, system administration and external communications. Telidon page creation and document and task management functions were also included in the original plan but these features did not become operational during the field trial period.

The original multidisciplinary Impact Assessment team, consisting of representatives from Mount Saint Vincent University, Queen's University, Universite de Montreal, Architectural Diagnostics of Ottawa, Public Archives of Canada and Public Works Canada was established in the summer of 1983. A research plan was developed in which data was to be gathered on environmental, organizational, information management and behavioural issues through a variety of data collection methods.

This process began with a pretest, completed in November/December of 1983, approximately six months before the equipment was to be installed. A second (and at that time final) data collection, using similar instruments, was taken in February of 1985, 6 months after installation. Three groups were used: the quasi-experimental group, consisting of the group selected to receive OCS equipment as part of the field trial; a quasi-control group, consisting of an analagous unit in the same government department with no computer equipment; and a unit of long-term users who had access to word processors for several years.

Following the end of the field trial and the first evaluation, a subset of members of the original Impact Assessment team*, those concentrating on the social, organizational, and environmental aspects, were asked to do a follow-up study one year later. While the first two data collections were funded under the OCS programme, the third data collection and the composition of this report were supported by the Canadian Workplace Automation Research Centre. Similar research instruments and procedures were used as much as possible; however the majority of the quasi-control respondents also had access to some type of computer equipment at this point. A number of personal computers had been brought in on an ad hoc basis by employees during the preceding six months. Since this did not constitute an integrated office communications system, and since the

* Specifically, it is conducted by the members from Mount Saint Vincent and Queen's Universities, and Architectural Diagnostics of Ottawa.

equipment had been in use only a short time, it was felt that differences between the three groups were still substantial. Following a staggered design, there was a continuum of computer usage across the three study groups. Long-term users were utilizing computer functions before the OCS project began, and therefore had access to such equipment for the pretest, interim and posttest data collections. OCS participants, who formed the quasi-experimental group, had no equipment at the time of the pretest, ensuring that interim and posttest measurements could be used to assess any changes that occurred following the introduction of the network. Finally, the transitional group had no equipment for the pretest or the interim, and had only recently received computer access by the time of the posttest data collection.

The subsequent chapters of this report provide: a general literature review, a description of the methodology and data collection techniques, the research findings, and a final discussion. Chapter 2 outlines the macro issues surrounding technological change. Following this general orientation, Chapter 3 provides a detailed methodological description of the Impact Assessment project. Chapters 4 through 7 present research findings which cover the effects of computerization on work attitudes, environmental conditions, health, and work processes and procedures. In Chapter 8, the analyses focus on the attitudinal and behavioural reactions of the users. And in conclusion, a final discussion chapter (9) highlights some of the major findings and suggests what might prove to be useful avenues for future research.

2 LITERATURE REVIEW

2.1 Perspectives on Technological Change

2.1.1 Macro Level Views

It has been argued that the various approaches to the now extensive literature on the social impact of microelectronic technology on society can be divided into five basic streams. Mowshowitz (1981) calls these approaches technicism (characterized by a naive belief that new technology is synonymous with progress, and that any problems are practical ones caused by faulty design or implementation); progressive individualism (the underlying belief that computers are beneficial in the long run, but it is recognized that elites and established bureaucracies will be obstacles to a wide-spread distribution of benefits and thus that reform of the policy will be required); elitism (which calls for and welcomes an elite of computer specialists and allies to "properly" manage the economy and the country); pluralism (the classic belief that countervailing interest groups will check each other and assure a positive outcome to the computer revolution); and radical criticism (which asserts that microelectronic technology will reinforce existing social control patterns leading to almost total domination by a capitalist elite over an increasingly powerless population).

With this classification, Mowshowitz has further subdivided and refined the familiar split between the optimistic and the pessimistic schools. The optimists, who are found among the ranks of the technicist, reformist, pluralist and elitist factions, do have certain beliefs in common - namely, that microelectronic technology will lead to a better future for all and that it can be introduced without radically altering the existing social arrangements and distribution of power in western societies. The hidden value judgement here, of course, is that the status quo is "good" and that it would be "bad" if the computer revolution made the society more elitist and less egalitarian. Science itself is seen as value free, and computer technology as the result of the "natural" progress of discovery of laws governing our world.

A variant of this school is represented by Daniel Bell, who contends that the major effect of computers will be an information revolution which will shift and redistribute concentrations of power in an entirely new direction. As he says:

> ...just as capital and labour have been the central variables of industrial society, so information and knowledge are the crucial variables of postindustrial society (Bell, 1981: 505-6).

This communications revolution will produce far-reaching change in all spheres of life, Bell says, including work, culture, family life, education, transportation and social control. Bell is clearly excited by what he envisages - the transformation of residence patterns as

people no longer need to live near their jobs in large cities, the possibilities of long-term planning by the state, the development of national goals, the merging of telephone and computer systems, the expansion of education through computer-aided instruction, and similar changes in virtually all aspects of our lives (Bell, 1981:513-14). Clearly, to Bell, these events have the potential for changing life for the better in the western developed capitalist societies.

Others, however, see mass unemployment and increasing control by the state and its allies in the corporate boardrooms as the inevitable consequence of microelectronic technology. Mowshowitz (1981), who calls this school radical criticism, argues that it subdivides into the determinists and the devolutionists. The former represent a mirror-image version of the technicists. Both see technology as an omnipotent determinant of the future; however, unlike the technicists, the radical critics dislike the direction in which they see it taking us. They foresee a world in which power will be increasingly taken from the bottom 90 percent and given to the top 10 percent of the population. Information technology, they argue, has been developed by multinational corporations in pursuit of profit maximization. It was not created or perfected in order to further democratization or to fulfill real human needs, and it is, not surprisingly, creating an extension of capitalist domination far beyond the factory walls and extending into every facet of society (Robins, 1982; Braverman, 1974).

The devolutionists are slightly more optimistic in that they, while accepting that the potential for increasing inequality and control exists, argue that the potential for creating alternate "people-friendly" social arrangements also exists; that decentralization in the political and economic spheres is made possible also, although the struggle to achieve it will be long and hard (Noble, 1978; Kling, 1980). The extent and the possibility of such control is, however, a highly debated issue. Many theorists now argue that the very development of computers is in no sense value free - they are not neutral artifacts which just evolve as a result of free ranging scientific enquiry; they are artifacts designed and conceived in ways which will benefit some groups at the expense of others (Berman, 1986; Winner, 1980). Moreover, it is because their design and utilization favours some groups, interests and modes of thought that the capitalist class has been overeager to promote the computer revolution as a scientific innovation, to be opposed only if one is "anti-progress". Theorists of this school also acknowledge that, while others may explain the origins of technological change, the consequences and effects it actually has are unlikely to be exactly what the original promoters desired. Actual consequences are shaped by very complex and as yet imperfectly understood social, economic, historical and technological processes which vary widely between and among societies.

Social scientists in all these categories do agree, however, on the centrality of technology and of the state; while disagreeing, as spelled out above, on the consequences, directions and implications of this. The technology critics (Braverman, 1974; Noble, 1984; Offe, 1982; Berman, 1986; Winner, 1980) believe that, with the move from the

laissez-faire stage of capitalism into monopology capitalism, the state will have to reassess its role on all levels. Thus, due to the fiscal crisis of the state and the resulting decline in revenues which can already be seen, the state will increasingly remove itself from many welfare or service oriented functions, in order to stress more direct forms of social control. Thus, if trade unions become militant as they see their members replaced by technological "progress", the state will cope with this by, on the one hand, sponsoring job sharing and labour/management/government tripartite schemes, while on the other hand promoting wage freezes and even de-unionization. It may also intervene more directly on the ideological level, facing the crisis in employment opportunities by either promoting value changes to help people cope with unemployment (through a de-emphasis on the centrality of wage labour, of property ownership and the work ethic in favour of abstract, non-material value systems); or it may encourage ideologies which scapegoat the victims of economic change on the individual level (blaming "decline" on homosexuals, criminals or other despised groups with moral standards which are perceived as low, who are seen as suffering from "lack of discipline"), while emphasizing traditional values (home, family and community) as well as nationalism (Offe, 1984). The former orientation appears, at this point, to be more characteristic of the Canadian state; the latter of the American.

Much of the literature discussed thus far has been highly speculative and theoretical. The important work now being done is the empirical work which tests out these grand theories. While it is true that the future is not yet with us (by definition), many sectors of society have lived with computerization, sometimes for decades. Simplistic generalizations and technological determinism are now giving way to studies investigating exactly what has happened in different institutional spheres when computers have been introduced. Technology shapes society but, in a dialectical fashion, society also shapes technology. And increasingly we are being forced to realize that it is people who ultimately have the power to determine the uses to which technology will be put. It is people - specifically but not exclusively those in powerful positions in key institutions - who determine whether technology will be designed and manufactured in ways which maximize human potential, creativity, and control, or which exclude and deny these characteristics. This is the first and in many ways the most significant level of choice (Kling, 1980; Jones, 1980; Noble, 1978, 1984; Rosenbrock, 1982). People decide how to apply and use technology at work, and how, as well as whether, to use it at home or in leisure activities. People decide whether its distribution and use will be governed by private market forces and slanted in favour of developments which will make a profit, or whether certain applications and capabilities of microelectronic technology will be seen as public rights, commodities with national implications as public airwaves have come to be. In these ways, then, the impact of this technology has come to be seen as contingent on a whole series of human choices and decisions conditioned, as such choices always are, by the political, economic, and even cultural realities which dominate the particular society. Thus, the science and technology produced by a capitalist society in the late twentieth century is necessarily of a character which reflects the social relations, productive relations, and values

of that society (Winner, 1977); but this fact does not mean that employees, consumers, managers and others can have no voice in their future, or that this freezes any society's options in an unchangeable way.

2.1.2 Issues and Consequences

In this study we are less interested in the global or even societal effects of the computer revolution, however, than in the specific effects of office communications systems on one aspect, the nature of work. The controversies about the future of work have revolved around such issues as whether work as we know it will disappear, or whether the standard corporation will be totally transformed, made obsolete, or stripped of its work force. We cannot yet pronounce on such overreaching developments; however, we are beginning to understand some of the specific issues which govern the decision to introduce new office technology and some of the consequences when one does. To summarize, it now appears that the following are accurate generalizations:

1. There is no one unvarying impact of new technology on the organization or the employees - there are many different impacts, depending on the ways in which the technology is introduced, the intentions of those responsible for the change, the technology itself, and the way the employees react to and change the technology, especially during the crucial "debugging" stage following initial implementation. If management has been seeking a way to completely reorganize the office or exercise more direct control over clerical employees, the move to an office communications system provides an opportunity to do this. But the resulting effects on the quality of working life in the office must be seen as the result not of the technology but of the management decision to reorganize. Office communications systems, it now appears, can be used to accomplish such aims, or they can augment the social organization, patterns of communication, and other characteristics of the existing office. The impact, then, depends on the way in which work is organized around the technology, and this in turn depends on worker resistance, and on management priorities and power (Wilkinson, 1982; Frances et al., 1982; Boddy and Buchanan, 1982).

2. Innovation does not just happen. The introduction of major technological change has required a promoter in virtually all the organizations studied; that is, the presence in senior management of at least one person who is convinced of the virtues of computerization and willing to argue this position is a necessary precondition. Moreover, in virtually every case, the decision to adopt new systems was justified on the grounds of lower labour/production costs and increased productivity. Different levels of the organization have different motives for supporting (or opposing) such systems - top management usually want a higher return on investment;

middle management want more control over the work force; and the supervisory staff want a smoother work flow and fewer disruptions (Boddy and Buchanan, 1982). Overall, the cost/productivity factor and the promise of increased control over "the human factor" (employees) have emerged as the significant factors (Boddy and Buchanan, 1982; Rader, 1982; Wilkinson, 1982). This does not mean such aims are necessarily realized in the decision to introduce this technology. Johnson et al., (1982) report that word processing systems are usually introduced and cost justified for the wrong reasons. That is, they are typically seen as new, and more efficient, ways to accomplish the same ends. However, the uses that evolve later through adaptation and reinvention, usually turn out to be the most productive ones, rather than the uses governing the original decision to purchase equipment. Moreover, companies which originally saw the creation of large pools of word processors as the ideal way to maximize both productivity and control over employees have largely been forced by enlightened self-interest (since such "rationalized" systems rapidly become the least productive units in the organization) to break these up into small units of 13 or fewer employees, or to abandon this approach entirely (Johnson et al., 1982).

3. It appears that the potential of office communication systems to replace existing channels of communication has been highly exaggerated. Oral communication, either face-to-face or mediated by the telephone, serves many functions in an organization beyond the mere transmission of information. It cements trust, establishes contacts, and spurs motivation. Moreover, many internal transactions require the exchange of a type of information which cannot easily be reduced to a written form. Thus, it now appears that the new telecommunications technologies will replace only a small percentage of the existing message channels; namely those of simple content which now are transmitted by impersonal mail or telex modes. They will have only a marginal effect on the most frequent and the most crucial type of office communication, which is oral communication conducted by telephone or face-to-face (Picot et al., 1982). One author goes beyond this to argue that we must curb our enthusiasm for new technologies lest we do real harm to organizations.

   > An overenthusiastic deployment of the new technologies, without taking into account the social character of an organizational structure and performance, would be harmful. This would not only hinder individuals' need satisfaction, but in many cases the organization's viability would be endangered due to the rigidity and sterility of the communication structure and its lack of ability to adapt to change (Picot et al., 1982:130).

4. Finally, we can list some of the advantages and disadvantages of microelectronic technology and the changes which have occurred when it has been introduced into an organization. As

before, one must distinguish between types of usage, types of organizations, and types of technology employed. Where technology is used to supplement or replace existing skills - for example, replacing typewriters with word processors but leaving other aspects of the job unchanged - there seems to be minimal impact on job satisfaction, attitudes to work, health, or any other variable. There may well be an impact on productivity but even that has not been conclusively demonstrated as yet, although certain kinds of paperwork do get done more quickly and efficiently (Hedge and Crawley, 1982; Krois and Benson, 1980). However, as stated earlier, this approach may be failing to take advantage of the real potential of automation. On the other hand, technological change can produce increased dissatisfaction, isolation, and deskilling if staff are moved from traditional organizing formats into central word processing pools. Their output of pages per day goes up, but the resulting lack of familiarity with authors' individual styles and preferences means that more time must be spent correcting documents (Boddy and Buchanan, 1982). In environments where people use the new technology to amass information (as do managers and policy analysts), real though conflicting effects can be found. If the equipment delivers in a reliable, consistent fashion, managers may find their control of their work processes increased, and may thus report more satisfaction, or work efficiency. However, it appears that stress and time pressure also increase, because the technology accelerates the pace at which decisions must be made, and increases the desire of superiors for "perfection", however this is defined. Moreover, the fact that more information is available makes people feel they must get and use it whether it is essential or not, leading to information overload (O'Reilly, 1980; Kaufman, 1973; Birchall and Hammond, 1981).

In manufacturing, where technology has been designed and implemented primarily to replace workers and reduce their control over the work process, it is clear that substantial displacement of workers, and underemployment and deskilling for the remainder, have occurred (Shaiken et al., 1983; Wilkinson, 1982; Noble, 1978, 1984; Rosenbrock, 1981, Burawoy, 1985). Automated factories often lead to more boredom, less autonomy, more centralization, more management monitoring and control, and less union leverage. On the other hand, such factories are usually safer, and the work is lighter and cleaner for the employees remaining. Productivity, in terms of return on investment, is again problematic as the more efficient work process must be balanced against frequent system failures which now shut down all production rather than just a segment of it, and are usually not amenable to repair by any but outside experts who must be found and brought in. (Downtime seems to average, at the present time, almost 20 percent, although this varies widely among different establishments.) Moreover, as workers exercise less control over the production process, they understand it less and

develop fewer skills which make them promotable. And if one brought into the productivity equation the wider social costs of unemployment and underemployment, the net gains would be still more uncertain.

Overall, for both blue collar and white collar employees, the literature indicates that where technology is introduced and used to complement human skills, work satisfaction increases. Where it is used to replace those skills, dissatisfaction and significant displacement (job loss), which have already occurred in manufacturing, are a real possibility in the office as well.

We have little solid evidence on the deskilling phenomenon in office environments. Although specialized pools of word processors exemplify such initiatives, these are now becoming recognized as yielding few gains in productivity (Johnson et al., 1982). The long predicted replacement of middle management does not seem to have occurred yet, perhaps because they usually have some power to decide which groups in the organization are superfluous and which are not, and people seldom eliminate themselves. Or perhaps middle management actually fill important integrative roles in the organization which are never recognised in the flow charts, which make them indispensible even if their specific task function is disappearing. Thus, the much predicted flattening of the organizational pyramid does not appear to have occurred to any significant level. (Leavitt and Whisler, 1985; Mumford and Banks, 1967; Stewart, 1971; Taviss, 1970; Bjorn-Anderson, 1977.)

2.2 **Conclusion**

This discussion has purposely been kept at a high level of abstraction, because we look at the specific literature which relates to substantive issues within each chapter. Thus, this discussion has been predominantly macro-level in orientation, while the study examines issues which are more distinctively micro-level. The linkages between the two levels of analysis are not unproblematic; however, we attempt to spell them out, if only in speculative form, within the narrower chapter-based discussions. The dominant trend in the literature today is the movement towards empirical studies which test out the implications of the theories outlined here. Critical or radical theorists focus on the ways in which the very design of technology promotes certain interests and hurts others, and provide instances which illustrate this (Noble, 1984; Burawoy, 1985). Pluralists, technicians and others continue to do fact-finding studies providing us with valuable data on the introduction and effects of computer systems in a wide variety of settings (for example, Johnson, et al., 1982; Rice and Rogers, 1980). The overall shape these patterns will take is not clear at the present time.

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3 METHODOLOGY

Although the results to be presented in this report are based on a case study of the policy sector of a large federal government department, a quasi-experimental design has been utilized to assess the effects of computerization within this context. Three primary data collections were conducted: the pretest, six months prior to the installation of OCS; the interim, six months after installation; and the posttest, 20 months after installation. In congruence with a formative evaluation approach, findings were presented to the implementing department numerous times throughout the observation period.

This chapter will describe the following components of the impact assessment research:

1 formative evaluation approach
2 definition of study groups
3 description of computer installations and implementation procedures
4 concurrent organizational changes that could influence the interpretation of the impacts of OCS
5 data collection methods, instruments and response rates
6 analysis techniques

3.1 Formative Evaluation Approach

The OCS field trial that forms the basis of this report was, by its very nature, a developmental process with respect to hardware and software, in that both were essentially experimental in nature. A formative evaluation approach, therefore, was seen as the most consistent with the aims of the original program. The field trial proved to be a learning experience in relation to the system and its development, as well as to its implementation and its impact on the users and the organization. As it was impossible to develop a priori predictions concerning the consequences of introducing OCS, it was important that those managing the project receive feedback throughout the course of the trial. A formative evaluation process by which information was fed back to the management after each data collection served as one way of assisting in the successful execution of the project. In addition, the formative approach built on the overall orientation of the DOC field trial, which was to involve the OCS users as fully as possible in each stage. Thus, user perceptions and comments collected by the Impact Assessment team were the basis for adjustments within the field trial until it ended. Such a process, therefore, carried through on the philosophy of the field trial, facilitated the acceptance of the OCS system and provided an opportunity to gain a comprehensive understanding of the impacts of OCS on the field trial site.

Although formative evaluation was the process perhaps best suited to minimizing dislocation, alienation and productivity losses during the

implementation phase, it could be considered to have methodological drawbacks. If one considers an experimental design to be the most reliable way of assessing the impacts, the approach taken for this impact assessment was a very different one. While comparisons could be made between the field trial population (OCS participants) and other units which did not originally receive the computer equipment, in fact, constant intervention meant that it was often impossible to say with great certainty that the OCS program caused some particular change in the organization or people's behaviour. In essence, until the field trial ended, the impact assessors dealt with a whole series of situations which changed frequently in the light of new developments and insights. Thus, this approach was not, in the experimental sense, a clean, uncontaminated design. However, the experimental design has already been found to be less effective and less practical in assessing ongoing, functioning organizations, as well as being disruptive to the employees and management involved (Immel, 1983; Steelcase, 1978-1980; Helander, 1983). The addition of a follow-up data gathering one year after the field trial ended, a year in which all three groups were left untested and untouched, adds to the reliability and validity of our results, and compensates to some extent for earlier methodological impurities.

To the extent that we have good pretest data and some means of group comparisons, we are in a position to at least suggest the possible consequences of introducing OCS into the policy sector of the department. The increase in complexity caused by the formative approach was, therefore, not overly significant, given the situation under study. The approach was appropriate to the site and problems associated with it were certainly offset by gains to the field trial in other areas such as implementation and employee morale. In fact, because this approach was taken, it was possible to specify the points during the changeover at which difficulties arose and assess whether the organization's reaction to problems alleviated or exacerbated them. Such information would have been impossible to obtain with a classic experimental design.

3.2 Definition of Study Groups

When field research is conducted within dynamic complex organizations it is impossible to follow a traditional experimental design. For example, under the conditions of the current study it would not have been reasonable to expect that the researchers could decide which personnel would receive computer equipment through random assignment. Given this practical limitation, the Impact Assessment team adopted a quasi-experimental structure for the study. The implementing Department chose to concentrate the OCS installation within one specific branch and the Impact Assessment team was given permission to select a second branch to act as a quasi-control group. Of course, the selection process was restricted by the fact that no two divisions of any organization are identical, as such comparability would be redundant. The branch that was found to most closely approximate the selected OCS recipients was similar in that it fulfilled a policy

function but the substantive areas of policy formation and related staff qualifications were quite different.

In order to understand the project under discussion, it is essential to have an appreciation for the primary groups that form the basis of comparisons. Because the OCS impact assessment follows a quasi-experimental design, two primary groups must be distinguished: those who received OCS and those who did not receive OCS.

Within this report the nonequivalent control group is designated the **"transitional group"** because such respondents were not part of the OCS field trial and did not have access to any computer equipment until the final phase of the observation period. The quasi-experimental group, on the other hand, was composed of respondents who received the OCS network and were therefore termed **"OCS participants"**. Although not part of the formal quasi-experimental design, a final category of **"long-term users"** was incorporated into the study because there were a few respondents who had access to some type of computer equipment prior to the observation period.

Even though the quasi-control group was selected because of its similarities with the unit designated as OCS participants, it was impossible to obtain a perfect subject match. Therefore, the interpretations of findings within this report are complicated by initial differences among the three study groups. We feel that the best approach to this problem is to sensitize the reader to the primary points of contrast as a foundation upon which to judge subsequent technological and organizational changes. The transitional, OCS participant and long-term user groups differ in terms of both job composition and demographic characteristics.

Generally, respondents can be classified as falling under three basic job types: support staff, officers and managers. **Support staff** are responsible for secretarial, word processing and other clerical duties, and are designated by SCY, CR, and OCE classifications. **Officers** perform such tasks as developing policy and cabinet documents, responding to correspondence, writing speeches and composing press releases, and fall under the PM, ES, AS, IS and ENG classifications. Finally, **managers** perform supervisory and regulatory roles within the EX and SM classifications. At the time of the pretest data collection, the transitional group had a preponderance of officers while most of the long-term users were concentrated in support classifications (Table 3.1).

Even though the experimental and control groups were both involved in policy formation, the content of their respective mandates were obviously different. As a consequence of these differing mandates, the officer role varied among the three groups; those designated to be OCS participants were mostly policy analysts in the PM category, whereas those in the transitional group held scientific and technical positions, and finally, long-term users included information officers. Because the long-term users were primarily information officers, they frequently worked under tight deadlines. Although policy analysts in the OCS participant group were not subjected to such constant

pressures, they had a relatively heavy workload because of the constant influx of correspondence. In contrast to both of these situations, officers in the transitional group tended to work on more lengthy, slower paced technical and scientific reports. Thus, there were some substantive differences in the content of professional roles within the three groups under study.

The most striking difference in the support category is between long-term users and all others. At the time OCS was introduced, all support staff using computerized equipment were concentrated in specialized word processing jobs; whereas, support staff in the transitional and OCS participant divisions still held traditional secretarial positions.

In addition to these clear distinctions in job content, general demographic characteristics also differed across the three groups. Distinctions were found with respect to age, education, language preference, language usage, length of tenure with the department and salary level.

Members of the transitional group tended to be older and more highly educated than other respondents. Whereas only 10 percent of OCS participants and 21 percent of long-term users were over 40 years of age, 43 percent of the transitional group fell within this category (Table 3.2). Likewise, the transitional group demonstrated slightly higher educational levels (Tables 3.3. and 3.4).

Further distinctions were exhibited in the areas of linguistic preference and usage. Table 3.5 demonstrates the unilingual English preferences of the quasi-control subjects. Sixty-eight percent of the transitional group as compared to 46 percent of OCS participants and 40 percent of long-term users expressed a particular preference for English. In turn, these preferences were carried over to the actual work situation with the vast majority of transitional respondents using English in their daily work (Table 3.6).

Perhaps as a consequence of the existing differences in age, education and job type, members of the transitional group also had the most lengthy work records and highest salary levels. Forty-five percent of the transitional respondents had been working in the department for over eight years and 42 percent were earning an annual salary in excess of $50,000 (Tables 3.7 and 3.8).

Although all of the aforementioned respondents were drawn from the policy sector of a large federal government department, it is clear that there were qualitative differences in the formation of the three groups. As in most organizational studies, the matching or random selection of participants was impossible. However, the research team made every effort to familiarize themselves with precise contextual details to assist in the interpretation of the results.

Most of the time series analyses for this report will follow the above transitional, OCS participant and long-term user categorization; however, in some cases we will refer to other subsets of respondents.

'Concentrated users' refers to one branch within the OCS category where all individuals were trained and had access to the network. **'Active users'** refers to those people who used a computer in their daily work, thus excluding respondents who had access to but did not use such equipment. **'Continuous respondents'** are those cases that completed pretest, interim and posttest questionnaires, whereas **'discontinuous respondents'** are the new cases introduced into the sample by staff turnover.

3.3 Computer Installations and Implementation Procedures

As the primary aim of this project was to assess the impacts of technological change, the group designations given in Section 3.2 were based on the timing of computer installations. This study was originally designed on the basis that the branch selected as a quasi-control group would not receive any computer equipment throughout the observation period. By comparing pre and post-computer conditions across groups it would therefore be possible to determine if any observed differences were related to the equipment installation or broader changes in the organization as a whole. However, the quasi-control group had acquired access to numerous electronic devices by the time of the final data collection, twenty months after the OCS introduction. Once one group has started to use computers, it is not very long until others will also want to acquire such equipment; thus the rapid dispersion of this technology makes it difficult to maintain an uncontaminated control group over the length of time required for posttest data collections. In the context of the OCS field trial, what this has meant is that the findings follow a staggered design with the introduction of electronic procedures occurring at different times for each of the three groups. Long-term users were utilizing computer functions before the OCS project began, and therefore had access to such equipment for the prestest, interim and posttest data collections. OCS participants, who formed the quasi-experimental group, had no equipment at the time of the pretest, ensuring that interim and posttest measurements could be used to assess any changes that occurred following the introduction of the network. Finally, the transitional group had no equipment for the pretest or the interim, and had only recently received computer access by the time of the posttest data collection.

Essentially, a staggered design means that computer related changes should appear at different times for the various groups under study. For example, if the introduction of a computer has a positive effect on job satisfaction one would expect an increase in job satisfaction levels at the time of the interim data collection for OCS participants and a comparable increase at the posttest data collection for the transitional group.

Although this staggered design methodology was not originally planned, it offers a relatively good structure for assessing the implications of computerization. Unfortunately, the interpretation of findings is complicated by differences in equipment design, accessibility and implementation procedures. As outlined in the background section, the

OCS computer system that formed the basis of this impact assessment was a local area network which contained a substantial variety of functions and enabled electronic communication. The equipment available to long-term users consisted of personal computers or stand alone word processing units. Likewise, the transitional group acquired personal computers which had no communication potential. While each OCS participant and long-term user had his/her own personal unit, only a few microcomputers were available in the transitional group. As a consequence of this restricted access among transitional respondents, existing microcomputers were placed on trolleys which could be moved from one office to another.

These striking contrasts in hardware, software and system access were intensified by differences in implementation procedures. The OCS project was designed as a four-day in-house training program with active user support. (For more detail on the OCS training and installation process, refer to the earlier Impact Assessment Training Volume). Prototypical work units were also introduced to better facilitate the environmental strains created by computer usage. Although some problems arose, as would be expected in any experimental situation, the OCS management team spent a great deal of resources on equipment selection, installation and user education. In comparison, the transitional group received their equipment in a rather sporadic and unplanned fashion, with no formal training program or suitable environmental modifications.

It is important to understand the exact nature of the equipment and the implementation procedures utilized because such factors may create differing reactions to technological change among the three groups under study.

3.4 Concurrent Organizational Changes

One primary difficulty encountered in organizational research is the disentanglement of confounding factors. It is hard to determine if variations in such factors as work attitudes and health are attributable to technological change or other modifications in the host institution. In the preliminary stages of this field trial, senior management personnel made an important decision concerning the structure of work processes. The OCS network was to be designed and implemented in such a way that it would cause as little disruption as possible to established procedures. The content of all jobs would remain intact, with the only shift being from paper to electronic information processing. Thus, job classifications and pay scales would also be constant. Although this philosophy was retained on an official level, informal changes eventually led to substantial modifications in the corresponding roles and job content of officer and support positions.

In addition to the informal changes that occurred as an indirect result of the introduction of OCS, there were also a number of other organizational changes that were in no way connected with the technological change and could therefore complicate the interpretation

of the findings. During the field trial period, there were four different ministers and a variety of other changes in senior executive staffing which resulted in policy shifts and departmental reorganizations. In conjunction with these personnel changes, the 1984 federal election resulted in substantial staffing reassignments and a departmental restructuring. As a consequence of the new priorities, the workload for OCS participants expanded in response to increased demands for policy papers, briefing notes, answers to questions in the House and executive correspondence.

On top of all these work related concerns, members of the concentrated user group were also confronted with dramatic changes in their physical environment (for more extensive information on this area see the earlier detailed Environmental Impact Assessment Volume.) Even before the computer system was installed, a substantial portion of officers in the concentrated user group were moved from closed offices into an open area. This movement to open space, although dictated by increased staffing, was not favourably received by the participants. Some officers went so far as to transfer to other jobs because of their discontentment with the new work stations.

The complexity of such environmental considerations was further intensified by the frequency of changes in accommodations. Some individuals were relocated as many as 8 times over the observation period. Thus, in accordance with all dynamic organizations, this department underwent many concurrent changes over the field trial period. The diversity of these changes makes it difficult to precisely delineate the unique consequences of introducing OCS.

To some extent, the quasi-control group can assist in filtering out the independent effects of OCS. If interim changes in work attitudes, health or environmental assessments are consistent across experimental and control groups, these changes are unlikely to be a consequence of OCS, which was only installed for use within the experimental population. However, some differences may be attributable to other modifications that occurred specifically within the divisions designated as OCS participants and not within the comparable control group. The move to open space, for instance, was one significant point of differentiation. Although the subsequent introduction of computer equipment in the transitional group can, to some extent act as a repeat test of interim findings for the OCS group, it is clear that reactions may differ because of equipment design and implementation procedures.

Overall, the results to be presented in this report can only be understood on the basis of a careful consideration of contextual factors. Through the subsequent discussion of data collection procedures, it will become clear that the research team utilized an extensive variety of methodological techniques to ensure that they had a clear and comprehensive record of this dynamic organizational setting.

3.5 Data Collection Methods, Instruments and Response Rates

The complexity of the field trial necessitated that the Impact Assessment team collect data at various stages throughout the project in order to fully understand the events and their impacts on individuals and the organization. It was also necessary to use a variety of data collection methods. The choice of method was dictated by the complexity of the issues being considered, the number of people involved, the amount of time required and the disruption which would occur by the team adopting a particular method.

Overall, the impact assessment included the following forms of data collection:

- self-administered questionnaires on quality of working life, environmental and training issues
- participant observation of the training program
- personal interviews with support staff, officers and managers
- personal interviews with key informants on various issues
- time allocation sheets
- environmental monitoring
- environmental observations and checklists
- electronic collection of system usage statistics

All structured personal interviews and self-administered questionnaires can be found in the supplementary text entitled "Impact Assessment Data Collection Instruments". The quality of working life questionnaires, environmental questionnaires, work processes and procedures interviews, support staff interviews and time allocation sheets were administered during pretest, interim and posttest data collections. These repetitions enabled comparisons of many factors at three critical points in time.

Self-administered questionnaires were distributed and collected by members of the OCS evaluation team. Each potential respondent received a packet containing: a letter of introduction, a qestionnaire in English, an identical questionnaire in French, and a return envelope. Respondents were encouraged to seal the return envelope immediately upon completion to ensure the confidentiality of their answers. The evaluation team made three return visits to collect the completed instruments. The first and second pick-ups were scheduled for the two days following distribution, and the third was undertaken one week later. Anyone unable to respond within this time period was asked to return their questionnaire by mail to the impact assessment office in Halifax.

Personal interviews were also conducted in both official languages. If the respondent had a private office, the interview was conducted in his/her work area. If the respondent worked in an open area, the interview was conducted in a board room to assure privacy.

The following sections will outline the design, content, purpose, target population and response rate for each of the aforementioned data collections.

3.5.1 Self-administered QWL Questionnaires

The quality of working life component of this project was addressed primarily through self-administered questionnaires distributed to all members of the transitional, OCS participant and long-term user groups for the pretest, interim and posttest data collections. Such a personal reporting approach was deemed preferable not only because it allowed for a high degree of confidentiality, but also because it was relatively non-disruptive and time efficient.

a) Pretest Questionnaire

The pretest questionnaire was designed to encompass a variety of subject areas: work attitudes, health, demographic information, and computer related training and experience. More specifically, the work attitude component probed the dual concepts of job satisfaction and alienation. Following an extensive review of the literature, question wordings were developed to parallel those utilized in the "Canadian Work Values" survey (Manpower and Immigration, 1975). The final indices were selected not only because they seemed the most appropriate for this population, but also because the Manpower and Immigration research provided a national sample against which to compare the results of this field trial. The development of multiple item indices is particularly significant in a longitudinal study because such an approach reduces measurement error and increases reliability. This offsets, in part, the problem of introducing additional errors through data replication (Struening and Guttentag, 1975:245, 247).

In the area of health, questions monitored the frequency with which respondents experienced a variety of symptoms ranging from headaches and eye strain to general feelings of stress. To follow through this line of investigation, each person was also asked for an assessment of the extent to which work had contributed to any such complaints. Further probing for the degree of severity was accomplished by identifying the illnesses for which a physician had been consulted. Questions on corrective lenses were also included as some researchers maintain that VDT usage is particularly harmful for those who wear eye glasses.

General background and demographic questions on tenure, work experience, future expectations, linguistic preferences, age and education were incorporated into the pretest questionnaire to act as predictors of subsequent computer acceptance. It is, for example, commonly held that older, less well educated employees find it difficult to adapt to technological change.

Although the core questions on work attitudes, health, background and demographic characteristics were applicable to all respondents in the transitional, OCS participant and long-term user groups, questions pertaining to computerization differed for these three groups. Rather than overburden the respondents with non-applicable issues, three separate versions of the QWL questionnaire were prepared. The first version, administered to the transitional group, included only the

core questions on work attitudes, health, background and demographics. In addition to this core segment, the second version of the questionnaire, given to those designated to be OCS participants, covered past computing and word processing experience, general opinions about office automation and expectations with respect to OCS. It was also necessary to develop a third version of the questionnaire for long-term users who already had access to microelectronic facilities at the time of the first data collection. On this third form, people were able to comment on their experiences with using the word processing equipment that existed in the department prior to the introduction of OCS.

b) Interim Questionnaire

The primary aim of the interim questionnaire was to detect the short-term implications of introducing an integrated computer system into an ongoing office environment. Work attitude and health questions were repeated verbatim for this second data collection. The section on computer usage, however, did reflect the introduction of OCS. Although questions on general opinions, such as "Overall, how do you feel about the introduction of computer related processes into the office", could be replicated, some other areas required slight wording modifications as speculative questions on the pretest became reflective on the posttest.

Example:

Pretest: "Do you think this new equipment will make your job easier, make no difference, or make your job more difficult?"

Interim: "Has the new equipment made your job easier, made no difference, or made your job more difficult?"

In most cases, the background and demographic sections were eliminated on the interim questionnaire since such information had already been gathered. However, a sheet requesting this information was appended for those respondents who did not receive a pretest questionnaire because they entered the department after December, 1983. The interim instrument also included a wide variety of questions on opinions about OCS. Two separate questionnaires were necessary to identify the effects of the computer system on work related activities. The version for support staff concentrated on typing and revisions, whereas the version for officers and managers focused on composition and review procedures. Both groups were also asked about computer usage and their opinions surrounding the various functions on the system.

c) Posttest Questionnaire

The self-administered posttest questionnaire was designed to capture the long-term effects of computerization. Similar to the interim instrument, work attitude and health measures were repeated verbatim, and a number of questions were included to assess behavioral and

attitudinal responses to the new equipment. However, this posttest questionnaire did differ from its earlier counterparts in that it also incorporated questions on the physical environment. While QWL and environmental issues were covered on separate instruments for the pretest and interim data collections, the final posttest questionnaire combined these two areas of investigation.

The response rates for the various QWL questionnaires were as follows:

	distributed	returned	response rate
pretest	132	112	85%
interim	112	104	93%
posttest	150	119	79%

3.5.2 Self-administered Environmental Questionnaires

The environmental assessment focused on the impact of microtechnology on the physical work area. While expert observations and measurements of physical characteristics will be discussed later, these self-administered questionnaires provided the respondents' perceptions.

A five page environmental questionnaire was used to gather data from staff. It was derived from a functional analysis questionnaire which was developed over the past few years in consultation with Public Works Canada (PWC) and tested in numerous building evaluation and diagnostic studies. The PWC questionnaire was analyzed and adapted based on assessments of the previous applications and critiques from the Impact Assessment team, and then tailored to the specific context under study.

The pretest questionnaire asked respondents to rate various aspects of their work environment, the layout and the building as well as to report actions taken to change or modify conditions. Respondents spent about ten minutes answering the questionnaire.

The questionnaire for the interim study had three additional pages to be answered only by staff who worked on OCS or other microtechnology. Those questions probed specific information about the equipment, the conditions in which it was used and how well it had been accommodated in the workspace. Several questions were added to the pretest questionnaire which focused on the impact of microtechnology on environmental attributes such as noise, heat and space.

As previously mentioned, the most pertinent environmental questions were incorporated into an integrated questionnaire for the final posttest data collection.

The response rates for the various environmental questionnaires were as follows:

	distributed	returned	response rate
pretest	133	123	92%
interim	126	116	92%
posttest	150	119	79%

3.5.3 Self-administered Training Questionnaire

In addition to the quality of working life and environmental questionnaires, another self-administered instrument was distributed in December, 1984. This data collection had as its primary focus the assessment of training and user support.

The first section of the training questionnaire covered users' perceptions of the adequacy of the information they had received in relation to the installation and use of OCS. Following this, respondents were given an opportunity to comment on the quality of the training program. Informal learning processes were also monitored by asking people how they expanded their knowledge of the system and resolved problems outside designated training periods. Finally, some system appraisal items were incorporated to gauge user acceptance during the initial implementation phase.

The training questionnaire was designed for everyone who participated in the OCS training program. Fifty-nine questionnaires were distributed, of which 46 were returned, for a final response rate of 79 percent.

3.5.4 Participant Observation of the Training Program

Observation of the training sessions allowed the Impact Assessment team to gain first hand information about the actual structure and content of the program. At the same time, by listening to users' questions it was possible to learn something about the problems they faced and the ability of the training team to respond to these problems. As a technique, observation was appropriate for both classroom and one-on-one sessions. Because members of the Impact Assessment team were known by the OCS participants and by the trainers, their observing the sessions appeared to be treated as just one more feature of the field trial and did not seem to inhibit any of the training activities.

In order to standardize the observation process, each of the observers worked within the following guidelines:

- The observer did not personally participate in discussions or ask questions during the training session.
- The observer made specific notes on:
  - the time periods used for the various components of the session;
  - the content of the instruction and discussions;

- the questions asked by participants;
- the manner in which the trainer handled questions;

. The observer also personally assessed the difficulty of the information being presented and recorded her perceptions of whether or not the participants were having difficulty in understanding the material.

A total of eight sessions were observed, involving some 30 OCS participants. Although the results of these observations are not fully described in this report, they will be drawn upon for contextual information. A detailed written account of the training program can be found in an earlier Impact Assessment Report.

3.5.5 Personal Interviews with Support Staff, Officers and Managers

Although self-administered questionnaires were used to gather data from the total population, a more detailed understanding of the opinions of users was derived through personal interviews with members of the concentrated user group. Support staff, officers and managers all responded to indepth interviews on a number of occasions throughout the field trial period. Such close contact with the user population provided valuable insights into the evolutionary nature of technological change. Short and long-term reactions to computerization can differ substantially.

a) Prestest Interviews

Prior to the introduction of OCS, interviews were conducted with support staff to gain a comprehensive understanding of existing work procedures. This was to provide a point of comparison for the evaluation of future electronic processes. In addition to this descriptive account, respondents were asked to express their opinions on established work procedures and speculate on the advantages and disadvantages of the OCS introduction.

Officers were also approached for an interview before the computer system was put in place. Although this interview schedule was primarily designed to examine work flows and approval procedures, some questions elicited the respondents' comments on their current job and the existing work procedures. As with support staff, officers were encouraged to indicate their expectations with respect to OCS. The core of the data derived from these interviews with officers forms the basis of the work processes and procedures chapter.

As management personnel often play a key role in initiating and structuring technological change, it was imperative for the OCS Impact Assessment team to also have a clear understanding of the objectives and expectations of this group. To this end, management pretest interviews focused on what the respondents thought should be the results of OCS, and how they believed these goals could best be realized.

Pretest interviews were conducted with five support staff, ten officers and six managers, within the concentrated user group. Support staff interviews averaged thirty minutes in duration, while the more extensive work flow interviews with officers took approximately 1 1/2 hours. Management interviews also averaged 30 minutes in length. In the vast majority of cases, the people approached for these interviews were very co-operative and often enthusiastic about having an opportunity to express their personal opinions.

b) Interim Interviews

Although comprehensive training sessions were not conducted until the summer of 1984, ten personnel (three support staff and seven officers) from the concentrated user group were selected for preliminary training in May of that year. These first ten users were provided with Hyperion microcomputers which resembled the final OCS equipment except that text processing was the only available software.

The first ten users were interviewed two weeks after their training session. These interviews provided insights into the initial reactions to OCS. Questions addressed such topics as the functions used, evaluations of the training program, difficulties experienced and suggestions for future uses.

The interim interviews were conducted approximately six months after the intensive OCS training, in the summer of 1984. Once again, support staff, officers and management personnel were approached to provide an assessment of the new computer system. Support staff responded to questions covering a variety of areas: the extent and type of usage, general attitudes toward the equipment, user support, and future expectations with respect to OCS. Officers, likewise, reported on any changes they had experienced in relation to their work procedures and the perceived positive and negative effects of electronic document processing. Management interviews were designed to provide a general assessment of the implementation phase and to monitor the extent to which the OCS network had fulfilled initial expectations.

The interim interviews again were conducted with seven officers and five support staff in the concentrated user group. Because of staff turnover during the field trial period, only six of the original interviewees were available for the interim data collection. The officers for both stages were, however, drawn from two specific divisions and all the support staff in the concentrated user branch were interviewed on both occassions. These interviews averaged 45 minutes in length for support staff and one hour for officers. Management interviews were again about 30 minutes in duration.

c) Posttest Interviews

Posttest interviews were similar to those utilized for the first two data collections, and were conducted 20 months after the installation of OCS. Once again, support staff, officers and managers were able to

express their opinions about the new computer system and describe any changes that had occurred in work procedures.

These posttest interviews continued within the concentrated user group. At the final data collection there were eight support staff, eleven officers and five managers. Support staff and manager interviews averaged about 20 minutes, whereas officers required approximately 30 minutes.

3.5.6 Personal Interviews with Key Informants

While interviews within the concentrated user group provided insights into the reactions of the user population, the Impact Assessment team also felt it was necessary to talk to some additional people who played key roles in the design and implementation of the system. On-site project managers and trainers were interviewed to understand the formulation of initial functional specifications and the subsequent difficulties experienced during training. The company supplying the hardware also provided insights into its role in the field trial. From an environmental perspective, the building manager was interviewed on numerous occasions to obtain information on the capacity of electrical, heating and ventilation systems to cope with the introduction of the new technology. Finally, job classifications and pay scales were examined through discussions with members of the personnel department. The information from these key informants was very important in monitoring the interrelated forces that were operating during the introduction of technological change.

3.5.7 Time Allocation Sheets

One of the key goals of the impact assessment was the identification of any changes that occurred with respect to job content and work structures. To this end, the OCS Impact Assessment team distributed time allocation sheets when people were using traditional work procedures, and then again 6 months and 20 months after the OCS network was installed.

Both support staff and officers received structured forms to complete which listed the various components of their jobs and which asked them to estimate the proportion of the work week that they spent on each activity. The support staff sheet included such items as typing, retyping, and filing, while the list for officers concentrated on information retrieval, analysis and document composition.

These time allocation sheets were completed by the support staff and officers who responded to indepth interviews. At the conclusion of each interview, a time allocation sheet was given to the respondent and the results were collected the next day.

3.5.8 Environmental Monitoring

The environmental component of this study included not only users' perceptions of their work area derived through self-administered questionnaires but also on-site measurements. These measurements were collected following the completion of the environmental survey questionnaires by occupants. Architectural and Building Sciences, PWC, conducted a pretest of environmental attributes within the concentrated user group site in November-December 1983, and in February-April 1984 using a similar set of procedures. The tests and procedures were slightly modified and expanded to provide more comprehensive testing in December 1984. Key tests, as listed in figure 3.1, were conducted to characterize the environmental performance for the building quality issues under study. Controls were used to account for the seasons, and for the performance of the building conditioning systems (e.g. air handling, perimeter heating).

Most of the tests in the first two surveys were done once, providing a "snap-shot" view of environmental performance at a specific time. The various tests conducted by different disciplines, such as acoustic and thermal, were not necessarily conducted at similar times, but instead were spread out over several weeks. For the interim survey, quite a different approach was taken. The site was wired up at one time. All tests were conducted over the same time period. Tests monitored performance over an entire work week. For example, microphones were installed at select sites to continuously monitor and record occupied noise criterion. For thermal and air quality measurements, instruments were left at select sites. Both continuous monitoring and instantaneous sampling were used. For the latter, readings were taken on a regular basis, several times a day for a week.

The results of the tests of environmental attributes were compared with national or international standards to establish levels of performance. Some tests, as noted, were adapted from published procedures to incorporate current research or take account of field conditions. For example, for the Illumination and Visual Comfort Analysis, three supportive sets of information were reviewed:

1. A hypothetical model of a desirable luminance, working environment was constructed. This was used as a "Control Model" against which the physical measurements and questionnaire responses were quantitatively and qualitatively evaluated.
2. The physical environment was evaluated and findings from visual tests reviewed.
3. User responses to questionnaires were analyzed to ascertain user perceptions about their working environment and user health complaints.

These three steps were performed for each work station in the open office areas of the concentrated user group.

3.5.9 Environment Observations and Checklists

Both general and detailed checklists were completed by expert observers of the physical environment. The general checklist included clothing, type of work space, relationship to window and individual modifications. This was completed by the person who distributed the questionnaires. The data was used to clarify questionnaire data and to provide specific environmental descriptions to relate to other data.

To describe the objective attributes of workspaces, a detailed nine-page checklist was completed for each workspace. This included observations, photographs, detailed floor plans with furniture layout and reflected ceiling plan. This tool allowed an analysis of the specific features contained in each workspace such as floor area or number of pieces of furniture. Changes to workstation furnishings and locations were updated at regular intervals and compared with the occupants' perceptions.

A detailed reporting of the results of environmental monitoring, observations and checklists can be found in an earlier Environmental Impact Assessment report. In the context of this integrated report, such information will be used primarily as an interpretative tool to better understand the responses of the user population.

3.5.10 Electronic System Usage Statistics

Personal reportings of system usage were supplemented by electronically collected system usage statistics. The OCS network was designed to automatically collect information on both the duration and type of usage. For the period of February 12 to April 17, 1985, the Impact Assessment team received detailed data on the functions for which people were using the system; however, this data was not available at the time of the posttest data collection.

3.6 **Analysis Techniques**

From our discussion of the data collection instruments and methods, it is clear that the Impact Assessment team has a comprehensive view of the OCS project. This report concentrates primarily on the responses of the user population obtained through self-administered questionnaires and personal interviews. The supplementary text entitled "Impact Assessment Data Collection Instruments" contains the questionnaires and interview schedules that form the basis of the presented findings. As previously mentioned, more comprehensive information on objective environmental conditions and a description of the training program can be found in the detailed Impact Assessment reports compiled following the interim data collection.

The findings for this report will be presented primarily through analysis of variance and correlation techniques. The basic format for the impact assessment follows a 3 x 3 factorial design delineating the

transitional, OCS participant and long-term user groups over the pretest, interim and posttest data collection periods. However, the analyses that focus on specific subsets of the general population (e.g., officers) are confined to a 2 x 3 design because of an insufficient number of respondents in the long-term user group. All analysis of variance procedures have been conducted following an independent rather than a repeated measure design, and Cochran's C was used to test the assumption of homogeneity of variance. More topic specific characteristics of the analysis techniques will be outlined within the subsequent chapters.

Although this study tracks the same organizational units over time, the respondents within each of these units differ substantially from one data collection to the next. Thus, the possibility of repeated measure analysis was ruled out by the high turnover within the survey population. Figure 3.2 displays the number of continuous cases in the various groups. Only 40 percent of the initial respondents were available for the pretest, interim and posttest data collection. However, this turnover in staff was relatively consistent across all three study groups and was, therefore, unlikely to bias the results.

In the area of bivariate relationships, Pearson's Product Moment Correlation Coefficient has been used as the basic measure of association. After collapsing categories, these correlations were double checked with Somer's d (asymmetric).

The respondents for this study clearly form a case study rather than a random sample of any larger population. Therefore, the measures of statistical significance cannot be interpreted in the traditional manner. Under these conditions, statistical significance can intuitively be understood as the probability that one could have obtained differences as great as the observed group differences by random assignment (Blalock, 1972:238-239).

All of the coding, entry, cleaning and analysis of the data for this project has been conducted at Mount Saint Vincent University in Halifax. SIR, the Scientific Information Retrieval package, was used for data management purposes, and SPSS, the Statistical Package for the Social Sciences, was used for statistical procedures. These packages were available through the Cyber 170-720 computer at Dalhousie University.

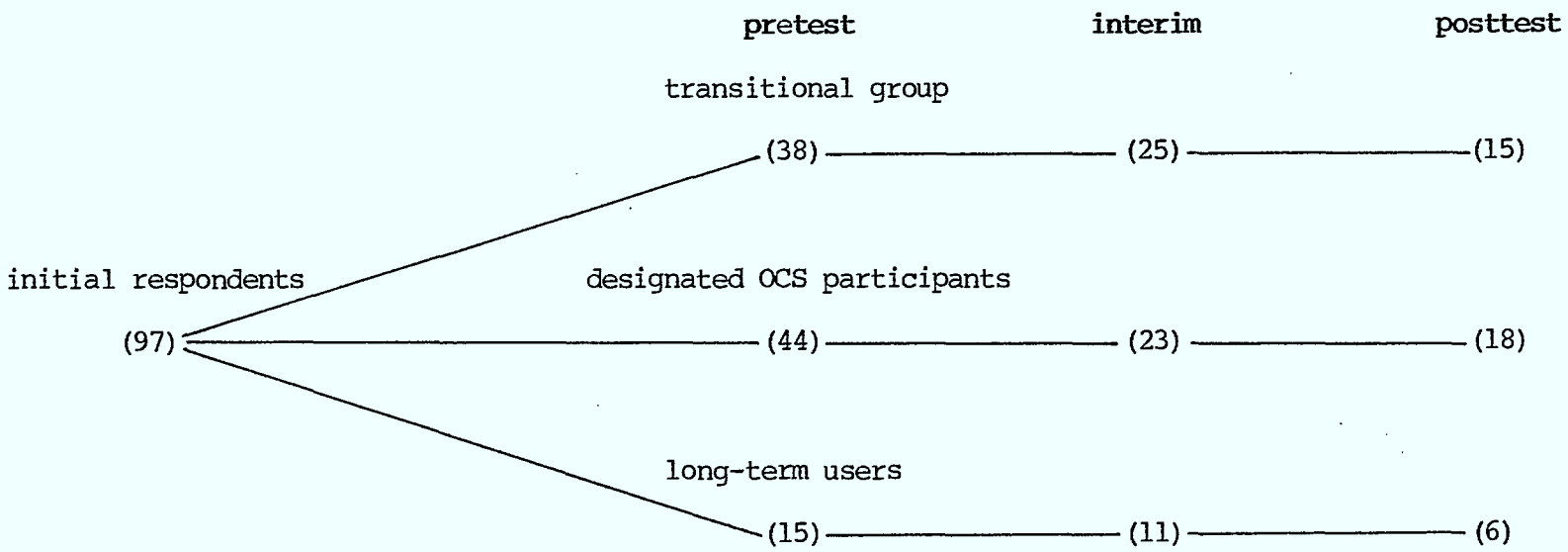
Figure 3.1

Environmental Attribute Tests

Attribute	Tests Used	12/83	2/84	12/84
Thermal and air quality	Dry bulb temperature	X	X	X
	Wet bulb temperature	X	X	X
	Globe termperature	X	X	X
	Operative temperature	X	X	X
	Vertical temperature difference			X
	Air temperature			X
	Relative humidity	X	X	X
	Air speed and direction	X	X	X
	Ventilation rate			X
	Thermographic analysis			X
	Temperature of supply air	X	X	X
	Floor surface temperature			X
	Electronic wire tap - FUNDI radiant heat panel and fan		X	X
	Floor plan and HVAC system drawing analysis	X	X	X
	Macro air movement pattern	X	X	X
	Micro air movement pattern	X	X	X
	CO_2 count	X	X	X
	Organic Vapours	X	X	X
	Formaldehyde	X	X	X
	Negative ion	X	X	X
	Particulates			X
	VDT radiation			X
Illumination and visual quality	Horizontal illumination with body shadow (Eh)	X	X	X
	Task contrast (C)	X	X	X
	Task contrast reduction (R)	X	X	X
	Task luminance (LT)	X	X	X
	Task background luminance (LB)	X	X	X
	Luminance readings on surrounding environment	X	X	X
	Equivalent sphere illumination (ESI)	X	X	
	Contrast rendition factor (CRF)	X	X	
	Lighting effectiveness factor (LEF)	X	X	
	Electronic wire tap on FUNDI lights		X	X
Acoustics and aural quality	Unoccuppied and occupied noise criterion (NC)	X	X	X
	Transmission loss through partitions	X	X	X
	Reverberation time	X	X	X
	Sound propagation	X	X	X
Energy consumption	Line disturbance analyser	X	X	X
	Line monitors on FUNDIs		X	X

Figure 3.2

Distribution of Continuous Respondents by Group and Data Collection Period



These numbers refer to responses for the quality of working life questionnaire. Although the pretest included 112 cases, 15 were excluded from subsequent analyses because these people worked in the Minister's office and were totally displaced prior to the interim data collection.

Table 3.1

Job Type by Group

	transitional group	OCS participants	long-term users
support staff	13%	36%	53%
officers	84	46	47
managers	3	18	0
	N = 38	44	15

missing cases = 0

Table 3.2

Age by Group

	transitional group	OCS participants	long-term users
under 30	8%	33%	43%
30 to 35	33	36	21
36 to 40	16	21	15
over 40	43	10	21
	N = 37	42	14

missing cases = 4

Table 3.3

Percentage of Respondents Who Have Some Type of Post Secondary Education by Group

	transitional group	OCS participants	long-term users
	94%	87%	85%
N =	37	44	13

missing cases = 3

Table 3.4

Years of Post Secondary Education by Group

	transitional group	OCS participants	long-term users
less than 3 years	14%	37%	11%
3 to 4 years	23	14	33
5 or more years	63	49	56
N =	35	35	9

missing cases = 6

Table 3.5

Language Preference by Group

	transitional group	OCS participants	long-term users
English	68%	46%	40%
French	16	11	20
no preference	16	43	40
	N = 37	44	15

missing cases = 1

Table 3.6

Language Usage by Group

	transitional group	OCS participants	long-term users
English	70%	45%	33%
French	11	10	20
both English and French	19	45	47
	N = 37	44	15

missing cases = 1

Table 3.7

Number of Years with Department by Group

	transitional group	OCS participants	long-term users
1 year or less	21%	23%	27%
2 to 3 years	13	42	33
4 to 7 years	21	21	13
8 or more years	45	14	27
	N = 38	43	15

missing cases = 1

Table 3.8

Annual Salary by Group

	transitional group	OCS participants	long-term users
less than $20,000	11%	26%	32%
$21,000 to $30,000	17	21	27
$31,000 to $40,000	8	12	27
$41,000 to $50,000	22	29	7
$51,000 or more	42	12	7
	N = 36	42	15

missing cases = 4

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4 WORK ATTITUDES

Labour unions, social policy organizations and government agencies are expressing increasing concern that the current computer revolution may have negative repercussions for the general quality of working life (Armstrong, 1983:119; Greenbaum, 1976:42; Regan, 1981; Labour Canada 1982; Belanger, 1983; Pollack, 1981). Therefore, this chapter of the report presents the results of work attitude measurements taken prior to, during and following the implementation of an integrated electronic network. We are attempting to understand what impacts, if any, the introduction of a computer system has on the degree of expressed job satisfaction and alienation.

The chapter begins by presenting a number of frameworks under which the association between technological change and work attitudes can be examined. Having completed this orientation, conceptual and operational definitions are provided and the research findings presented.

4.1 Competing Perspectives

Although theorists and researchers alike are predicting that the current technological revolution will have profound impacts on the structure and content of work, the hypothesized consequences of these changes for the general quality of working life are by no means consistent. While some fear that computerization will lead to a general degradation of the work force, others see this technological advance as a means of automating repetitive features of labour processes, thus ensuring that work in general becomes more interesting and intrinsically rewarding. In contrast to both of these direct approaches, there are also those who propose that the implications of computerization will vary in accordance with implementation procedures and resultant changes in existing work structures.

The next three sections describe the negative, positive and indirect consequences that may arise from computerization. We have chosen to divide our discussion into these three sections to clarify the possible impacts that are currently hypothesized in the literature. The fundamental theoretical and philosophical premises of the authors who present the perspectives could be categorized quite differently, but methodologically this particular chapter is concerned with the possible results that may be expected following the introduction of an electronic office system. Because much of the literature on office automation has focused on the clerical component of the labour force, we will use this line of work to provide concrete examples and contrasts between the competing scenarios. This is not, however, to say that the impacts of computerization are specifically concentrated in the secretarial field. It is evident that electronic processes are also being rapidly dispersed throughout practically all technical, professional and managerial classifications.

4.1.1 Negative Perspective

From a negative perspective, it is argued that computer systems are designed in such a way that they dictate modifications to work procedures which subsequently diminish individual control, intrinsic job content, skill and task diversity, promotional opportunities and extrinsic rewards (Belanger, 1983; Burawoy, 1978:291, 294; Cotgrove 1972:447; Noble, 1978:342 Braverman, 1974). The underlying premise for these hypotheses is usually that machine design is governed by capitalist motives. The desire for increased productivity, and thereby increased profit, leads to the design of machines which can reduce labour costs and which can operate at very high levels of efficiency. This, in turn, causes a deterioration of working conditions if not prevented by the intervention of organized labour. The new machines are seen as a means of reducing requirements for personal decision making on the part of the operators (Feldberg, 1983; Belanger, 1983). Whereas earlier technological developments displaced physical demands, computers have the capacity to perform much of the intellectual component of work.

While this negative scenario has obvious implications for assessments of autonomy and intrinsic job content, it may also adversely affect workers' evaluations of their pay, job security and promotional opportunities. Diminished educational requirements can result in lower salary scales, and promotional opportunities may also decline because of the worker's inability to demonstrate capabilities necessary for upward mobility. In addition, declining skill requirements can result in decreased job security because of the relative ease of replacement. It is conceivable that computerization could have negative repercussions throughout virtually every facet of work attitudes, ranging from feelings of meaninglessness and insecurity to lower assessments of pay and promotional opportunities.

The support role serves as an apt illustration of this perspective. Accurate typing, spelling and accounting abilities, for instance, are seen as declining in importance because such capabilities are pre-programmed into existing electronic text processing and spreadsheet functions (Menzies, 1982; Huws, 1982:25). People can be reduced to simple input devices as computers perform all necessary analytical procedures. This line of reasoning can also be expanded beyond clerical work to include a much wider range of occupations related to information retrieval, analysis and storage.

4.1.2 Positive Perspective

In complete contrast to these dismal predictions, the positive perspective maintains that new electronic devices will improve intrinsic job satisfaction by removing the need for any workers to perform repetitive boring tasks (Hald, 1981; Broom, 1970; Dubin, 1970). The immense storage, analytical and retrieval potential of computers, and the versatility of hardware and software, means that these new devices can accomplish or eliminate the necessity of many repetitive tasks. People currently employed in low level jobs can

take on more interesting and challenging duties as the boring aspects of office work are increasingly automated. In addition, the intellectual demands of such restructured positions can be expected to open avenues for advancement and higher remuneration. Thus, the quality of working life hypotheses generated by this perspective would directly oppose those outlined above. Assessments of intrinsic job content, autonomy, promotional opportunities and pay would improve as computers increasingly perform those components of work processes that do not require human intelligence and ingenuity.

Within the clerical field, computers may diminish filing and retyping requirements, consequently leaving more time for administrative duties. As the need for essentially mechanical tasks declines, support staff would be able to move into more intrinsically and extrinsically rewarding positions.

4.1.3 Indirect Perspective

The most extensively utilized scenarios on technological change emphasize intervening variables. The results of computerization are thought to be more closely tied to the manner of implementation and subsequent changes in the labour processes than to the equipment itself (Braverman, 1976:35; 1975:22-23; Brunet, 1980:18-19; Menzies, 1982:28; Noble, 1978; Labour Canada, 1982). We will first describe how various components of the implementation process may influence work attitudes, and then discuss how changes in work structures and the allocation of job tasks can result in long-term modifications in work attitudes.

a) Implementation Procedures

Many articles have stipulated that successful technological change depends upon the involvement of the user population at all stages of implementation and the provision of appropriate training (Cockroft, 1979:32-33; Ranney, 1982:74).

If workers have had little or no input into equipment selection and installation procedures, they may resent the added uncertainty which inevitably arises during times of change. A study of Nova Scotia Provincial Government employees demonstrated a positive correlation between the degree of involvement in equipment related decisions and subsequent assessment of the impacts of computerization (Clark et al., 1986:10). Respondents who had little input into the selection, placement or use of computerized equipment were less likely to feel that this technological change had led to any improvement in their jobs or work in general. In addition, most workers were expected to develop their computer skills through hands-on experience on the job, with little or no formal instruction (Clark et al., 1986:10-12). Thus, negative work attitudes may arise during the implementation period unless change is introduced through a plan that includes user participation and comprehensive training.

The assessment of supervisory practices provides an apt illustration of how technological change could have a negative impact on work attitudes. If the introduction of a computer system is seen as a management directive over which workers have no control, tensions could arise between staff and their superiors. Thus, the evaluation of supervisory practices would be expected to decline during the implementation period. Such negative work attitudes, however, could be minimized by incorporating worker input throughout the decision making process.

b) The Labour Process

While implementation procedures may affect work attitudes in the short-term, revised labour processes can institute more long-term changes in work attitudes. If a computer system is introduced in such a way that it leads to increased fragmentation and polarization one would expect a decline in job satisfaction and increased feelings of alienation among the work force. Alternatively, if a computer is used to supplement and thus enlarge skill and task variety, this could have a positive impact on work attitudes. Because such structural factors are recognized as the primary determinants of job satisfaction and alienation levels, computerization could also result in virtually no change in attitudinal measures if electronic procedures are introduced in such a way that no reallocation of work roles occurs.

Employers sometimes have used the implementation of a computer system as a means of justifying increased job specialization and the polarization of work processes (Green, 1982). From a financial stance, it is argued that the expense of this new equipment necessitates its constant use. This goal is then accomplished through the creation of specialized computer related positions with some people performing the conceptual component while others execute controlled predetermined activities (Braverman, 1974; Feldberg, 1983). The possible combinations and permutations of this management philosophy are virtually endless and cover a large number of job types. Each organization has a variety of functions and related tasks which can be divided and subdivided into an extensive array. Such specialization and polarization, however, can have pronounced negative consequences for worker well-being (Touraine, 1965). As jobs are fragmented, and decision making becomes increasingly centralized, more and more workers are allocated to jobs which lack both autonomy and intrinsic involvement. In addition, reduced responsibility within these fragmented jobs also makes it impossible for workers to demonstrate qualities necessary for promotion and pay increases. Thus, changes based on traditional scientific management principles could result in negative assessments of extrinsic as well as intrinsic factors.

Continuing with the clerical analogy, this indirect degradation scenario is exemplified by the formation of word processing and data entry pools. In some establishments, the traditional secretarial role is subdivided into two distinct positions: administrative support and word processing (Buchanan, 1982). Under these circumstances, administrative secretaries perform duties such as composing

correspondence, attending meetings and scheduling appointments. In contrast, word processor operators continually type and edit documents. Previous studies have demonstrated that people employed in the new specialized word processing jobs express significantly more dissatisfaction and alienation than traditional or administrative secretaries (Benjamin, 1976).

The contrasting management scheme for introducing technological change is, of course, to adopt a decentralized system that would assist rather than replace personal decision making (Science Council of Canada, 1980:44-45; 1982:46). Through this approach the computer becomes a tool to enlarge both the scope and skill requirements for all positions. This enlargement could also have the additional spin-off of opening up career avenues and improving bargaining power. Such a structure would be expected to enhance rather than diminish morale and general job satisfaction.

Direct computer linkages provide great potential for the redistribution of tasks. Thus, clerical work could be enhanced rather than downgraded through decentralized management policies. Improved communication networks could enable secretaries to perform some of the accounting and bookkeeping activities previously undertaken in centralized facilities.

As a final possibility, the installation of computerized equipment could produce little or no change in work attitudes if organizational structures remain constant. Under the condition where a computer simply acts as a new tool to perform preexisting work routines and roles, attitudes would be expected to reflect the consistency of organizational design rather than technological differences.

Looking once again at clerical workers, one would not expect a change in work attitudes if new electronic systems functioned essentially as replacements for typewriters, initiating no qualitative differences in job content or task requirements. Even if text processing reduced the time required for entry and editing, this might simply mean that each secretary would perform more of the same type of work rather than that the actual allocation of duties would be revised.

4.1.4 Interconnections Among the Various Perspectives

Although the negative, positive and indirect paradigms have been presented as mutually exclusive to clarify the possible consequences of introducing a computer network, in reality there are often areas of interaction and overlap. Many of the references cited above provide illustrations of both direct and indirect effects of technological change. There is a close tie between the technology utilized and the design of the labour process. Certain computer systems may be seen as "enabling" particular forms of work organization. And, as the computer age progresses, changing equipment designs may consequently encourage the reorganization of existing structures.

4.2 Impact Assessment Context

In order to understand the implications of technological change from the indirect perspective, one must be aware of the implementation procedures utilized and any structural changes that occurred in the organization under study. A detailed description of OCS training and installation processes can be found in an earlier impact assessment report prepared for the Department of Communications. However, we will briefly describe the most salient issues for this chapter.

OCS training consisted of a four-day program supplemented by active user support. Personnel were expected to develop their computer competency while maintaining a regular workload. Although everyone was encouraged to use the OCS system, support staff were left with few alternatives because of the removal of typewriters. As outlined in the methodology chapter, computer equipment was installed for the transitional group in a much more sporadic and unplanned fashion with no consistent in-house training program.

Changes in labour processes, as outlined in chapter 7, can best be described as gradual and informal. On an official level, the OCS functions were designed to mimic existing work processes, and the new equipment was expected to create as little disruption as possible to established work patterns. However, the content of both support and professional positions had been enlarged after the system was in place for approximately 1 1/2 years. Officers were conducting more text entry and editing, while support staff had expanded their responsibilities in the areas of budgeting, expense claim processing, statistical calculation and tabulation, and proofreading. These informal changes were not accompanied by any reclassifications or salary increases. The rather brief exposure to computer equipment within the transitional group meant that no pronounced changes in job content had resulted from the introduction of this equipment by the time of the final data collection.

4.3 Conceptual Definitions and Measurement Techniques

The literature on work attitudes is divided into two primary areas: job satisfaction and alienation. The fundamental distinction between these two areas is the designation of predetermined or variable human needs or desires. Job satisfaction theorists maintain that people are dissatisfied when the type of work they perform does not coincide with their particular desires or expectations. The concept of alienation, on the other hand, is based on a discrepancy between job content and fundamental human needs for autonomy and meaningful activity. While job satisfaction research concentrates on the evaluation of many work related characteristics, alienation research focuses only on the respondent's perceptions of intrinsic features.

4.3.1 Job Satisfaction

Although few concise definitions of job satisfaction exist, there seems to be consistent agreement that this concept refers to a subjective state which is dependent upon the desires of the particular individual (Locke, 1976:6; Smith et al., 1969:6; Bacharach and Aiken, 1979:854; Westley, 1979:116-120). For the purposes of this investigation, satisfaction will be defined as a positive cognitive state which results when the perceived characteristics of the job meet or exceed expectations in the direction respondents personally define as favourable.

Researchers have traditionally examined job satisfaction from two distinct although complementary approaches (Seashore and Taber, 1975). The facet-specific approach provides detailed evaluations of a large number of components of the job and the work environment; these factors cover pay, supervision, co-workers and intrinsic work content (Locke, 1976; Gruenberg, 1980; Waters and Roach, 1971; Armstrong, 1971; Dunnette et al., 1967; Kahn, 1972). In contrast, the facet-free approach views satisfaction as a total, all encompassing evaluation. This type of global concept is typically monitored through questions such as: "Overall, how satisfied would you say you are with your job?" (Gruenberg, 1980; Manpower and Immigration, 1975).

The facet-specific job satisfaction measure for this study asked respondents to rate the truth value of 17 statements on a four-point scale. The question was formulated as follows:

> "Here are some things people say about jobs. We would like you to indicate how true each statement is of your current job. Would you say the statement is very true, somewhat true, not very true or not at all true of your job?"

Four indices were formed from the original 17 statements to reflect evaluation of supervision, co-workers, promotional opportunities and intrinsic job content. Extrinsic factors were retained as separate variables because internal reliabilities varied substantially across the three data collections, and this could have distorted the results of statistical procedures. Figure 4.1 presents operational definitions for the concepts and standardized Cronbach's alphas on each of the indices.

Only one facet-free job satisfaction question was included on all three questionnaires. Response categories ranged from very satisfied to very dissatisfied and the wording was as follows: "All in all, how satisfied would you say you are with your current job?"

4.3.2 Alienation

The conceptual definitions of alienation utilized in this study were derived primarily from the works of Blauner and Shepard (Blauner, 1964; Shepard, 1971, 1972, 1974a, 1974b). We have concentrated on two sub-components of the alienation concept, powerlessness and meaninglessness.

> "In the work situation, powerlessness occurs when the worker feels that he is an object dominated and controlled by other people or a technical system such that, as subject, he cannot alter his condition" (Shepard, 1971:3).

This is, then, a lack of autonomy. The related concept of meaninglessness is thought to occur when processes are so fragmented that people cannot see the usefulness of their individual endeavours or how their work contributes to the final product (Faunce, 1970:408; Israel, 1971:210; Shepard, 1972:266; Blauner, 1964:22-24). Thus, a person may lose the feeling that his/her specific contribution is valuable or important.

Operationalizations for the alienation concepts are also given in Figure 4.1. The questions included under the powerlessness dimension measure the respondent's assessments of his/her control over job content, physical movement and the speed of work. Meaninglessness, on the other hand, includes statements pertaining to the perceived value of work, the degree of job specialization and the assessment of responsibility.

4.4 Analytical Procedures

As described in the methodology chapter, analysis of variance techniques have been used to examine the work attitudes of the transitional group, OCS participants and long-term users at three points in time. The pretest was conducted six months prior to the installation of the integrated OCS computer network, the interim was conducted six months after the installation of OCS, and the posttest was conducted twenty months after the installation of OCS. Following a staggered design, the introduction of computerized procedures occurred at different times for each of the three groups. The long-term users had access to microcomputers over all three data collection periods, the OCS participants had access to the OCS local area network during the second and third data collection periods and the transitional group had access to microcomputers only at the time of the third data collection. Thus, a pronounced interaction effect should be in evidence if, in fact, computerization does create changes in work attitudes.

In presenting the results, six separate sets of analysis of variance tables have been included for the job satisfaction and alienation measures. The first set of tables examines the work attitudes of all three experimental groups over the pretest, interim and posttest data collections (Tables 4.1 and 4.2). The second set of tables refers to comparisons between the transitional and OCS participant groups (Tables 4.3 and 4.4). The third set of tables concentrates on active users, making it possible to establish if certain trends are particularly pronounced among those members of the affected work groups who actually used a computer in their daily work (Tables 4.5 and 4.6). Although the people who declined to adopt new electronic procedures form an interesting group, there were insufficient cases in this category to perform any time series analyses. The fourth and

fifth sets of tables reconstruct the analyses for continuous and discontinuous respondents to determine if the responses of stable employees differed from those of their more mobile counterparts (Tables 4.7 through 4.10). Finally, officers are selected for separate analyses in the sixth set of tables (Tables 4.11 and 4.12). This procedure also could not be repeated for support staff or managers because of insufficient cases. Tables 4.3 through 4.12 refer to only the transitional and OCS participant groups because the number of cases in the long-term users group was too small to permit further breakdowns.

To supplement these analysis of variance results, means tables have been included to display the average work attitude scores for the transitional group, OCS participants and long-term users at all three data collection points (Tables 4.13 through 4.25). Any discrepancies between these results and the trends exhibited within the continuous, discontinuous or active user sub-categories will be precisely stipulated in the text. Tables 4.26 through 4.38 also present separate mean scores on all attitudinal variables for support staff and officers. Even though the number of cases is insufficient to perform statistical analyses for support staff, these means tables permit some general comparisons between the two job types. Although inconclusive, this may highlight what could prove to be some interesting contrasts for future research.

4.5 Findings

In presenting the findings for this study, we will begin by discussing the trends exhibited for the job satisfaction indices: supervision, co-workers, promotional opportunities, intrinsic factors, extrinsic variables and general job satisfaction. Having completed these sections, we will then move on to a discussion of alienation measures: meaninglessness and powerlessness.

4.5.1 Job Satisfaction

The following sections focus on evaluations of numerous job factors that may be modified by the introduction of technological change. Even if the equipment does not have a direct effect on job satisfaction, changes may occur as a result of implementation procedures or the subsequent reallocation of job duties.

a) Supervision

The existing theoretical and empirical literature on technological change accords little attention to workers' assessments of their superiors during the implementation period. However, it is obvious that management strategies play a key role in determining the success or failure of any implementation project (Mick, 1983; Ranney, 1982). When a computer system is installed one might expect the added stress created by the adoption of new procedures to adversely affect workers' evaluations of those individuals in positions of authority. In

particular, respondents who are dissatisfied with the new means of conducting their work may blame management personnel for initiating such changes.

Although Tables 4.1 and 4.3 demonstrate significant differences in the evaluations of superiors given by transitional, OCS participant and long-term user groups, these differences remain relatively constant over time. Thus, the absence of an interaction demonstrates that the introduction of computerized procedures has no overall impact on the supervision index.

A quite different picture comes to light in Table 4.26. While officers in the participant group show a steady increase in the evaluation of supervisory personnel over the three time periods, support staff in this group exhibit a drop in their assessments of superiors at precisely that point when the OCS network was installed (interim data collection). Support staff in the transitional group show a similar decline at the time of the interim data collection, but this is comparable to the trend among officers in the same group and thus probably attributable to some alternative organizational change unique to these particular work units. Also, in contrast to all other categories, supervisory evaluations among support staff in the transitional group continued to decline for the posttest data collection. In consideration of this total picture, we would conclude that while computerization does not appear to have adversely affected the evaluation of supervisors among officers, there is some indication that support staff may give more negative assessments of their supervisors during the initial implementation period.

Although we did not have an opportunity to examine the means by which computers were introduced into the transitional group, our observations of the OCS trial provide a plausible explanation for the differing reactions of support and professional staff. The adoption of electronic procedures was a much more gradual and voluntary process for officers than it was for secretaries. In most cases, officers were able to exercise at least some discretion over the purposes for which they used the new system. In contrast, support staff found their typewriters removed and replaced by terminals. Personal interviews revealed that support staff felt pressured because their superiors' expectations exceeded what they were able to accomplish given the instability of the system and their own inexperience. Thus, it is not surprising that secretaries and officers viewed their supervisors differently during the initial adjustment period.

In the context of supervision, there is evidence that technological change may have created some negative reactions during the initial implementation period. However, such detrimental effects were primarily experienced by support staff and may be attributable to their lack of control over system usage. Following the indirect implementation perspective previously outlined, the introduction of a computer system may instill negative feelings about supervisory practices if people are not allowed at least some discretion over electronic applications.

b) Co-workers

The stress created during times of change can also have adverse consequences for interpersonal relationships within the office. When people are faced with the ambiguity created by new procedures, increased anxiety may result in tensions among co-workers. Alternatively, the group approach to training, sharing ideas and assistance, may lead to increased cohesion.

The results of a questionnaire distributed shortly after completion of the training program, demonstrated the significance of informal networks during the initial learning period. When users were experiencing difficulties, or did not understand how to use a particular function, they tended to rely on other staff for help. Seventy-three percent of all OCS participants said they frequently or sometimes sought assistance from their co-workers (Table 4.40).

Even though staff frequently approached each other for assistance during the initial implementation period, the results of work attitude measurements gave no indication of any mounting tension within the affected work units (Tables 4.1 and 4.3). In comparison with other respondents, OCS participants exhibited the most positive assessments of their co-workers both prior to and throughout the implementation phase (Table 4.14). One might speculate that computerization could have quite different results if relationships within an office were already strained prior to computerization. However, members of the transitional group, who originally had the lowest rating on the co-worker index, also showed an increase rather than a decrease in the evaluation of co-workers following the implementation of computerized procedures (posttest) (Table 4.14). In conclusion, there is no indication that technological change had any effect on relationships among workers.

c) Intrinsic Factors

Whereas some believe that repetitive tasks will be automated leaving more time for interesting and challenging work, others predict that people will increasingly function as simple input devices while computers perform the required analytical functions. Given the enlargement of jobs within this context, the indirect perspective would also lead to hypothesized increases in the area of intrinsic job satisfaction.

Similar to many of the other job satisfaction measures, the participant group gave significantly higher assessments of the intrinsic components of their jobs at all three data collection points (Tables 4.1, 4.3 and 4.15). It is clear that when electronic procedures were introduced into a relatively positive work environment this change did not result in diminished assessments of intrinsic factors; however, positive results were also not observed consistently.

At the time of the interim data collection, assessments of intrinsic factors had improved for both support staff and officers as the new

equipment provided a challenge for the participants. However, continued measurement showed a subsequent decline in the intrinsic index for officers. Even though our discussions of posttest work processes and procedures demonstrate quite extensive changes for the content of both professional and support jobs in the OCS participant. group, only support staff exhibit a corresponding long-term increase in their evaluations of the intrinsic characteristics of the job (Table 4.28). This finding may be related to the types of tasks that were adopted by the different job types. While this technological change enabled support staff to perform more administrative duties, officers did much more typing, filing and editing. Thus, the lack of a comparable increase in the intrinsic job satisfaction expressed by officers may be a consequence of the types of tasks added to their jobs. Our society has traditionally downgraded the importance of clerical activities; therefore, the acquisition of such skills may not be recognized as enhancing the interesting and challenging aspects of work. This line of thinking was in evidence during training sessions when a number of the officers expressed the opinion that they should not be learning to conduct such tasks as typing, editing, messaging and filing because these were really the responsibilities of their secretaries.

Even though computers had been introduced into the transitional group by the time of the posttest, usage was still quite ad hoc and there had been little time for any real qualitative changes to appear in the content of secretarial or professional positions. Thus, it is not surprising that the responses of this group did not show an increase on intrinsic job satisfaction measures (Table 4.28).

While it is clear that neither direct positive nor direct negative changes resulted from the introduction of OCS, indirect modifications in job content may have had a favourable influence for support staff in the long-term. Even though both officers and support staff acquired new skills and responsibilities as a result of computerization, officers did not demonstrate any corresponding increase in evaluations of intrinsic factors. The enlargement of jobs, through the addition of computer related skills and duties does not necessarily result in increased job satisfaction. The extent to which job enlargement enhances intrinsic job satisfaction instead may be contingent upon social norms which define the relative value of the new tasks.

d) Promotion Opportunities

The hypotheses surrounding promotional opportunities also differ substantially for the three perspectives on technological change. From one viewpoint, people argue that computerization will expand advancement channels by diminishing the need for lower level jobs. In contrast, others believe this equipment will diminish skill requirements, depriving workers of the means by which to demonstrate their potential to perform higher level tasks. From an indirect perspective, it is not entirely clear what changes would be hypothesized for this particular federal government application. Although no formal reevaluations or reclassifications resulted from

the introduction of OCS, both officers and support staff acquired new duties and skills in addition to their existing qualifications.

The findings give little indication that the introduction of electronic procedures led to any consistent positive or negative changes in evaluations of the adequacy of promotional opportunities (Table 4.1 and 4.3). With respect to support staff, there was a marked decline in both the participant and transitional groups at the particular time period when computerization occurred (Table 4.29). This seems to have been a temporary reaction, as the mean score for support staff in the participant group had again increased at the time of the posttest data collection. Although many see the development of computer related skills as a way of increasing the advancement potential of support staff, such improvements may depend upon modifications in work processes rather than technological change. Support staff in the OCS participant group did not show an increase on the promotional opportunities index until the posttest data collection when the structure of work procedures had changed to provide them with more administrative tasks. Similar to previous discussions under intrinsic factors, support staff may have been more likely than officers to recognize their newly acquired skills as being important for upward mobility.

The trend for officers runs exactly counter to support staff responses. For this group, assessments of promotional opportunities improved during the interim data collection and declined for the posttest. Initially enthusiastic feelings about the acquisition of new computer skills may have been discouraged by the subsequent lack of official recognition through either reclassifications or raises.

Some interesting contrasts appeared between the continuous and discontinuous respondents (Tables 4.7 and 4.9). These people who remained throughout all three data collections exhibited a significant decline in the evaluation of advancement opportunities; whereas, the more mobile respondents showed no such tendency. This finding is consistent for both the OCS participant and transitional groups and, therefore, is unlikely to be related to the introduction of computerized procedures.

Similar to the discussions of supervision and co-workers, respondents who were part of the OCS field trial gave the most positive evaluations of promotional opportunities throughout all three data collections. Although support staff exhibited an initial decline in their evaluations of advancement channels, this condition improved after they had been using the computer system for 20 months.

In general, it appears that computerization has had neither a direct positive nor a direct negative effect in this area. Although no reclassifications occurred on an official level, the evaluation of promotional opportunities had improved for support staff by the time of the posttest data collection. Support staff appear to see their newly acquired skills as a means of moving into better jobs. Thus, from an indirect perspective, the adoption of more administrative

responsibilities may have been seen as improving career potential among support staff.

e) Extrinsic Variables

For the purposes of this study, extrinsic factors include pay, job security and fringe benefits. Unions are concerned that current technological changes will cause them to lose ground at the bargaining table (Belanger, 1983:3). Clauses covering equitable remuneration and guaranteed job security are increasingly being incorporated into collective agreements to protect the membership against the degradation and displacement that is thought to result from computerization.

Within the context of this federal government project, management assured all personnel that job descriptions would remain the same and they would not lose their positions as a result of OCS. Thus, according to the indirect perspective one would expect the evaluations of extrinsic factors to remain relatively constant.

Both transitional and OCS participant groups exhibit a marked decline in their evaluations of job security over the three data collections (Table 4.3 and 4.18). Continuous respondents also demonstrate a significant main effect of time for the pay variable (Table 4.7). However, the absence of an interaction makes it highly unlikely that such changes are related to the introduction of electronic procedures. More plausible explanations can be derived from an understanding of the organizational context. The comprehensiveness of the increase in feelings of insecurity is not surprising given the magnitude of the organizational changes that occurred between 1983 and 1986. As outlined in the methodology section, the department was confronted with numerous ministerial changes, reallocations of responsibilities and revised mandates over the field trial period.

In the case of declining assessments for pay, this trend is only evident for the continuous respondent group (Table 4.7). In congruence with promotional opportunities, those people who remained in the same work unit for a lengthy period of time became more and more dissatisfied with their salaries. This may well be reflective of the organizational culture within the federal government which sees frequent job changes as the norm. If people still hold the same position after three years, they may recognize themselves as being "stuck" and thus become negative about the adequacy of their pay as well as the possibilities for moving into a better position. Kanter has elaborated on this type of reaction in her book entitled Men and Women of the Corporation (1977).

In examining differences between officers and support staff in the area of extrinsic rewards, a pronounced distinction appears with respect to pay (Table 4.30). Support staff in both the transitional and OCS participant groups show a substantial decline in their assessments of this variable at the time when computerized procedures were introduced. Responses of OCS participants, however, did return to normal after the system had been in place approximately 1 1/2

years. Although these work attitudes leveled off after lengthy usage, initial reactions among support staff were generally negative. The explanation for the distinctiveness of the attitudes expressed by this group could again be related to the element of choice. Members of this particular job type were not given the option of when they wanted to use the computer and for what purposes. Under presssure to learn the new electronic procedures while at the same time maintaining a regular workload, they may have felt that such extra demands should have been compensated by increased financial remuneration.

Throughout the population as a whole, there was little indication that the introduction of computerized procedures resulted in any changes for extrinsic job satisfaction levels. Although support staff exhibited an initial decline in their evaluations of pay, this may have been linked to the additional energy invested in the learning process as this variable had stabilized after the system had been in place for over a year.

f) General Job Satisfaction

Similar to the findings discussed under the facet specific measures, general job satisfaction exhibits a significant difference across the three groups under study (Table 4.39). The OCS participants are the most satisfied with their jobs, while the long-term users are the least satisfied. However, the unvarying responses of the transitional and OCS participant groups, at the time of computerization, make it unlikely that the relatively negative responses among long-term users are linked to computer usage.

4.6 Alienation

With alienation measures, we turn from evaluations of the adequacy of job characteristics to perceptions of specific components of work. To a large extent, alienation focuses on issues of control and autonomy.

a) Meaninglessness

Under the meaninglessness dimension, we will consider any changes that occurred in respondents' perceptions of the value of their work, the degree of responsibility accorded them and the extent to which they were able to personally carry a project through to completion.

The index measuring the perceived value of work focuses on the individual's perception of his/her contribution to the development of a worthwhile product. Because this dimension of the meaninglessness concept is the most closely associated with intrinsic factors, it is not surprising that the results are very similar to those discussed under that component of facet-specific job satisfaction (Tables 4.2 and 4.4). Although support staff in the OCS participant group showed a marked improvement in assessments of the value of their work by the time the computer system had been in place for approximately 1 1/2 years, officers exhibited no such trend (Table 4.33).

A relatively similar scenario comes to light in the area of job specialization. The extent to which respondents experienced a fragmentation of work duties was monitored through assessments of the following statement: "my job is arranged so that I can do an entire piece of work from beginning to end". By the time of the posttest data collection, support staff in the participant group were much more likely to feel that they were able to personally complete designated tasks (Table 4.34). This may be related not only to changes that occurred in the relationship between the duties of support staff and officers, but also to the modified role of the word processing centre. Prior to the introduction of OCS, long documents were routed to a centralized word processing facility; however, once branch secretaries were equipped with computerized equipment they could personally perform all required clerical duties.

The third and final component of meaninglessness refers to the degree of autonomy accorded the individual. If people do not have discretion in how they conduct their work, they are unable to feel that they are making a personal contribution to the final product. In the area of computerization it is questionable whether or not machines are depriving workers of this very crucial feature of work. Responsibility is the one area where computerization may have had a direct negative effect on work attitudes. When confining analyses to active users, time exhibits a significant main effect (Table 4.6). Although the interaction is not statistically significant at .05, it is significant at .1. Table 4.22 also gives a more precise illustration of the forces at work. While the degree of personal responsibility declined for OCS participants at both the interim and posttest data collection, a similar reaction was not exhibited by the transitional group until the posttest when computers had also moved into this work environment. Another interesting finding is shown in Table 4.10. For discontinuous respondents, there is a significant interaction, and this follows the time sequence for the implementation of electronic procedures (Table 4.41).

Even though we have seen no indication that computerization has had long-term adverse effects in any of the other areas of work attitudes, it does seem that people are less willing to take personal responsibility for their work once computers are in place. Anyone who has ever used a computer can probably understand why office workers would have such a reaction. System crashes, improper diskette maintenance and power surges are just a few of the multitude of problems that can lead to information distortion or loss. As such delays and malfunctions are usually out of the hands of the operator, it is not surprising that people feel less personally responsible for the outcome. Support staff, for instance, may no longer feel they can guarantee that they will have a document ready for a certain deadline because the system could go down making it impossible for them to extract the necessary information.

In consideration of the distinction between continuous and discontinuous users, new staff may exhibit the strongest reaction in this area because of their insecurity with the system. The training received by new employees was not as extensive as it had been for the

continuous group and they obviously had less time to perfect their skills. Thus, machine errors could be compounded by human errors that resulted from unfamiliarity with computerized procedures.

Following the indirect perspective which concentrates on implementation procedures and changes in job content, it appears that support staff perceived themselves as having more autonomous and valuable jobs following the introduction of OCS. Because officers conducted much of their own text entry and editing, support staff could carry out more administrative duties. This is not, however, to say that all results of computerization were positive. Both support staff and officers felt less personally responsible for the results of their work after the installation of OCS. Thus, this is one area where electronic procedures may have had a direct negative impact on work attitudes.

b) Powerlessness

The underlying dimension of the concept of powerlessness is the element of control. In this study we have examined the amount of control experienced in three separate areas: job content, physical movement and the speed of work.

Although long-term users did not exhibit distinctively negative evaluations for the other job satisfaction and meaninglessness measures, considerations of powerlessness demonstrate some pronounced differences. Long-term users gave substantially more negative evaluations of their freedom of movement and the speed of work (Tables 4.2, 4.24 and 4.25). At first sight this could indicate that the effects of computerization take longer to develop than the period covered by this research project. However, given our understanding of the job types included under this category it seems most probable that these findings result because of pronounced differences in job duties rather than the existence or absence of computerized equipment. Respondents in the third group cover job classifications that are responsible for dedicated word processing and the development of press releases and speeches that must be accomplished under strict deadlines. Thus, it is not surprising that the combination of these respondents results in the presentation of negative work attitudes in the areas of control over physical movement and work speed. Further evidence that computerization is not directly responsible for the lack of control among long-term users can be derived from the fact that neither the transitional nor the OCS groups showed any such tendency following the introduction of electronic procedures.

In addition to a significant main effect of 'group', Table 4.4 also demonstrates an interaction of time by group for the variable measuring the degree of control over work speed. Both the transitional and OCS participant groups experienced much more time pressure at precisely that point when computers were introduced (Table 4.25). Except for four days of formal training in the OCS group, respondents were not given any extra time to develop their computer skills during working hours. Within the federal government, as in the vast majority of other establishments, workers were expected to learn

new computer related functions while at the same time conducting all of their regular work duties.

Although computerization does not result in negative assessments of control over job content or physical movement, there is some indication that people experience heightened time pressure during the first few months of computer usage. Once again the results follow the general orientation of the indirect perspective on technological change. The manner of introduction, rather than the equipment itself, may have led to heightened stress during the initial few months of system usage.

4.7 **Conclusion**

The results of this research project indicate that computerization may have a direct impact on work attitudes in some areas and an indirect effect in other areas. The introduction of the computer system appears to have directly contributed to a decline in responsibility levels. From an indirect perspective implementation procedures may have temporarily affected evaluations of supervisory practices, pay and promotional opportunities. Finally, long-term changes in the labour process, appear to have instilled enhanced satisfaction for support staff in the areas of intrinsic job content and the perceived value of the job.

4.7.1 Direct Negative Effects

All observation groups and job types felt less responsible for the results of their work once a computer system was installed. The consistency of this finding makes it probable that the equipment, rather than other related factors, contributed to this change. The transition to electronic procedures brings with it a whole host of problems including system crashes, diskette corruption and power surges that can delay or distort document production. Thus, it is not surprising that people are less likely to feel in total control of the results of their work when using a computer network.

4.7.2 Indirect Effects of Implementation Procedures

There were also a number of changes in work attitudes that were unique to the interim data collection and therefore could be linked to implementation procedures. All groups experienced heightened time pressures during the initial adaptation period and support staff appear to have been particularly dissatisfied with their jobs when they were learning to use OCS.

The training and user support provided for the OCS field trial was much more extensive than that typically found throughout private industry and other government applications; however, workers were still expected to develop their computer related skills while at the same time maintaining a regular work load. Under such conditions, it

is not surprising that people experienced pronounced time pressures. This is a significant problem that is difficult to surmount because the implementing organization must continue operations while at the same time making the transition to electronic work procedures.

Although everyone experienced pressure in the area of time constraints, support staff may have been in a particularly stressful position during the initial learning phase. Unlike officers, support staff had virtually no control over the functions for which they used the new computer system. Personal interviews, conducted six months after the installation of OCS, revealed that support staff felt the expectations of their superiors exceeded what they were able to accomplish given their own inexperience and the bugs and glitches in the system. These increased work demands and insecurities, coupled with the lack of any compensatory pay raises, may have been responsible for the relatively negative assessments of supervisory practices and pay given by support staff during the first six months of computer usage.

4.7.3 Indirect Effect of Changes in the Labour Process

Finally, some of the positive changes in work attitudes did not surface until the computer system had been in operation for over a year. Indirect consequences of technological change based on revised work processes may take a relatively long time to surface.

By the time of the posttest data collection, 20 months after system installation, the jobs of both support staff and officers had been enlarged as a consequence of revisions in work roles and the adoption of new electronic procedures. However, only support staff demonstrated a corresponding increase in assessments of intrinsic job content and the value of their work. This leads to what might be a qualification of the indirect perspective that focuses on job enlargement as a significant determinant of positive attitudes. The addition of job duties may only result in increased satisfaction if new skills are deemed to be an improvement of existing qualifications. Because our society has traditionally downgraded the importance of secretarial skills, officers may not see text entry and editing responsibilities as making their jobs more interesting and challenging. For support staff, on the other hand, the long-term changes in job content compensated for initially negative reactions.

Overall, the results of the OCS field trial give only one indication of a direct negative consequence of computerization. On the other hand, the majority of changes in work attitudes appear to be linked to implementation procedures and structural changes in work processes rather than the equipment itself.

Figure 4.1

Operational Definitions of Concepts for Work Attitudes Chapter

Job Satisfaction Items

Supervision: A supervision index was formed by summing the respondent's evaluations of the following four statements:

- my superiors are competent in doing their jobs
- I receive fair treatment from my superiors
- my superiors are friendly
- my superiors are successful in getting people to work together

Response categories followed a four point scale with 1 meaning not at all true and 4 meaning very true. Index scores ranged from 4 to 16 with a mean of 12.53. Standardized Cronbach's alpha: pretest = .85, interim = .79, posttest = .79.

Co-workers: A co-workers index was formed by summing the respondent's evaluations of the following three statements:

- the people I work with are friendly
- my work gives me a chance to get to know other people
- I like almost all of the people I work with

Response categories followed a four point scale with 1 meaning not at all true and 4 meaning very true. Index scores ranged from 3 to 12 with a mean of 9.81. Standardized Cronbach's alpha: pretest = .64, interim = .57, posttest = .70.

Intrinsic: An intrinsic index was formed by summing the respondent's evaluations of the following three statements:

- the work is challenging
- I have an opportunity to develop my own special abilities
- the work is interesting

Response categories followed a four point scale with 1 meaning not at all true and 4 meaning very true. Index scores ranged from 3 to 12 with a mean of 8.96. Standardized Cronbach's alpha: pretest = .86, interim = .88, posttest = .77.

Promotion Opportunities: A promotion opportunities index was formed by summing the resondent's evaluations of the following three statements:

- the chances for promotion are good
- promotions are handled fairly
- everyone is given a chance to get ahead

Response categories followed a four point scale with 1 meaning not at all true and 4 meaning very true. Index scores ranged from 3 to 12 with a mean of 7.11. Standardized Cronbach's alpha: pretest = .80, interim = .76, posttest = .83.

Pay: The pay variable was derived from the response to the following statement:

- I am fairly paid for what I contribute to the organization.

Response categories followed a four point scale with 1 meaning not at all true and 4 meaning very true.

Job Security: The job security variable was derived from the response to the following statement:

- my future with the organization is secure

Response categories followed a four point scale with 1 meaning not at all true and 4 meaning very true.

Fringe Benefits: The finge benefit variable was derived from the response to the following statement:

- the fringe benefits are good

Response categories followed a four point scale with 1 meaning not at all true and 4 meaning very true.

General Job Satisfaction: The general job satisfaction variable was derived from responses to the following question:

- All in all, how satisfied would you say you are with your current job?

Response categories followed a 4 point scale with 1 meaning very dissatisfied and 4 meaning very satisfied.

Alienation Items

Perceived Value of Job: An index was formed by summing responses to the following three statements:

- this job is one where a lot of other people can be affected by how well my work is done
- the work I do on this job is very meaningful to me
- just doing the work required by the job provides many chances for me to figure out how well I am doing

Response categories followed a four point scale with 1 meaning strongly disagree and 4 meaning strongly agree. Index scores ranged from 4 to 12 with a mean of 9.49. Cronbach's alpha: pretest = .73, interim = .63, posttest = .70.

Degree of Job Specialization: The job specialization variable was derived from responses to the following statement:

- my job is arranged so that I can do an entire piece of work from beginning to end

Response categories followed a four point scale with 1 meaning strongly disagree and 4 meaning strongly agree.

Responsibility: The responsibility variable was derived from the response to the following statement:

- whether or not this job gets done correctly is clearly my responsibility

Response categories followed a four point scale with 1 meaning strongly disagree and 4 meaning strongly agree.

Control Over Job Content: The job content variable was derived from the response to the following statement:

- my job gives me considerable opportunity for independence and freedom in how I do the work

Response categories followed a four point scale with 1 meaning strongly disagree and 4 meaning strongly agree.

Control Over Movement: The control over movement variable was derived from the response to the following statement:

- if I wanted to leave my work for half an hour I would have to tell my superior or make a record of it

Responses to this statement were reverse scored to assure that the highest number always represents the most positive situation. Thus, 1 means strongly agree and 4 means strongly disagree.

Control Over Speed of Work: The control over speed of work variable was formed by summing responses to the following two statements:

- I find I have to be more concerned with how much work I get done than how well I do the job
- I feel I have to work too fast most of the time

Responses to these statements were also reverse scored with 1 meaning strongly agree and 4 meaning strongly disagree. The correlation between these two items was .36.

Table 4.1

Factorial Analysis of Variance for Job Satisfaction Items
Transitional Group, OCS Participants and Long-term Users

	time	group	time X group	within	within df
Supervision					
MS	10.586	19.793	1.091	4.988	289
F	2.112	3.968*	.219		
Co-workers					
MS	4.746	8.223	1.127	2.134	305
F	2.224	3.854*	.528		
Intrinsic					
MS	.295	28.302	2.132	3.976	299
F	.074	7.118***	.536		
Promotion Opportunities					
MS	8.001	43.868	3.714	3.462	284
F	2.311	12.671***	1.073		
Extrinsic					
pay	1.249	.307	.029	.519	301
MS	2.408	.591	.057		
F					
job security					
MS	2.132	1.142	.440	.661	302
F	3.226*	1.728	.665		
fringe benefits					
MS	.147	3.278	.558	.688	301
F	.213	4.765**	.811		

Between df = 2 for time, 2 for group and 4 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4.2

Factorial Analysis of Variance for Alienation Items
Transitional Group, OCS Participants and Long-term Users

	time	group	time X group	within	within df
Meaninglessness					
perceived value of job					
MS	.950	20.447	2.473	3.741	294
F	.254	5.466**	.661		
degree of job specialization					
MS	1.254	1.342	.602	1.059	304
F	1.184	1.267	.568		
responsibility					
MS	.855	.864	1.333	.621	303
F	1.376	1.390	2.145		
Powerlessness					
control over job content					
MS	.331	1.647	.571	.791	306
F	.419	2.082	.722		
control over movement					
MS	.123	12.766	.419	1.268	302
F	.097	10.067***	.331		
control over speed of work					
MS	4.459	20.540	4.131	2.187	301
F	2.039	9.393***	1.889		

Between df = 2 for time, 2 for group, 4 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4.3

Factorial Analysis of Variance for Job Satisfaction Items
Transitional Group and OCS Participants

	time	group	time X group	within	within df
Supervision					
MS	7.427	38.586	.904	4.993	248
F	1.488	7.728**	.181		
Co-workers					
MS	1.485	16.440	.623	2.167	262
F	.685	7.588**	.287		
Intrinsic					
MS	1.350	50.333	.472	4.014	258
F	.336	12.541**	.118		
Promotion Opportunities					
MS	10.787	68.166	6.032	3.187	243
F	3.385*	21.389**	1.893		
Extrinsic					
pay					
MS	1.313	.378	.056	.515	258
F	2.552	.735	.109		
job security					
MS	5.738	1.029	.141	.668	260
F	8.594***	1.542	.211		
fringe benefits					
MS	.018	3.128	.782	.687	258
F	.026	4.553*	1.138		

Between df = 2 for time, 1 for group and 2 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4.4

Factorial Analysis of Variance for Alienation Items
Transitional Group and OCS Participants

	time	group	time X group	within	within df
Meaninglessness					
perceived value of job					
MS	.009	37.324	3.890	3.789	255
F	.002	9.851**	1.027		
degree of job specialization					
MS	.064	.400	.110	1.056	261
F	.061	.379	.104		
responsibility					
MS	1.666	1.517	.984	.650	261
F	2.562	2.333	1.513		
Powerlessness					
control over job content					
MS	.007	2.937	2.731	.753	263
F	.009	3.899*	.970		
control over movement					
MS	.683	2.425	.117	1.222	258
F	.559	1.984	.096		
control over speed of work					
MS	2.374	15.714	7.613	2.177	258
F	1.091	7.219**	3.497*		

Between df = 2 for time, 1 for group and 2 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4.5

Factorial Analysis of Variance for Job Satisfaction Items
Transitional Group and OCS Participants - Active Users Only

	time	group	time X group	within	within df
Supervision					
MS	5.462	39.309	.182	5.089	214
F	1.073	7.724**	.036		
Co-workers					
MS	1.669	14.603	.962	2.085	225
F	.801	7.004**	.462		
Intrinsic					
MS	1.574	52.042	1.127	4.001	222
F	.393	13.008***	.282		
Promotion Opportunities					
MS	7.994	60.784	5.328	3.159	207
F	2.530	19.239***	1.687		
Extrinsic					
pay					
MS	.513	.853	.084	.005	221
F	1.663	.163	.009		
job security					
MS	5.769	1.273	.078	.643	224
F	8.976***	1.981	.121		
fringe benefits					
MS	.043	2.603	.652	.660	222
F	.065	3.942*	.958		

Between df = 2 for time, 1 for group and 2 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4.6

Factorial Analysis of Variance for Alienation Items
Transitional Group and OCS Participants - Active Users Only

	time	group	time X group	within	within df
Meaninglessness					
perceived value of job					
MS	.662	46.464	3.400	3.703	218
F	.179	12.549***	.918		
degree of job specialization					
MS	.069	.438	.183	1.036	224
F	.067	.423	.176		
responsibility					
MS	2.617	2.102	1.362	.632	224
F	4.137**	3.323	2.153		
Powerlessness					
control over job content					
MS	.009	2.242	.535	.767	226
F	.012	2.922	.698		
control over movement					
MS	.510	3.337	.033	1.195	222
F	.427	2.792	.027		
control over speed of work					
MS	1.253	16.431	3.159	2.099	221
F	.597	7.829**	1.505		

Between df = 2 for time, 1 for group and 2 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4.7

Factorial Analysis of Variance for Job Satisfaction Items
Transitional Group and OCS Participants - Continuous Respondents Only

	time	group	time X group	within	within df
Supervision					
MS	8.053	21.075	.472	4.080	86
F	1.974	5.165*	.116		
Co-workers					
MS	1.402	3.350	.473	1.791	93
F	.783	1.870	.264		
Intrinsic					
MS	.585	27.277	.079	4.108	92
F	.142	6.640**	.019		
Promotion Opportunities					
MS	11.373	35.967	5.218	2.716	86
F	4.187*	13.240***	1.921		
Extrinsic					
pay					
MS	2.079	.182	.073	.302	91
F	6.884**	.604	.240		
job security					
MS	.916	.014	.310	.260	93
F	3.527*	.053	1.194		
fringe benefits					
MS	.012	11.829	.442	.490	90
F	.025	24.158***	.903		

Between df = 2 for time, 1 for group and 2 for time X group

* p < .05 ** p < .01 *** p < .001

Table 4.8

Factorial Analysis of Variance for Alienation Items
Transitional Group and OCS Participants - Continuous Respondents Only

	time	group	time X group	within	within df
Meaninglessness					
perceived value of job					
MS	.276	15.522	3.911	3.338	90
F	.083	4.651*	1.172		
degree of specialization					
MS	.292	.866	.595	.912	93
F	.820	.949	.652		
responsibility					
MS	1.276	1.670	.053	.608	92
F	2.098	2.745	.087		
Powerlessness					
control over job content					
MS	.684	1.565	.038	.634	93
F	1.079	2.468	.059		
control over movement					
MS	.502	7.064	.139	.730	92
F	.687	9.678**	.190		
control over speed of work					
MS	1.503	23.593	.801	1.257	91
F	1.196	18.772***	.638		

Between df = 2 for time, 1 for group and 2 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4.9

Factorial Analysis of Variance for Job Satisfaction Items
Transitional Group and OCS Participants - Discontinuous Respondents Only

	time	group	time X group	within	within df
Supervision					
MS	1.282	11.698	1.154	5.566	156
F	.230	2.102	.207		
Co-workers					
MS	3.024	11.344	1.347	2.392	163
F	1.264	4.743*	.563		
Intrinsic					
MS	1.930	17.979	.252	4.043	160
F	.477	4.447*	.062		
Promotion Opportunities					
MS	2.584	35.143	3.407	3.476	151
F	.743	10.110**	.980		
Extrinsic					
pay					
MS	.125	2.402	.106	.606	161
F	.206	3.962*	.175		
job security					
MS	3.412	3.041	1.139	.864	161
F	3.950*	3.520	1.319		
fringe benefits					
MS	.095	.131	.411	.766	162
F	.124	.171	.537		

Between df = 2 for time, 1 for group, 2 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4.10

Factorial Analysis of Variance for Alienation Items
Transitional Group and OCS Participants - Discontinuous Respondents Only

	time	group	time X group	within	within df
Meaninglessness					
perceived value of job					
MS	.300	13.228	1.200	4.052	159
F	.074	3.264	.296		
degree of job specialization					
MS	.181	.124	.297	1.140	162
F	.158	.109	.261		
responsibility					
MS	.846	.661	2.754	.660	163
F	1.283	1.002	4.176*		
Powerlessness					
control over job content					
MS	.556	1.723	1.415	.828	164
F	.672	2.080	1.708		
control over movement					
MS	.813	1.224	.028	1.361	160
F	.597	.899	.021		
control over speed of work					
MS	.840	.438	8.896	2.544	161
F	.330	.172	3.497*		

Between df = 2 for time, 1 for group and 2 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4.11

Factorial Analysis of Variance for Job Satisfaction Items
Transitional Group and OCS Participants - Officers Only

	time	group	time X group	within	within df
Supervision					
MS	3.558	32.147	4.468	4.474	152
F	.795	7.186**	.999		
Co-workers					
MS	.445	14.963	2.338	2.112	159
F	.211	7.084**	1.107		
Intrinsic					
MS	2.828	55.164	4.486	3.944	157
F	.717	13.986***	1.137		
Promotion Opportunities					
MS	9.281	40.174	1.517	3.330	146
F	2.787*	12.063***	.455		
Extrinsic					
pay					
MS	.646	1.133	.653	.452	156
F	1.430	2.506	1.445		
job security					
MS	5.868	.062	.155	.632	159
F	9.285***	.098	.245		
fringe benefits					
MS	.063	.366	1.050	.657	156
F	.096	.557	1.599		

Between df = 2 for time, 1 for group and 2 for time X group

* p < .05 ** p < .01 *** p < .001

Table 4.12

Factorial Analysis of Variance for Alienation Items
Transitional Group and OCS Participants - Officers Only

	time	group	time X group	within	within df
Meaninglessness					
perceived value of job					
MS	.045	17.095	4.722	4.246	154
F	.011	4.026*	1.112		
degree of job specialization					
MS	.760	.001	.537	1.055	158
F	.720	.004	.509		
responsibility					
MS	1.066	3.346	.389	.585	159
F	1.824	5.722*	.665		
Powerlessness					
control over job content					
MS	.297	1.814	.138	.700	160
F	.424	2.591	.198		
control over movement					
MS	.469	6.388	1.232	.898	156
F	.522	7.111**	1.371		
control over speed of work					
MS	.149	22.612	7.203	2.256	158
F	.066	10.021**	3.192*		

Between df = 2 for time, 1 for group and 2 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4.13

Supervision - Mean Scores for Transitional Group, OCS Participants and Long-term Users

group		time			
		pretest	interim	posttest	row mean
transitional group	M	12.31	11.89	12.32	12.20
	SD	2.11	2.32	2.10	
	N	(36)	(36)	(56)	
OCS participants	M	13.34	12.56	12.98	12.94
	SD	2.40	2.34	2.18	
	N	(38)	(46)	(42)	
long-term users	M	12.54	11.82	12.86	12.36
	SD	2.11	2.21	2.35	
	N	(13)	(17)	(14)	
column mean		12.79	12.19	12.63	12.53

Table 4.14

Co-workers - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	9.60	9.46	9.61	9.56
	SD	1.48	1.50	1.68	
	N	(37)	(37)	(57)	
OCS participants	M	9.93	9.96	10.28	10.06
	SD	1.37	1.40	1.33	
	N	(43)	(48)	(46)	
long-term users	M	9.50	9.56	10.36	9.78
	SD	1.16	1.46	1.50	
	N	(14)	(18)	(14)	
column mean		9.73	9.71	9.97	9.81

Table 4.15

Intrinsic - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	8.61	8.61	8.50	8.56
	SD	2.27	2.26	1.89	
	N	(36)	(36)	(56)	
OCS participants	M	9.42	9.67	9.29	9.46
	SD	2.15	1.86	1.67	
	N	(43)	(48)	(45)	
long-term users	M	8.57	8.23	9.08	8.59
	SD	1.65	2.19	1.85	
	N	(14)	(17)	(13)	
column mean		8.98	9.05	8.88	8.96

Table 4.16

Promotion Opportunities - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	7.15	7.00	6.02	6.61
	SD	1.75	1.75	1.89	
	N	(33)	(35)	(53)	
OCS participants	M	7.85	7.82	7.68	7.78
	SD	1.74	1.84	1.70	
	N	(39)	(45)	(44)	
long-term users	M	7.00	6.33	6.31	6.52
	SD	2.27	2.20	2.32	
	N	(13)	(18)	(13)	
column mean		7.45	7.26	6.72	7.11

Table 4.17

Pay - Mean Scores for Transitional Group,
OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	3.14	3.08	2.88	3.01
	SD	.86	.60	.69	
	N	(37)	(37)	(56)	
OCS participants	M	3.21	3.11	3.00	3.10
	SD	.81	.70	.64	
	N	(42)	(47)	(45)	
long-term users	M	3.27	3.18	3.00	3.15
	SD	.70	.73	.78	
	N	(15)	(17)	(14)	
column mean		3.19	3.11	2.94	3.07

Table 4.18

Job Security - Mean Scores for Transitional Group,
OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	2.92	2.84	2.50	2.72
	SD	.92	.73	.93	
	N	(37)	(37)	(56)	
OCS participants	M	3.14	2.92	2.58	2.88
	SD	.77	.74	.75	
	N	(43)	(48)	(45)	
long-term users	M	3.00	3.00	3.00	3.00
	SD	.55	.84	.91	
	N	(14)	(18)	(13)	
column mean		3.03	2.90	2.59	2.83

Table 4.19

Fringe Benefits - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	2.61	2.78	2.71	2.70
	SD	.87	.75		.85
	N	(36)	(37)	(56)	
OCS participants	M	3.05	2.83	2.89	2.92
	SD	.80	.91	.78	
	N	(42)	(48)	(45)	
long-term users	M	3.00	3.06	3.29	3.11
	SD	.93	.97	.47	
	N	(15)	(17)	(14)	
column mean		2.87	2.85	2.85	2.86

Table 4.20

Perceived Value of Job - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	8.92	9.17	9.33	9.16
	SD	1.98	2.10	2.00	
	N	(36)	(36)	(55)	
OCS participants	M	10.14	9.85	9.71	9.90
	SD	1.92	1.55	2.12	
	N	(42)	(47)	(45)	
long-term users	M	9.50	8.88	9.29	9.19
	SD	1.31	2.09	1.94	
	N	(12)	(16)	(14)	
column mean		9.57	9.44	9.47	9.49

Table 4.21

Degree of Job Specialization - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	2.53	2.56	2.45	2.50
	SD	.95	.94	1.02	
	N	(38)	(36)	(56)	
OCS participants	M	2.46	2.40	2.44	2.43
	SD	1.15	1.04	1.02	
	N	(44)	(47)	(46)	
long-term users	M	3.00	2.78	2.36	2.72
	SD	1.04	1.11	.93	
	N	(14)	(18)	(14)	
column mean		2.56	2.52	2.43	2.50

Table 4.22

Responsibility - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	3.05	3.19	2.93	3.04
	SD	.77	.86	.65	
	N	(38)	(36)	(57)	
OCS participants	M	3.44	3.15	3.04	3.21
	SD	.82	.86	.89	
	N	(43)	(47)	(46)	
long-term users	M	3.33	2.88	3.43	3.20
	SD	.72	.72	.51	
	N	(15)	(16)	(14)	
column mean		3.27	3.12	3.03	3.14

Table 4.23

Control Over Job Content - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	3.03	2.84	2.91	2.92
	SD	.72	.93	.91	
	N	(38)	(37)	(57)	
OCS participants	M	3.05	3.23	3.13	3.14
	SD	1.10	.76	.72	
	N	(44)	(47)	(46)	
long-term users	M	3.14	2.89	2.79	2.94
	SD	1.03	1.08	.89	
	N	(14)	(18)	(14)	
column mean		3.05	3.03	2.98	3.02

Table 4.24

Control Over Movement - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	3.22	3.14	2.98	3.09
	SD	1.15	1.10	1.10	
		(36)	(36)	(56)	
OCS participants	M	2.98	2.92	2.87	2.92
	SD	1.08	1.12	1.09	
	N	(43)	(47)	(46)	
long-term users	M	2.20	2.11	2.43	2.23
	SD	1.21	1.28	1.22	
	N	(15)	(18)	(14)	
column mean		2.95	2.85	2.87	2.89

Table 4.25

Control Over Speed of Work - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	5.87	5.94	5.16	5.58
	SD	1.47	1.29	1.53	
	N	(38)	(36)	(57)	
OCS participants	M	5.21	4.98	5.30	5.16
	SD	1.57	1.34	1.58	
	N	(43)	(44)	(46)	
long-term users	M	4.86	4.78	4.14	4.61
	SD	1.70	1.48	1.29	
	N	(14)	(18)	(14)	
column mean		5.42	5.30	5.09	5.26

Table 4.26

Supervision - Mean Scores for Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	14.50	13.54	13.27	13.53
	SD	3.00	1.92	1.79	
	N	(4)	(11)	(15)	
OCS participants	M	13.77	12.71	13.62	13.33
	SD	2.13	2.44	2.03	
	N	(13)	(17)	(16)	
column mean		13.94	13.04	13.45	13.41

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	12.00	11.04	11.97	11.75
	SD	1.88	2.16	2.14	
	N	(31)	(23)	(38)	
OCS participants	M	12.39	12.65	12.76	12.62
	SD	2.52	2.06	2.05	
	N	(18)	(23)	(25)	
column mean		12.14	11.85	12.29	12.11

Table 4.27

Co-workers - Mean Scores for Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	9.80	10.25	10.47	10.28
	SD	2.17	1.54	1.19	
	N	(5)	(12)	(15)	
OCS participants	M	9.69	9.88	10.69	10.08
	SD	1.54	1.41	1.35	
	N	(16)	(17)	(16)	
column mean		9.71	10.03	10.58	10.16

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	9.61	9.04	9.36	9.37
	SD	1.38	1.40	1.78	
	N	(31)	(23)	(39)	
OCS participants	M	9.75	10.04	10.07	9.97
	SD	1.16	1.34	1.33	
	N	(20)	(25)	(27)	
column mean		9.67	9.56	9.65	9.63

Table 4.28

Intrinsic - Mean Scores for Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	7.25	9.54	8.86	8.90
	SD	3.50	2.21	1.23	
	N	(4)	(11)	(14)	
OCS participants	M	8.19	8.76	9.56	8.84
	SD	2.45	1.75	1.67	
	N	(16)	(17)	(16)	
column mean		8.00	9.07	9.23	8.86

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	8.74	8.13	8.38	8.44
	SD	2.11	2.26	2.12	
	N	(31)	(23)	(39)	
OCS participants	M	9.68	10.00	9.15	9.60
	SD	1.53	1.85	1.76	
	N	(19)	(25)	(26)	
column mean		9.10	9.10	8.69	8.94

Table 4.29

Promotion Opportunities - Mean Scores for Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	7.50	7.18	5.62	6.25
	SD	1.73	1.60	1.94	
	N	(4)	(11)	(13)	
OCS participants	M	7.67	7.24	8.19	7.69
	SD	2.06	2.08	.91	
	N	(15)	(17)	(16)	
column mean		7.63	7.21	7.03	7.25

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	7.07	6.91	6.16	6.64
	SD	1.80	1.92	1.91	
	N	(28)	(22)	(37)	
OCS participants	M	7.71	8.23	7.38	7.75
	SD	1.61	1.51	2.00	
	N	(17)	(22)	(26)	
column mean		7.31	7.57	6.67	7.12

Table 4.30

Pay - Mean Scores for Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	3.60	3.00	2.29	2.77
	SD	.55	.60	.73	
	N	(5)	(12)	(14)	
OCS participants	M	3.00	2.71	3.06	2.92
	SD	.89	.59	.57	
	N	(16)	(17)	(16)	
column mean		3.14	2.83	2.70	2.86

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	3.06	3.09	3.08	3.08
	SD	.89	.60	.58	
	N	(31)	(23)	(39)	
OCS participants	M	3.37	3.38	3.80	3.23
	SD	.68	.50	.69	
	N	(19)	(24)	(26)	
column mean		3.18	3.23	3.05	3.14

Table 4.31

Job Security - Mean Scores for Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	2.60	2.58	2.71	2.64
	SD	.89	.90	1.14	
	N	(5)	(12)	(14)	
OCS participants	M	3.00	2.88	2.67	2.85
	SD	.89	.86	.62	
	N	(16)	(17)	(15)	
column mean		2.90	2.76	2.69	2.77

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	3.00	2.96	2.44	2.75
	SD	.93	.64	.85	
	N	(31)	(23)	(39)	
OCS participants	M	3.15	2.88	2.48	2.81
	SD	.74	.67	.80	
	N	(20)	(25)	(27)	
column mean		3.06	2.92	2.46	2.78

Table 4.32

Fringe Benefits - Mean Scores for Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	3.40	3.08	2.86	3.03
	SD	.55	.79	.95	
	N	(5)	(12)	(14)	
OCS participants	M	3.33	3.06	3.38	3.25
	SD	.72	.90	.50	
	N	(15)	(17)	(16)	
column mean		3.35	3.07	3.13	3.16

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	2.50	2.70	2.74	2.65
	SD	.86	.64	.75	
	N	(30)	(23)	(39)	
OCS participants	M	2.90	2.76	2.58	2.73
	SD	.88	.93	.81	
	N	(19)	(25)	(26)	
column mean		2.65	2.73	2.68	2.68

Table 4.33

Perceived Value of Job - Mean Scores for Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	10.40	10.18	9.73	10.00
	SD	2.61	1.54	1.44	
	N	(5)	(11)	(15)	
OCS participants	M	10.06	10.25	10.56	10.29
	SD	2.44	1.12	1.55	
	N	(16)	(16)	(16)	
column mean		10.14	10.22	10.16	10.18

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	8.63	8.78	9.19	8.90
	SD	1.81	2.28	2.22	
	N	(30)	(23)	(37)	
OCS participants	M	9.83	9.56	9.22	9.50
	SD	1.65	1.80	2.34	
	N	(18)	(25)	(27)	
column mean		9.08	9.19	9.20	9.16

Table 4.34

Degree of Job Specialization - Mean Scores for Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	2.60	2.58	2.40	2.50
	SD	1.14	.90	1.12	
	N	(5)	(12)	(15)	
OCS participants	M	2.25	2.25	2.69	2.40
	SD	1.06	1.06	1.08	
	N	(16)	(16)	(16)	
column mean		2.33	2.39	2.55	2.44

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	2.47	2.59	2.45	2.49
	SD	.92	.96	1.03	
	N	(32)	(22)	(38)	
OCS participants	M	2.70	2.52	2.30	2.49
	SD	1.17	1.08	1.03	
	N	(20)	(25)	(27)	
column mean		2.56	2.55	2.38	2.49

Table 4.35

Responsibility - Mean Scores for Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	3.20	3.36	3.20	3.26
	SD	.84	1.03	.68	
	N	(5)	(11)	(15)	
OCS participants	M	3.19	3.06	2.88	3.04
	SD	1.05	1.06	.89	
	N	(16)	(16)	(16)	
column mean		3.19	3.18	3.03	3.13

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	3.00	3.09	2.82	2.95
	SD	.76	.79	.64	
	N	(32)	(23)	(39)	
OCS participants	M	3.47	3.20	3.11	2.24
	SD	.70	.76	.93	
	N	(19)	(25)	(27)	
column mean		3.18	3.15	2.94	3.07

Table 4.36

Control Over Job Content - Mean Scores for Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	3.60	2.58	3.13	3.00
	SD	.55	1.08	1.06	
	N	(5)	(12)	(15)	
OCS participants	M	2.94	3.25	3.19	3.12
	SD	1.39	.68	.54	
	N	(16)	(16)	(16)	
column mean		3.10	2.96	3.16	3.08

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	2.91	2.96	2.85	2.89
	SD	.69	.88	.84	
	N	(32)	(23)	(39)	
OCS participants	M	3.00	3.24	3.11	3.12
	SD	.97	.83	.85	
	N	(20)	(25)	(29)	
column mean		2.94	3.10	2.96	2.99

Table 4.37

Control Over Movement - Mean Scores for
Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	2.20	1.82	2.33	2.13
	SD	1.64	.98	1.11	
	N	(5)	(11)	(15)	
OCS participants	M	2.44	2.56	2.50	2.50
	SD	1.21	1.15	1.21	
	N	(16)	(16)	(16)	
column mean		2.38	2.26	2.42	2.35

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	3.40	3.69	3.21	3.40
	SD	1.00	.47	1.04	
	N	(30)	(23)	(38)	
OCS participants	M	3.05	2.96	3.07	3.03
	SD	.91	1.10	.92	
	N	(19)	(25)	(27)	
column mean		3.26	3.31	3.15	3.24

Table 4.38

Control Over Speed of Work - Mean Scores for Transitional Group and OCS Participants by Job Type

Support Staff

group		time			
		pretest	interim	posttest	row mean
transitional group	M	6.20	5.27	4.67	5.13
	SD	1.30	1.49	1.34	
	N	(5)	(11)	(15)	
OCS participants	M	5.69	5.33	5.69	5.57
	SD	1.62	1.05	1.25	
	N	(16)	(15)	(16)	
column mean		5.81	5.31	5.19	5.40

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	5.78	6.22	5.39	5.72
	SD	1.52	1.13	1.60	
	N	(32)	(23)	(39)	
OCS participants	M	5.05	4.71	5.33	5.04
	SD	1.47	1.52	1.62	
	N	(19)	(24)	(27)	
column mean		5.51	5.45	5.36	5.43

Table 4.39

General Job Satisfaction - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	2.92	2.97	2.86	2.91
	SD	.60	.65	.52	
	N	(37)	(36)	(56)	
OCS participants	M	3.07	3.15	3.20	3.14
	SD	.74	.55	.65	
	N	(43)	(47)	(46)	
long-term users	M	2.79	2.72	3.07	2.85
	SD	.80	.83	.48	
	N	(14)	(18)	(14)	
column mean		2.97	3.01	3.02	3.00

Analysis of Variance for General Job Satisfaction Transitional Group, OCS Participants and Long-term Users

	time	group	time x group	within	within df
General Job Satisfaction					
MS	.30	2.17	.37	.40	302
F	.75	5.40**	.93		

Between df = 2 for time, 2 for group and 4 for time X group

* $p < .05$ ** $p < .01$

Table 4.40

Frequency With Which People Relied Upon Co-workers for Assistance in Learning to Use OCS

frequently	31%
sometimes	42
seldom	22
never	5
	N=45

Table 4.41

Responsibility - Mean Scores for Discontinuous Respondents

group		time			
		pretest	interim	posttest	row mean
transitional group	M	2.74	3.36	2.95	2.99
	SD	.73	.79	.69	
	N	(19)	(17)	(38)	
OCS participants	M	3.40	3.06	2.97	3.44
	SD	.81	.86	.93	
	N	(30)	(33)	(32)	
column mean		3.14	3.16	2.96	3.07

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5 OFFICE ENVIRONMENTS

As one part of the whole impact assessment studies, this section includes examination of potential impacts of computerization on various aspects of the office environment and the changes perceived by office workers, as machines introduce additional cables and heat, change visual tasks and occupy space. Research shows a direct relationship between environment and job performance (BOSTI 1982). Recent environmental research indicates that office workers are becoming increasingly negative towards their work place, regardless of the whether information technology has been introduced. Although some of this dissatisfaction appears to stem from varying environmental conditions in offices, it is also likely that these dissatisfactions are also associated with heightened expectations for meaningful work, workers's sense of lack of control over work and environment, and an increased awareness of potential health hazards.

Furthermore studies have highlighted critical problems in accommodating concentrated installations of VDTs within existing buildings. There is increasing concern that wide spread installations of micro-technology will broaden and heighten environmental deficiencies in existing office buildings. A number of studies indicate that satisfaction with the office environment is an important predictor of both job performance and satisfaction with the office technology (Bickson and Gutek, 1983; The Productivity Center, 1983). Some of the environmental issues being raised are similar to the issues being raised about impact of computerization on work attitudes, and indeed, many studies link office environment as an important attribute of quality of working life.

Analogous to the work attitudes and health components of this study, environmental assessments were included on self-administered questionnaires distributed prior to, during, and following the implementation of an integrated electronic network. This chapter examines the relationships between computerization and the frequency with which workers experience changes in environmental qualities, including thermal comfort and ventilation, visual, noise and acoustics, amount of space to work, and installation.

5.1 Competing Perspectives and Hypotheses

The first perspective maintains that the introduction of micro-technology such as video display terminals, printers, file servers and central processing units have accentuated environmental deficiencies within buildings which are not easily resolved (Stewart 1980; ORBIT 1983; ABS/Mill 1983). In direct contrast, the second perspective holds that the environmental impacts of computerization are minimal, and that the development of new technologies will resolve all of the current problems. The third and final perspective emphasizes the importance of environment as one part of quality of working life in which individual fit, involvement and control are significant intervening variables on the differential effects of computerization (National Research Council 1983; National Bureau of Standards 1983).

In the first perspective, several studies have documented the problems being experienced in office buildings as information technology is introduced. Various performance evaluation studies of specific office buildings across Canada sponsored by Public Works Canada have highlighted critical problems in accommodating installations of VDTs (BDI/ABS 1983; ABS 1984; BMC, DSS 1985). These have been identified by expert opinion, testing and user surveys and have included problems of thermal comfort and ventilation, noise and acoustics, illumination and visual comfort, ergonomics, layout, space planning and furnishings, and communications, power and wire management. One of the initial landmark studies on information technology and office environments concludes:

- "Information technology is not easy to assimilate into office buildings;
- "The popular conception that most information technology equipment can operate in general office areas is optimistic;
- "Current problems experienced in accommodating computer equipment are not short-term;
- "Information technology will change the way in which organisations use buildings and influence design priorities;
- "Information technology changes patterns of space use in buildings. Its effect on overall demand for space is less clear;
- "Buildings vary greatly in their capacity to take information technology;
- "Extensive and premature renovation of existing buildings will be expensive but inevitable." (ORBIT, 1983:4-8)

The second perspective is the commonly held belief that environmental impacts of computerization are minimal, and that the development of new technologies will resolve all of the current problems. This perspective is held largely by technological manufacturers who are marketing new systems, and MIS or related professionals who are trying to acquire and install new systems. They seem to believe that these are excuses being created by reluctant users and when confronted with specific examples, dismiss them as being short-term problems which will be resolved within the next generation of equipment.

In the third and final perspective, office environment is emphasized as one part of quality of working life in which individual fit, involvement and control are significant intervening variables on the differential effects of computerization. The ORBIT-2 study identifies the "need for fundamental change in the kinds of buildings that will work in this evolving era of information technology", with the "economic impact of facilities on operational success" becoming increasingly important (ORBIT-2 1985:35). Trends indicate that as knowledge workers become users, they will demand more control over jobs and office environments as compensation for their technological immersion (Rubin, NBS, 1983). Too often VDTs have been introduced into workplaces with inadequate or inappropriate planning and with too little concern about the well-being of workers. "Stress can best be reduced by optimizing the fit between a worker and his or her working environment, rather than standardizing environments regardless of individual needs and abilities; and participation in decision making and some degree of individual control over the nature and pace of work allows workers to achieve maximum person-environment fit (Committee on Vision,

National Research Council, 1983:26-27).

The hypothesized consequences for this field trial would differ for each of the three competing perspectives. From the first perspective one could generate the following hypotheses:

- an increase in environmental problems reported, such as heat, ventilation, air quality, noise
- a decrease in environmental satisfaction
- an increase in the negative effects of environmental characteristics on ability to do the work.

The second perspective would predict that there be no real changes either in the incidence of environmental problems, in environmental satisfaction or in the effect of environment on job performance. The third perspective would predict differential effects as opposed to the consistent effects of the first two perspectives. Hypotheses might include that:

- changes in environmental problems and overall environmental satisfaction reported will vary according to degree of environmental and job control, with those with less control reporting more problems than those with greater control
- those with less control more likely to report environmental characteristics as having a negative effect on their job performance.

5.2 Office Settings

The department under study is the primary tenant in the north tower of a 20 storey, twin tower office building in downtown Ottawa completed in 1975. The space is leased by the Government and is representative of a general purpose office building of that time. The typical office floors are 26 m (85 feet) wide by 56 m (185 feet) long, with the major axis East-West as shown in Figure 5-1. The central building core contains elevators, washrooms, fire stairs and mechanical and electrical spaces. This leaves office areas of just over 8 m (27 feet) deep along the long edge of the core and 18 m (60 feet) deep at either end of the main axis of the building. The building enclosure is precast concrete panels with rectangular fixed glazing windows filling most of the center.

The building systems were designed for open plan office layouts with a few enclosed offices to be grouped in interior areas around the core. Currently most floors have many enclosed offices on the perimeter. Each office floor is serviced by two identical air handling systems. The air distribution systems include a variable air volume system, servicing the perimeter zones, and a constant volume system, servicing the interior zones. Air distribution, lighting and fire sprinklers are integrated into an acoustic tile suspended ceiling system. Fluorescent light fixtures with plastic lens diffusers are on a five foot checkerboard grid. Lights are zoned by floor and turned off or on through a centralized computer control system with override switches provided on each floor. Gyproc partitions to create enclosed offices extend from the floor to the suspended ceiling and tend to correspond with the five foot module of the ceiling grid.

Electric power, other than for overhead lights, is located in the floor

slab. In open office areas, electrical outlets and telephone connections are brought up through floor mounted pedestals. In enclosed offices and open areas near partitions, electrical outlets and telephone connections are located in partitions. There is one duplex provided per person. PAC poles are used for data cable in open offices. Floors are carpeted throughout office areas. All exterior windows have venetian blinds and medium weight, neutral colored draw curtains.

In October 1983, the impact assessment sample was initially designed to include four groups on the top three floors: the concentrated user group and one other branch on one floor; one branch on the floor below; the Corporate groups on the floor above. There were to be three main groups: OCS participants, a comparative group of non-participants, and a small group of people who already had access to micro-technology. By the post-test data collection, the comparative group of non-participants had recently received equipment in a rather uncoordinated and sporadic manner and so this group became designated as the transitional group.

Within these groups there were major differences in office accommodation, including a range of office layouts and conditions, which underwent varying degrees of change through reorganization and renovation over the course of the study. This study examines environmental effects of computerization by office type (open or enclosed offices) and by job type (support staff or officer) for the transitional and the active OCS user groups. Variations of office type and job type within each of the groups studied is presented in Table 5.1.

5.3 Methodology

The findings reported in this study refer primarily to the respondent's subjective assessment of attributes of the office environment. The self-administered questionnaires utilized prior to, during and following the implementation of the OCS network included questions asking respondents to rate aspects of temperature, ventilation, illumination, noise, privacy, space, layout and installation, as well as the overall effect of the physical characteristics of the environment on ability to do the work.

In earlier impact assessment surveys on this site, field data about environmental conditions within the concentrated user group offices was collected by Architectural and Building Sciences, Public Works Canada through objective on-site measurements and expert assessments. These measurements were collected following completion of the environmental survey questionnaire by occupants at the pretest and the interim data collection, plus a third intervening time to assess environmental conditions following major renovations to the concentrated user group accommodation and prior to installation of OCS. These field data are commented on in passing. For a more detailed examination of these and the environmental impact within the concentrated user group, refer to the Office Communications Systems Field Trial Impact Assessments: Office Environment volume, Department of Communications.

The questionnaire used for the pretest data collection was derived from previous office environmental evaluation work. The questionnaire was

expanded for the interim data collection to gather responses about equipment installation. In both of these applications, the environmental questionnaire was a stand alone questionnaire, distributed prior to the quality of working life questionnaires. Prior to the final data collection, the environmental questions were integrated into one comprehensive quality of working life questionnaire. The sequence of questions and in a few cases, the wording of questions and responses were modified.

The environmental results are presented somewhat differently than results in other sections of this study. Firstly, some OCS participants never or rarely used their equipment. Responses from these people about the environmental conditions around their non-active OCS workstations masked the environmental side-effects of those who were actively using the equipment. Thus in discussing many of the environmental findings, we chose to focus on active OCS users rather than on all OCS participants. Secondly, to further probe findings, we also chose to focus upon what was happening within the concentrated user group where every employee had an OCS workstation within their individual work place. Because long-term users were few in number and were geographically scattered, the findings from this group are more difficult to interpret. Therefore the study focuses on the transitional and active OCS user groups, and on the concentrated user group as a sub-set of the latter. Finally, the study also examines office type as a major environmental variable.

5.4 Findings

The physical work environment is examined from several factors. Firstly, we examined ambient conditions in and around individual work places. This includes three main sub-sections: temperature and ventilation; lighting and visual quality; noise distractions and acoustic quality. Secondly, we examined space and layout issues. Thirdly, we examined specific computer installation issues, as well as other broader facility design and management issues. Finally, we examined the overall environmental effect on job performance reported by individuals.

5.4.1 Temperature and Ventilation

Perception of thermal comfort is affected by air movement and conversely, perception of ventilation is affected by temperature. Therefore changes to either temperature or air speed may affect occupant comfort within an office environment. Since office communications systems produce heat, they may affect occupant perception of both thermal comfort and ventilation effectiveness. Even without installations of such systems, occupant perception of temperature and ventilation can vary considerably within the same office building, due to variations in layout, fit-up and system performance. This added heat can be a problem in office buildings in specific locations where mechanical fit-up has been neglected as the space has been renovated over time.

Responses to temperature and ventilation questions are reported in Tables 5.2-5.8. During the pretest survey, prior to installation of OCS equipment, there was a wide divergence of ratings. Within the designated

concentrated user group, 46% of the staff rated temperature and 59% rated ventilation as bad or very bad, while in another branch only 13% overall rated temperature and 25% rated ventilation as bad or very bad. Responses from both open and enclosed office occupants were similar within each branch. Local differences in heating, cooling and ventilating systems performance given fit-up and layout differences explain the variation in pretest ratings, in which the transitional group generally gave more positive ratings compared to the more negative ratings given by the OCS users. The extreme problems within the concentrated OCS user group were recognized, extensive renovations were undertaken and conditions surveyed again prior to the installation of the OCS equipment and the interim survey. Conditions in the concentrated user branch improved dramatically with only 25% rating temperature and only 19% rating ventilation as bad or very bad after renovations and prior to equipment installation.

Once the equipment was installed, the interim survey highlighted some interesting problems. Heating, cooling and ventilating systems in this building are zoned to serve half a floor and do not necessarily bear any relationship to branch space allocation. Thus added heat load in specific locations had negative side effects for adjacent areas. Within the concentrated user group, complaints about temperature being bad or very bad rose from 25% after renovations to 32% after installation (Table 5.2) and on site monitoring of average operative temperatures confirmed increases. Among long-term users, complaints rose from 11% to 50%, while among the transitional group increases were slight. However in all groups surveyed more people reported problems with ventilation (Table 5.5), and particularly air freshness (Table 5.7). All groups also reported increases in frequency of temperature shifts (Table 5.4). Within the transitional group, ratings of bad ventilation increased from 33% to 47%, and within the long-term users, from 33% to 62%. Because of the higher temperatures, more people perceived the air as stale than before.

Furthermore, there were interesting differences by office type in the interim survey results. While occupants of open and enclosed offices within user groups generally tended to have similar patterns of response for temperature and ventilation during the pretest survey, during the interim survey more respondents in open offices rated both ventilation and temperature as bad to very bad than those in enclosed offices. These shifts were particularly significant within the concentrated user group, where the shift in open office ratings was from less than a fifth to one half the occupants, compared to only one quarter of the occupants of enclosed office. The problems were particularly noticeable in open areas where there were several OCS systems or other micro-electronic equipment in close proximity.

By the time of the post-test survey, additional equipment had been installed in most locations and the mechanical systems for cooling and ventilation were operating at capacity. Interestingly, fewer active OCS and long term users rated temperature as bad or very bad than at the interim survey (Table 5.2), although this seems to indicate not that they rated temperature as being improved, but perhaps that they had either accommodated themselves to the higher temperatures or given up complaining. This would be supported by the fact that only minorities rated temperature around their desk location as just right, with almost half reporting

temperatures much too or somewhat warm in all categories (Table 5.3). Although respondents in certain groups were making less strong complaints about temperatures, complaints about ventilation increased in all groups, to the point that in most categories, at least half the population rated ventilation as bad or very bad (Table 5.5). Extremely high proportions rated air movement around their desk location as very or somewhat still (from 61% of the transitional group to 81% of the concentrated user group- Table 5.6). High proportions rated air freshness as very to somewhat stale (from 68% of the transitional group to 86% of the concentrated user group - Table 5.7)

Temperature and ventilation appear to be stong influences on an individual's ability to do office work. A temperature/ventilation index was compared to ratings by individuals of the effects of environmental conditions in workplaces on individual job performance for the total study population, and then for clerical staff and for officers (Table 5.9). How occupants rate temperature and ventilation in their office environment has a strong correlation with how they rate the effect of the physical characteristics of their work space on their ability to do their work. This relationship is somewhat stronger for open offices occupants or clerical staff than for enclosed office occupants or officers. Extremely high proportions of open office occupants report more ventilation and temperature problems as compared to problem reports from occupants of enclosed offices (Table 5.36).

5.4.2 Lighting and Visual Quality

Lighting requirements vary for different kinds of office tasks, and can present conflicts, such as the need for bright light for reading printed paper versus low light levels for working on video display tubes (VDTs). Ambient lighting conditions are an important and controversial aspect to be considered in transforming the work environment from paper and people based to paper, people and VDT based environments.

The primary lighting system in the areas surveyed is an overhead recessed fluorescent tube system integrated into an overhead suspended ceiling system with fixtures distributed on a five foot checkerboard grid. The number of tubes actually working and the quantity of light emitted from any fixtures varies. Access to and quality of daylighting potential varies from floor to floor due to different layout conditions. Generally, much of the survey area has enclosed offices on the perimeter walls. Some respondents have access to task lights as well. Furthermore how individuals orient themselves and their work surfaces to light sources also influences lighting and visual quality. Thus there is the potential for wide variation in lighting and visual quality throughout the office space.

Lighting and visual quality have been rated by respondents as some of the least problematic attributes of the environment (Tables 5.10-5.14). In the pretest data collection similar proportions of respondents in the transitional (14%) group and in the concentrated users (19%) group reported lighting as bad or very bad. Within the concentrated user group, after renovations to the layout and the introduction of an experimental workstation, which included task lighting, to all occupants of open

offices, no one rated the lighting as bad or very bad, and the proportion rating it as good or very good increased from 19% to 48%.

After installation of the OCS equipment, 11% of the concentrated user group rated lighting as bad or very bad in the interim data collection. In the posttest data collection, this proportion increased to 26%. In particular in the post-test data collection, higher proportions of officers than support staff within the OCS user group report lighting as bad to very bad (22% versus 12%) and lower proportions rated it as good to very good (14% versus 50%). OCS user group officers also reported the brightness of lights around their particular desk location as being much too or somewhat dim (8% in the interim versus 22% in the posttest data collection - Table 5.11). While OCS user group support staff reported the same proportion of ratings of reflections on VDT screens as being very or somewhat bothersome (27% interim, 28% posttest), officers had much greater variation (33% interim, 68% posttest -Table 5.12). These findings correspond to the findings reported in the Health section 2.5, "eye strain appears to decline among support staff and intensify for officers in the OCS participant group at the time of the posttest data collection... Reduced demands for transcription may have reduced health complaints for secretaries, whereas officers may be experiencing more of these difficulties as they adopt text entry and editing resposibilities."

At the time of installation, efforts were made to advise individuals as to how best to locate their VDT given lighting conditions around their desk. Given the staff turnover and the lack of documented instructions about optimizing lighting conditions for VDT work, it is probable that furniture and equipment has been shifted, increasing the potential for visual discomfort and fatigue.

Other than this, there is not much variation in the responses of the three groups at the time of the posttest data collection, when most repondents had some access to working on VDTs. While the long-term users are the least negative about lighting conditions around their desk locations (only 7% report bad or very bad conditions) and are less bothered by reflections on the VDT screen, more rate the brightness of lights as being much too or somewhat dim (21%) than in either other group and none report lights as too bright. Office type (open versus enclosed) does not appear to be a major factor in rating of lighting in this study, other than among the OCS user group in the pretest data collection, when lighting conditions were less than desirable for many people in open offices.

Reflections on VDT screens (from many sources, including windows, overhead and task lights) are the most common problem in this study. Perhaps because of the lack of specific lighting problems perceived, the lighting index does not correlate as strong an influence on ratings of individual job performance (Table 5.14) as other environmental factors. However other research has indicated that occupants typically assess illumination as satisfactory. On-site measurements and health related complaints may be more accurate predictors of visual quality.

5.4.3 Noise Distractions and Acoustic Quality

Noise distractions and voice privacy are major concerns to office workers and have been rated by occupants as the most crucial environmental contributors to job performance in other studies. Workers may be dissatisfied with slight shifts in sound level, frequency, rhythm or tone. Micro-electronic equipment adds new sources of noise with fans, bells, signals and keyclicks. Although the keyboard of a VDT may be quieter than a typewriter, the rhythm or tone may irritate individuals, especially when it is first introduced. As micro-technology influences the acoustical quality of the workplace, subtle shifts need to be considered carefully. Summaries on questionnaire responses on noise distractions, noise from printers and noise from other office equipment is presented in Tables 5.15 - 5.18.

A significant source of noise distraction is often reported as "people talking nearby", but clearly the noise from micro-technological equipment is an important factor. All groups report a sizable increase in noise distractions from the interim to the posttest data collections. Of the OCS users, 44% in the posttest data collection report noise distractions as very bad to bad versus only 16% at the interim. There were similar increases for both the transitional and the long-term user groups, with occupants of open offices much more likely to report problems (Table 5.15).

There was a significant increase in the number of printers installed during the course of the study. Whereas 68% of the transitional group reported no printers near their desks in the interim data collection, only 18% reported this in the posttest. At the posttest collection, even lower proportions of open office occupants in both the transitional and OCS user groups report no printers nearby (7%, 9%). 38% of the open office occupants and 50% of the support staff in the OCS user group rate the printers as very distracting (Table 5.16). As printers become more pervasive throughout the office these problems will increase unless special attention is given to meaningful acoustic planning and treatment.

Acoustic quality is influenced by layout and amount of space, as well as by noise sources. Location of printers is important from a functional point of view. They must be easily accessible to users. In planning for the OCS equipment, large printer units were given to support staff. These more expensive units were selected for the acoustic shielding of their housing, but since much of the work has short print times of final, single feed sheets, the support staff find it easier and faster to leave the hoods open. Many of the hoods have never been closed and the tops of the open hoods are used for storage.

Providing a separate equipment room for printers is not necessarily an improvement. The equipment room in the concentrated user group is a standard office in which additional power outlets were installed. This room has standard office partitions which extend only to the underside of the dropped ceiling tiles. This does little to retard sound from travelling to adjacent areas. In addition there are other sound paths including ceiling tiles moved out of position during wiring and equipment installation which had never been replaced negating the acoustic baffle property of the ceiling, a door wedged open to handle the considerable

traffic to and from the room as well as to allow a fan to disperse heat from the room.

Like heat, noise seems to be tolerated to a certain threshold and then there is a rapid diminishing of tolerance. Furthermore, it may have wider effects than just the immediate workstation. Noise may travel between workstations, between areas of one floor and from floor to floor. In this study, noise factors were rated as important environmental contributors to job performance (Table 5.18). Clerical staff particularly rate noise as being a significant determinant of job performance, but this appears to be largely a function of layout.

5.4.4 Space, Layout and Privacy

The current understanding regarding optimal levels of space allocation for various kinds of work is limited because status and hierarchy are frequently used to establish workstation size and these criteria overshadow other rationales. There is a direct relationship between level in the organization and allocations of floor area within the Canadian federal government. Traditionally offices have been designed to optimize work flows and minimize movement of people and paper, although changes of organization, staff and layout over time often erode initial intentions. As communication and work begin to flow electronically, spatial requirements need to be reexamined. However, space assessments are particularly difficult to compare over time as layouts in all areas being studied were modified, amounts of space shifted and workstations reconfigured.

Tables 5.19-5.21 indicate that there are significant differences in the rating of the adequacy of space in which to work, particularly among the continuous respondents, as shown in Table 5.19. Active OCS users show a steady decline in space ratings over the three time periods, with occupants of open offices giving much lower ratings for the posttest than occupants of enclosed offices. This steady decrease is particularly interesting given the masking effect of the increase from the pretest to the interim findings for OCS in open office and support staff. This shift is attributed to renovations to the office layout within the concentrated OCS user group which resulted in support staff, all of whom were located in open offices, being given improved conditions and more space.

Within the transitional group, not all people had equipment permanently installed in their workspace which would again mask results for others who at the posttest were more analogous to the OCS group at the interim period. More insight into these results are obtained from the marginals in Tables 5.22-5.27. Whereas similar proportions of the transitional and the active OCS users rated space for total workspace around individual desk locations as very to somewhat inadequate (slightly less than one quarter), different proportions rated space as spacious to very spacious (11% of transitional versus 24% of the active OCS). Both groups experienced renovations between the pretest and the interim data collections, which only partially explains some of the reduction in ratings of spacious at the interim. After the renovations in the concentrated user group, almost one third of the respondents rated space for total workspace as very to somewhat inadequate,

a sizable increase. In both groups there were much less positive responses from occupants of open offices than from those in enclosed offices, with these differences remaining consistent over time. For example in the posttest collection 75% of all open office respondents and 76% of all support staff in the active OCS group rated their total workspace as very to somewhat inadequate as compared to 26% of all enclosed office respondents and 32% of all officers (Table 5.22).

Particular problems include space for total workspace, work storage, work surfaces, document handling and reference document space near VDT. The inadequacy of space for individual work storage increased dramatically within the concentrated user group from 25% after renovations, to 43% at the interim and 52% at the posttest data collection (Table 5.23). Within the concentrated user group, ratings for space for work surfaces, document handling near VDT and reference space near VDT did not indicate similar large decreases from the interim to posttest data collection, although they indicated strong inadequacies. At the posttest, 45% of the concentrated user group rated space for work surfaces, 59% rated space for document handing near the VDT, and 50% rated reference document space near VDT as very to somewhat inadequate (Tables 5.24-5.26).

Although the transitional group did not indicate an analogous change in space inadequacy for total individual workspace or in space for work surfaces from the interim to the posttest, they did indicate large changes in space for individual work storage from 27% to 40% inadequate overall. At the posttest, this includes 60% of open office occupants compared to 31% of enclosed offices, and 47% of support staff versus 33% of officers. Overall at the posttest, how people felt about the adequacy of the space allocation within which they worked had a stronger correlation with their rating of the effect of the physical characteristics of their work space on their ability to do their work than any other environmental attribute (Table 5.27). There is a stonger correlation between support staff who are negative both about the amount of space and the overall environmental effect on ability to work than those who are positive about both, and the converse is true for officers. Officers who are positive about the amount of space are more likely to be positive about the overall environmental effect on their ability to work.

People's attitude toward the furniture arrangement within their individual workspace appears to be largely a function of space allocation, layout and office type. Responses over time were very similar for long-term users, active OCS users and the concentrated users. Higher proportions of these groups rated the furniture arrangement in their workspace as inappropriate than the transitional group at all times (Table 5.28). People in open offices are more likely to rate furniture arrangemment as inappropriate than those in enclosed offices.

Another function of space allocation and layout is privacy. Visual and voice privacy vary considerably depending on office and job type. While half of the occupants of open offices rate their visual privacy as unacceptable, only small proportions of occupants of enclosed offices give similar ratings. Likewise, high proportions of support staff, most of whom are in open offices, also give poor ratings to visual privacy (Table 5.30). Some vertical screening helps reduce visual distractions for workers in

open offices and increases their sense of visual privacy. Previous office experience is also a factor. If one is moved out of an enclosed office into open space, vertical screening does not always assist with the sense of lack of privacy.

In this study voice privacy is more of an issue in open offices than in enclosed. Again support staff in all groups report less privacy at all times than officers. Variations in office layout and staff changes, such as occured within the concentrated user group, explain some the fluctuations in response. For example, within the OCS User group, 88% of open office occupants rated no voice privacy at the pretest data collection versus 53% at the interim (Table 5.29), due to renovations, layout and furnishing changes, and staff turnover within the concentrated user group.

5.4.5 Equipment Installation and Facility Planning and Management

Installing micro-technology raises issues of both the capacity of the building as a whole to accommodate installations and of the quality of installation within individual workstations. The capacity and flexibility of a building to accommodate cable and connectors affects the ease and cost of the installation. In addition the location and installation of cables and connectors may impact individual workstations. These very specific installation issues highlight the increasing importance of facility planning and management as computerization increases within office buildings.

Electrical power and telephone connections in the study building are run through continuous channels encased in an underfloor distribution system with limited, predetermined access points. Since the channels were full with insufficient space for data cables which require electrical separation from power wires, the OCS installation was distributed vertically through the telephone shafts and horizontally in the return air plenum above the dropped ceiling tiles. Because of this distribution, the fire code required that the cable be teflon coated, increasing the cable cost nine fold ($1.84/m versus $0.20/m). Fifteen outlets were installed in the room housing the CPU, requiring installation of a new electrical panel. Although the wire installation fit into existing risers, the shafts are packed tightly leaving little space for more wires should expansion be required on another floor.

Meeting electrical and cabling requirements for the system installation was considerably more complex and costly than had been anticipated. Furthermore, the installation of the OCS equipment for 70 people brought the HVAC and electrical systems within the building to capacity, and additional major expansions of computer systems will involve major renovations to the building.

Space and layout planning for the concentrated user group were complicated by the nature of the field trial in which systems were being developed rather than bought off the shelf. Priority was given to delivering a functional and operational prototype system, often overshadowing or requiring tradeoffs which had space and layout implications. Changes which occured within the concentrated user group, such as the staffing increase

and associated renovations to office layout, were perceived by staff as associated with the OCS field trial. Responding to installation issues and staff concerns about facility changes took considerably more time and effort on behalf of the OCS project team than had been anticipated. Emphasis had to be given by the team to the management of the process of change and to keeping users informed.

Workstation installation issues probed in the questionnaires included the number and location of electrical outlets, and location of electrical cords and data cabling (Tables 5.31-5.34). Responses within the concentrated user sub-group are slightly less negative than responses from the total group of active OCS users for number and location of electrical outlets. They were also slightly less negative in the posttest than in the interim data collection, suggesting that initial aggravations and inconveniences either diminished or people found other solutions. Interestingly though, the transitional group was much less negative about most aspects of installation that the active OCS users, with the exception of location of electrical cords. This difference may be explained by the fact that some equipment is not installed for individual workstations within the transitional group. In some cases equipment is shared, either by being located at a non-assigned shared workstation to which people move when they are working on equipment, or equipment is on special wheeled tables and moved into individual workstations as it is used.

Although the standard allotment of one duplex electrical outlet was provided per person within the concentrated user group, power bars were required when the OCS equipment was installed. The number and location of electrical outlets and the location of data cables may limit the options for configuration or movement of workstations. The addition of cables, cords and power bars may increase the risk of people tripping.

Location of electrical outlets was the major installation complaint, with 47% of the transitional group and 52% of the active OCS users rating outlets as very poorly to poorly located at the time of the posttest. This includes 50% of all support staff versus 41% of officers within the transitional group and 64% of all support staff versus 47% of officers in the active OCS group.

5.4.6 Overall Effect of Environment

There is significant difference by group in rating of the overall effect on environmental characteristics on individual ability to work as shown in Table 5.35. Following the renovations and prior to installation in the concentrated user group, 33% of all staff rated the environment as a negative factor in terms of their ability to work. After equipment was installed, this proportion increased to 47%. A similar pattern is apparent in the transitional group where 13% of all staff rated effects as negative at the interim prior to their equipment installation, increasing to 33% at the posttest after their equipment installation.

In both groups support staff and occupants of open offices are more likely to rate the physical characteristics as having a very negative or negative effect than are officers or occupants of enclosed offices. Table 5.36

ranks reporting of environmental problems by open versus enclosed offices for the active OCS users at the time of the posttest, clearly demonstrating both the increased number and intensity of problems being reported by open office occupants over those reported by enclosed office occupants.

5.5 Conclusion

The results of this study indicate deterioration of the environmental conditions within the office work environment as a direct result of computerization. The introduction of concentrated installations of micro-electronic equipment added heat and noise, reduced ventilation effectiveness, cramped working space, and created changes in visual conditions. These findings are consistent with reports from increased proportions of staff that the overall physical environment had an increasingly negative effect on individual's ability do the job. Deterioration in environmental characteristics also correlate with increased reports of health problems. However, these findings vary according to degree of environmental control or office type, with those having less control (or open offices) reporting more problems than those with greater control. Occupants in open offices clearly felt the deteriorating environmental effects more than occupants of enclosed offices.

These findings have broader implications for the future introduction of computerization into office environments:

- Capacity of existing office buildings. Many existing office buildings will likely require significant costly adaptations to air handling, cooling and electrical systems, in order to accommodate large installations of office computerization.
- Role of facility planning and management. As the infrastructure of terminals, telephones, power outlets, cords and cables becomes more complex and capital investment increases, facility planning and management will assume greater organizational importance. The impact of computerization on the way an organization functions, and the inherent layout implications need to be reconceptualized and planned. The implementation of resultant facility changes will require skilled professional resources, capital costs and lead time. Proper mechanical fit-up should be budgeted for and implemented during installation to rectify existing environmental deficiencies and to anticipate the changed requirements due to computerization.
- Revised accommodation guidelines. Revisions to space allocation and fit-up guidelines are necessary to reflect the new conditions created by wide-spread computerization.
- Documented user instructions. Users need to be informed about facilities and how to optimize the performance of both computer equipment and building sytems.

Figure 5.1

Typical Floor Plan of the Office

This plan is a typical floor of the accommodation. The shaded area indicates the offices of the concentrated user group.

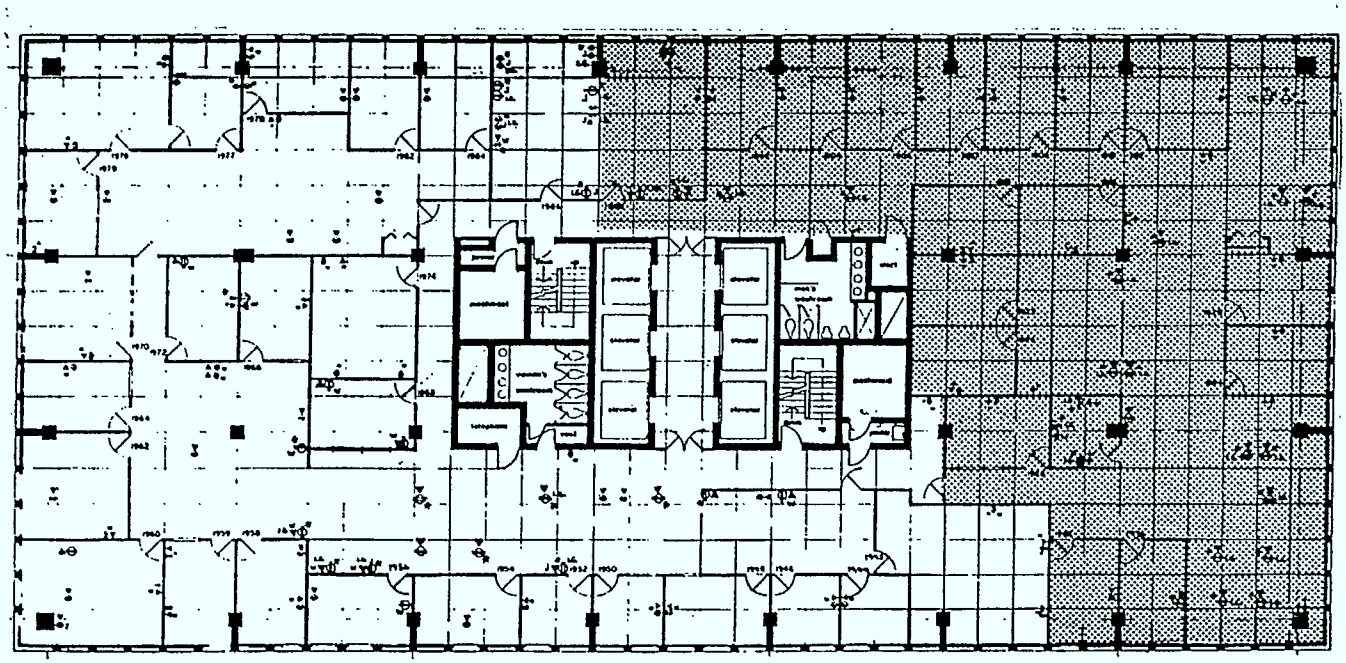

Figure 5.2

Operational Definitions of Concepts for Office Environments Chapter

Three environmental indices were formed from the posttest data: temven, noise and space.

TEMVEN: This is an index that was formed by combining questions on temperature and ventilation. Responses to the following four items were summed:

- temperature
- ventilation
- temperature shifts
- air freshness

Responses were grouped into thirds for crosstabulations, with 1 referring to the least favourable situation and 3 referring to the most favourable situation. Standardized Cronbach's alpha = .77.

NOISE: The noise index was formed by summing z scores for the following:

- reduction of noise distractions
- noise from printers
- noise from other office equipment

Responses were grouped into thirds for crosstabulations, with 1 referring to the least favourable situation and 3 referring to the most favourable situation.
Standardized Cronbach's alpha = .63.

SPACE: The space index was derived by summing responses to the following:

- space for total work space
- space for work storage
- amount of work surfaces

Responses were grouped into thirds for crosstabulations, with 1 referring to the least favourable situation and 3 referring to the most favourable situation.
Standardized Cronbach's alpha = .91.

LIGHT: The light variable refers to a single question that asked respondents to rate their lighting on a scale of 1 to 5 with 1 being very bad and 5 being very good. Groupings for crosstabulations cover: 1) bad, 2) acceptable, and 3) good.

EFFECT: This variable was derived from responses to the following question:

- Everything considered, how would you rate the effect of the physical characteristics of your work space on your ability to do your work?

Although response categories ranged from 1 to 5, this variable was recoded for crosstabulations with 1 meaning negative effect, 2 meaning no effect and 3 meaning positive effect.

Table 5.1

Variation in Office and Job Type
among survey groups over time

	TRANSITIONAL			OCS PARTICIPANT			CONCENTRATED USERS			
	T1	T2	T3	T1	T2	T3	T1	R	T2	T3
OFFICE TYPE										
Open office	22%	22%	26%	30%	29%	26%	21%	33%	41%	47%
Enclosed	78	77	74	70	71	74	79	66	58	53

	TRANSITIONAL			OCS PARTICIPANT		
	T1	T2	T3	T1	T2	T3
JOB TYPE						
Support	17%	22%	26%	36%	31%	33%
Officer	76	70	68	43	45	58
Manager	7	7	5	21	24	8

T1 = Pretest, December 1983

R = After renovations, prior to equipment installation, February 1984. Soon after the pretest data collection, a major renovation occurred within the concentrated user group offices in order to accommodate staff increases independent of the introduction of OCS. The renovation was recognized by the OCS project team was an opportunity to rectify some thermal and ventilation problems prior to equipment installation. Since these renovations significantly changed the office accommodation for the concentrated user group, another data collection using a summary questionnaire was implemented.

T2 = Interim, November 1984

T3 = Posttest, May 1986

Table 5.2

Rate TEMPERATURE conditions around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED				LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	R	T2	T3	T1	T2	T3
n=	45	40	57	34	38	26	33	28	31	45	17	20	14
Very bad-bad	13%	17%	26%	41%	34%	18%	46%	25%	32%	29%	11%	50%	29%
Acceptable	42	50	51	35	47	58	38	57	43	65	53	35	64
Good-very good	45	32	23	24	18	24	15	18	25	16	35	15	7

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICER		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	9	9	15	36	31	42	7	9	15	35	28	29
Very bad-bad	11%	22%	33%	14%	16%	24%	14%	22%	40%	14%	18%	21%
Acceptable	44	33	60	42	55	48	43	33	53	43	54	51
Good-very good	44	44	7	34	29	28	43	44	7	43	29	28

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICER		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	12	16	21	31	38	27	15	17	16	19	24	28
Very bad-bad	50%	50%	24%	42%	24%	15%	60%	41%	25%	42%	25%	14%
Acceptable	25	37	52	35	47	59	20	35	37	42	50	68
Good-very good	25	12	24	23	29	26	20	23	37	16	25	18

Table 5.3

Rate specific TEMPERATURE conditions around your particular desk location:

	TRANSITIONAL	ACTIVE OCS	CONCENTRATED			LONG-TERM USERS
	T3	T3	T1	T2	T3	T3
	55	39			28	13
Too warm	40%	51%	26%	42%	54%	46%
Just right	44	36	56	54	39	46
Too cool	16	13	18	4	7	8

	TRANSITIONAL GROUP	
	OPEN OFFICE	ENCLOSED
	T3	T3
n=	14	41
Too warm	50%	36%
Just right	36	46
Too cool	14	17

	ACTIVE OCS USER GROUP	
	OPEN OFFICE	ENCLOSED
	T3	T3
n=	19	23
Too warm	52%	52%
Just right	32	39
Too cool	16	9

Table 5.4

Rate specific TEMPERATURE SHIFT conditions around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	46	38	57	37	38	44	28	28	31	16	21	14
Very-frequent	31%	49%	44%	43%	53%	34%	39%	43%	29%	19%	52%	57%
Not noticeable	41	24	33	22	21	25	28	48	45	37	19	21
Constant	28	37	26	35	26	20	36	28	23	44	29	21
	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	10	9	15	36	29	42	8	9	15	35	26	39
Very-frequent	30%	44%	47%	31%	38%	43%	37%	44%	47%	26%	35%	44%
Not noticeable	30	22	27	44	24	31	25	22	27	46	27	28
Constant	40	33	27	25	38	26	37	33	27	29	38	28
	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	16	21	33	38	26	17	17	16	20	25	27
Very-frequent	50%	31%	29%	39%	55%	42%	53%	47%	44%	35%	44%	30%
Not noticeable	7	25	48	30	21	42	6	12	37	30	32	56
Constant	43	44	24	30	25	15	41	41	19	35	24	15

Table 5.5

Rate VENTILATION conditions around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED				LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	R	T2	T3	T1	T2	T3
n=	46	38	57	37	38	44	27	33	28	31	15	21	14
Very bad-bad	33%	47%	51%	51%	21%	48%	59%	19%	21%	52%	33%	62%	64%
Acceptable	44	32	37	30	60	39	26	66	68	42	53	33	36
Good-very good	24	21	12	19	18	14	15	15	11	6	13	5	0
	TRANSITIONAL GROUP												
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS			
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	
n=	10	8	15	36	30	42	8	8	15	35	28	39	
Very bad-bad	20%	25%	53%	36%	53%	50%	25%	25%	60%	37%	54%	49%	
Acceptable	60	75	40	39	20	36	62	75	33	34	21	38	
Good-very good	20	0	7	25	27	14	12	0	7	29	25	13	
	ACTIVE OCS USER GROUP												
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS			
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	
n=	14	16	20	32	39	27	17	17	15	19	25	28	
Very bad-bad	50%	44%	60%	38%	15%	41%	63%	31%	33%	47%	8%	57%	
Acceptable	43	56	25	34	62	48	41	47	47	26	72	36	
Good-very good	7	0	15	28	23	11	6	6	20	26	20	7	

Table 5.6

Rate specific AIR MOVEMENT conditions around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	43	40	56	37	37	44	28	28	31	17	21	13
Still	51%	45%	61%	34%	54%	73%	57%	61%	81%	65%	81%	77%
Good	40	37	25	40	50	0	30	27	23	23	9	15
Drafty	9	17	14	20	19	0	16	19	4	12	9	8
	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	8	9	14	35	31	42	6	9	14	34	28	39
Still	50%	33%	71%	51%	48%	57%	50%	33%	64%	53%	46%	59%
Good	25	33	14	43	39	29	17	33	21	41	39	26
Drafty	25	33	14	6	13	14	33	33	14	6	14	15
	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	16	21	33	37	26	17	16	16	20	25	27
Still	86%	69%	81%	36%	38%	69%	77%	75%	75%	50%	40%	74%
Good	14	18	14	39	40	27	11	12	25	30	40	19
Drafty	0	12	5	24	22	4	12	12	0	20	20	7

Table 5.7

Rate specific AIR FRESHNESS conditions around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	44	40	56	37	37	45	28	27	30	17	20	13
Stale	55%	62%	68%	62%	46%	78%	51%	52%	86%	47%	70%	85%
Not noticeable	41	22	30	27	46	18	25	41	7	53	30	15
Fresh	4	15	2	11	8	4	14	7	7	0	0	0
	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	9	9	14	35	31	42	7	9	14	34	28	39
Stale	78%	44%	86%	48%	68%	62%	71%	44%	86%	53%	64%	62%
Not notice.	22	33	14	46	19	36	29	33	14	41	21	36
Fresh	0	22	0	6	13	2	0	22	0	6	14	3
	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	16	21	33	37	27	17	16	16	20	25	28
Stale	64%	67%	76%	52%	38%	81%	65%	69%	69%	60%	32%	86%
Not notice.	36	37	14	33	51	18	35	31	25	25	56	11
Fresh	0	0	9	15	11	0	0	0	6	15	12	4

Table 5.8

Rate specific HUMIDITY conditions around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	43	40	57	37	37	45	28	28	31	17	21	14
Dry	47%	55%	40%	62%	68%	67%	61%	75%	65%	53%	66%	71%
Not noticeable	51	45	54	35	32	33	36	25	32	47	29	29
Humid	2	0	5	3	0	0	3	0	3	0	5	0
	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	9	7	15	34	31	42	7	9	15	33	28	39
Dry	67%	89%	53%	41%	45%	36%	71%	89%	53%	39%	50%	36%
Not noticeable	22	11	40	59	55	59	14	11	40	61	50	59
Humid	11	0	7	0	0	5	14	0	7	0	0	5
	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	16	21	33	37	27	17	16	16	20	25	28
Dry	71%	75%	62%	51%	64%	67%	71%	81%	69%	50%	44%	61%
Not noticeable	29	25	38	45	46	30	29	18	31	45	56	36
Humid	0	0	0	3	0	4	0	0	0	5	0	4

Table 5.9

EFFECT OF PHYSICAL CHARACTERISTICS OF WORK SPACE ON ABILITY TO DO WORK by TEMVEN INDEX for posttest

EFFECT	TOT. POP TEMVEN INDEX 1	2	3	N	CLERICAL STAFF TEMVEN INDEX 1	2	3	N	OFFICERS TEMVEN INDEX 1	2	3	N
1	54%	29%	16%	100% (44)	69%	15%	15%	(13)	48%	37%	15%	(27)
2	30%	35%	35%	100% (40)	38%	23%	16%	(13)	26%	43%	30%	(23)
3	11%	39%	50%	100% (28)	0%	40%	60%	(5)	13%	39%	48%	(23)
N	35% (39)	38% (38)	35% (35)	(112)	42% (13)	42% (13)	16% (5)	(31)	30% (22)	40% (29)	30% (22)	(73)

Pearson Correlation Coefficient TEMVEN .48 for total population (n=112)

Table 5.10

Rate LIGHTING conditions around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED				LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	R	T2	T3	T1	T2	T3
n=	42	39	57	35	38	45	26		28	31	16	21	14
Bad	14%	13%	16%	17%	10%	22%	19%	0%	11%	26%	6%	10%	7%
Acceptable	36	41	51	49	42	51	61	52	43	55	31	33	71
Good	50	46	33	34	47	27	19	48	46	19	63	57	21

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	9	9	15	33	30	42	7	9	15	32	27	39
Bad	22%	33%	20%	12%	7%	14%	28%	33%	20%	12%	7%	13%
Acceptable	44	33	47	33	43	52	43	33	53	31	37	51
Good	33	33	33	55	50	33	28	33	27	56	56	56

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	16	21	30	38	37	17	17	16	19	25	28
Bad	21%	0%	24%	13%	11%	22%	24%	0%	12%	11%	12%	22%
Acceptable	21	44	48	57	34	56	18	23	37	68	44	64
Good	57	56	28	30	55	22	59	77	50	21	44	14

Table 5.11

Rate specific BRIGHTNESS OF LIGHTS around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	46	37	56	37	38	44	28	28	30	17	20	14
Dim	20%	8%	14%	22%	3%	16%	25%	4%	23%	0%	20%	21%
Just right	63	62	64	65	71	61	57	71	60	82	75	79
Bright	17	30	22	13	26	23	18	25	17	18	5	0

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	10	7	15	36	30	41	8	7	15	35	27	38
Dim	40%	14%	27%	14%	7%	10%	25%	14%	27%	20%	7%	11%
Just right	50	57	47	67	63	71	62	57	47	60	63	71
Bright	10	29	27	19	30	19	12	29	27	20	30	18

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	15	20	33	37	27	17	16	16	20	24	27
Dim	7%	0%	25%	24%	5%	11%	12%	0%	12%	25%	8%	22%
Just right	79	80	55	67	73	63	76	75	75	70	75	48
Bright	14	20	20	9	22	26	12	25	13	5	17	30

Table 5.12

REFLECTIONS ON VDT SCREEN

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			35			42			28			13
Very bothersome			3%			5%			4%			8%
Smwt bothersome			26			52			61			38
Not bothersome			69			38			36			31
No reflections			3			5			0			23

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			7			28			7			27
Very bothersome			0%			4%			0%			4%
Smwt bothersome			57			18			43			22
Not bothersome			29			79			43			74
No reflections			14			0			14			0

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	16	19		28	24		15	14		21	25	
Very bothersome	6%	10%		0%	0%		7%	7%		0%	4%	
Smwt bothersome	25	42		29	58		20	21		33	64	
Not bothersome	50	37		57	42		40	57		62	32	
No reflections	19	10		14	0		33	14		5	0	

Table 5.13

BRIGHTNESS DIFFERENCE BETWEEN DOCUMENT AND SCREEN

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			36		35	40		25	27		20	12
Very bothersome			0%		0%	5%		0%	4%		0%	8%
Smwt bothersome			6		29	37		28	48		50	25
Not bothersome			89		60	52		56	41		45	67
No difference			6		11	5		16	7		5	0

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			8			28			8			27
Very bothersome			0%			0%			0%			0%
Smwt bothersome			12			4			0			7
Not bothersome			75			93			87			89
No difference			12			4			12			4

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	16	17		28	24		14	12		21	25	
Very bothersome	0%	12%		0%	0%		0%	8%		0%	4%	
Smwt bothersome	31	35		29	42		29	17		24	44	
Not bothersome	44	53		71	50		50	75		71	44	
No difference	25	0		0	8		21	0		5	8	

Table 5.14

EFFECT OF PHYSICAL CHARACTERISTICS OF WORK SPACE ON ABILITY TO DO WORK
by LIGHT INDEX for posttest

EFFECT	TOT. POP LIGHT INDEX 1	2	3	N	CLERICAL STAFF LIGHT INDEX 1	2	3	N	OFFICERS LIGHT INDEX 1	2	3	N
1	38%	42%	20%	100% (45)	38%	46%	15%	(13)	32%	43%	25%	(28)
2	7%	67%	26%	100% (42)	0%	47%	53%	(15)	9%	83%	9%	(23)
3	4%	50%	46%	100% (28)	0%	40%	60%	(5)	4%	52%	43%	(23)
	18%	53%	29%		15%	45%	39%		16%	58%	26%	
N	(21)	(61)	(33)	(115)	(5)	(15)	(13)	(33)	(12)	(43)	(19)	(74)

Pearson Correlation Coefficient LIGHT .40 for total population (n=115)

Table 5.15

Rate REDUCTION OF NOISE DISTRACTIONS around your particular desk location:
** note response wording not the same at all times

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED				LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	R	T2	T3	T1	T2	T3
n=	45	38	57	35	38	45	26	33	28	31	17	21	14
Very bad-bad	13%	13%	30%	29	16	44	19%	21%	11%	39%	35%	19%	36%
Acceptable	44	61	35	48	60	33	50	43	64	45	41	52	36
Good-verygood	42	26	35	23	24	22	31	36	25	16	24	29	28

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	10	8	15	35	30	42	8	8	15	34	27	39
Very bad-bad	20%	37%	60%	11%	7%	19%	12%	37%	53%	15%	7%	21%
Acceptable	30	37	33	49	67	36	37	37	33	44	67	39
Good-verygood	50	25	7	40	27	45	50	25	13	41	26	41

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	16	21	31	39	27	17	17	16	18	25	28
Very bad-bad	64%	37%	76%	16%	5%	18%	53%	23%	39%	28%	12%	29%
Acceptable	29	50	14	42	51	52	29	41	12	39	60	46
Good-verygood	7	12	10	42	44	30	17	35	19	33	28	25

Table 5.16

Rate specific NOISE FROM PRINTERS around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		38	57		37	45		28	31		21	14
Very distracting		3%	7%		11%	29%		7%	23%		9%	21%
Smwt distracting		16	35		32	33		39	39		29	21
Not at all distr.		13	40		38	20		32	19		38	43
None nearby		68	18		19	18		21	19		24	14

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		9	15		29	42		9	15		26	39
Very distracting		0%	13%		3%	5%		0%	7%		4%	5%
Smwt distracting		33	47		10	31		33	47		12	31
Not at all distr.		0	33		17	43		0	33		15	44
None nearby		67	7		69	21		67	13		69	20

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		16	21		37	27		17	16		24	28
Very distracting		19%	38%		5%	22%		18%	50%		4%	21%
Smwt distracting		31	38		24	33		24	31		29	29
Not at all distr.		31	14		32	22		29	19		33	21
None nearby		19	9		38	22		29	0		33	29

Table 5.17

Rate specific NOISE FROM OTHER OFFICE EQUIPMENT around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		38	56		38	45		28	31		21	14
Very distracting		2%	7%		10%	11%		0%	13%		5%	14%
Smwt distracting		31	45		42	38		53	38		28	29
Not at all distr.		16	39		24	29		28	26		24	50
None nearby		50	9		24	22		18	23		43	7

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		9	15		29	41		9	15		26	38
Very distracting		0%	13%		3%	5%		0%	13%		4%	5%
Smwt distracting		22	47		35	44		22	33		35	47
Not at all distr.		0	33		21	41		0	47		19	37
None nearby		78	7		41	10		78	7		42	11

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		16	21		38	27		17	16		25	28
Very distracting		6%	24%		8%	4%		12%	12%		8%	14%
Smwt distracting		56	38		24	41		35	31		36	36
Not at all distr.		25	29		26	26		29	44		24	21
None nearby		13	9		42	30		24	12		32	29

Table 5.18

EFFECT OF PHYSICAL CHARACTERISTICS OF WORK SPACE ON ABILITY TO DO WORK by NOISE INDEX for posttest

EFFECT	TOT. POP. NOISE INDEX 1	2	3	N	CLERICAL STAFF NOISE INDEX 1	2	3	N	OFFICERS NOISE INDEX 1	2	3	N
1	49%	31%	20%	100% (45)	1 61%	23%	15%	(13)	1 39%	36%	25%	(28)
2	24%	38%	38%	100% (42)	1 33%	33%	33%	(15)	1 22%	35%	43%	(23)
3	20%	38%	59%	100% (27)	1 0%	40%	60%	(5)	1 14%	27%	59%	(22)
	31%	33%	36%		39%	30%	30%		26%	33%	41%	
N	(35)	(38)	(41)	(114)	(13)	(10)	(10)	(33)	(19)	(24)	(30)	(73)

Pearson Correlation Coefficient NOISE .41 for total population (N=114)

Table 5.19

Factorial Analysis of Variance for Space Index

		time	group	time x group	within	within df
OFFICERS						
	MS	4.932	1.513	5.333	3.825	169
	F	1.289	.396	1.394		
SUPPORT						
	MS	6.448	.663	10.056	6.087	75
	F	1.059	.109	1.652		
CONTINUOUS						
	MS	17.413	4.321	31.384	6.561	163
	F	2.654	.659	4.783**		
DISCONTINOUS						
	MS	7.148	19.051	1.243	2.657	117
	F	2.691	7.171	.468		
ALL ACTIVE USERS						
	MS	17.566	17.654	12.484	4.530	238
	F	3.877*	3.897*	2.756		
OPEN OFFICE OCCUPANTS						
	MS	7.075	16.568	2.903	3.882	78
	F	1.823	4.268*	.748		
ENCLOSED OFFICE OCCUPANTS						
	MS	8.216	7.384	8.669	4.341	202
	F	1.893	1.701	1.997		

* p§ .05 ** p§ .01 *** p§ .001

Table 5.20

Space - Mean Scores for various groups over time

	pretest	interim	posttest
Active Users			
Transitional group			
M	8.435	8.205	8.275
SD	1.759	1.490	2.230
N	46	39	40
Active OCS group			
M	8.568	7.842	6.886
SD	2.566	2.212	2.374
N	37	38	44
Open offices			
Transitional group			
M	7.500	7.375	7.133
SD	2.121	1.768	1.846
N	10	8	15
Active OCS group			
M	6.857	6.875	5.475
SD	1.791	2.156	2.015
N	14	16	21
Enclosed Offices			
Transitional group			
M	8.694	8.419	8.690
SD	1.582	1.361	2.147
N	36	31	42
Active OCS group			
M	9.636	9.051	8.259
SD	2.547	2.492	1.973
N	33	39	27

Table 5.21

Space - Mean Scores for various groups over time

	time		
	pretest	interim	posttest
Support Staff			
Transitional group			
M	7.250	7.375	7.533
SD	2.315	1.768	2.416
N	8	8	15
Active OCS group			
M	7.706	7.941	5.937
SD	2.889	2.749	2.016
N	17	17	16
Officers			
Transitional group			
M	8.629	8.357	8.590
SD	1.592	1.420	2.099
N	35	28	39
Active OCS group			
M	8.850	8.440	7.714
SD	1.899	2.181	2.401
N	20	25	28

Table 5.22

Rate specific SPACE FOR TOTAL WORKSPACE around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED				LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	R	T2	T3	T1	T2	T3
n=	46	40	57	37	38	45	28		28	31	17	21	14
Inadequate	22%	17%	21%	24%	32%	49%	21%	18%	32%	39%	47%	52%	43%
Sufficient	67	80	70	51	60	47	50	57	68	52	47	33	57
Spacious	11	2	9	24	8	4	29	25	0	9	6	14	0

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	10	9	15	36	31	42	8	9	15	35	28	39
Inadequate	30%	33%	33%	19%	13%	17%	37%	33%	33%	20%	14%	18%
Sufficient	70	67	67	67	84	71	62	67	60	69	82	72
Spacious	0	0	0	14	3	12	0	0	7	11	4	10

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	16	21	33	39	27	17	17	16	20	25	28
Inadequate	64%	56%	76%	12%	15%	26%	59%	51%	75%	15%	20%	32%
Sufficient	36	37	19	49	61	67	29	41	25	60	64	57
Spacious	0	6	5	39	23	7	11	18	0	25	16	11

Table 5.23

Rate specific SPACE FOR WORK STORAGE around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED				LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	R	T2	T3	T1	T2	T3
n=	46	40	57	37	38	45	28		28	31	17	21	14
Inadequate	24%	27%	40%	32%	34%	60%	32%	25%	43%	52%	53%	48%	57%
Sufficient	70	67	49	51	63	38	50	61	57	42	47	43	43
Spacious	6	5	9	16	3	2	18	14	0	6	0	9	0

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	10	9	15	36	31	42	8	9	15	35	28	39
Inadequate	40%	56%	60%	20%	20%	31%	37%	56%	47%	23%	21%	33%
Sufficient	60	44	40	72	74	52	62	44	47	69	71	51
Spacious	0	0	0	8	6	17	0	0	7	9	7	15

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	16	21	33	39	27	17	17	16	20	25	28
Inadequate	57%	63%	90%	18%	18%	37%	53%	42%	75%	15%	24%	54%
Sufficient	43	31	9	52	72	56	35	47	25	75	72	39
Spacious	0	6	0	30	10	7	12	11	0	10	4	7

Table 5.24

Rate specific SPACE FOR WORK SURFACES around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED				LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	R	T2	T3	T1	T2	T3
n=	46	39	57	37	38	45	28		28	31	17	21	14
Inadequate	17%	28%	23%	27%	34%	53%	22%	29%	43%	45%	29%	48%	50%
Sufficient	76	72	72	60	60	44	64	57	57	48	71	43	43
Spacious	7	0	5	13	5	2	14	14	0	6	0	9	7

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	10	8	15	36	31	42	8	8	15	35	28	39
Inadequate	30%	37%	47%	14%	26%	14%	37%	37%	46%	14%	29%	13%
Sufficient	70	62	53	78	74	79	62	62	47	77	71	82
Spacious	0	0	0	8	0	7	0	0	7	9	0	5

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	16	21	33	39	27	17	17	16	20	25	28
Inadequate	50%	44%	81%	15%	20%	30%	41%	29%	75%	15%	28%	39%
Sufficient	50	56	19	61	61	63	47	65	25	75	60	54
Spacious	0	0	0	24	18	7	12	6	0	10	12	7

Table 5.25

How well has SPACE FOR DOCUMENT HANDLING NEAR VDT been accommodated in your work space:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			36		36	41		25	27		20	13
Inadequate			33%		53%	59%		56%	59%		65%	62%
Sufficient			61		44	34		44	33		35	38
Spacious			6		3	9		0	7		0	0

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			8			28			8			27
Inadequate			37%			32%			25%			33%
Sufficient			50			64			62			63
Spacious			12			4			12			4

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		15	18		29	24		14	13		22	25
Inadequate		83%	72%		52%	50%		79%	69%		45%	60%
Sufficient		27	22		45	42		21	23		50	32
Spacious		0	6		3	8		0	8		5	8

Table 5.26

How well has REFERENCE DOCUMENT SPACE NEAR VDT been accommodated in your work space:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			36		37	42		25	28		20	12
Inadequate			28%		43%	45%		48%	50%		50%	50%
Sufficient			64		54	45		52	39		50	50
Spacious			8		3	10		0	11		0	0

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			8			28			8			27
Inadequate			25%			29%			25%			30%
Sufficient			62			64			62			63
Spacious			12			7			12			7

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		15	19		30	24		14	14		22	25
Inadequate		67%	63%		40%	33%		71%	50%		36%	44%
Sufficient		33	26		57	58		29	43		59	44
Spacious		0	11		3	8		0	7		5	12

Table 5.27

EFFECT OF PHYSICAL CHARACTERISTICS OF WORK SPACE ON ABILITY TO DO WORK by SPACE INDEX at posttest

EFFECT	TOT. POP. SPACE INDEX 1	2	3	N	CLERICAL STAFF SPACE INDEX 1	2	3	N	OFFICERS SPACE INDEX 1	2	3	N
1	56%	22%	22%	100% (45)	61%	31%	8%	(13)	54%	18%	29%	(28)
2	21%	19%	59%	100% (42)	33%	33%	33%	(15)	17%	4%	78%	(23)
3	7%	32%	61%	100% (28)	20%	40%	40%	(5)	4%	30%	65%	(23)
	31%	23%	45%		42%	33%	24%					
N	(36)	(27)	(52)	(115)	(14)	(11)	(8)	(33)				(74)

Pearson Correlation Coefficient SPACE .52 for total population (N=115)

Table 5.28

Rate specific FURNITURE ARRANGEMENT IN YOUR WORKSPACE:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	46	40	57	37	37	45	28	27	31	17	20	14
Very inappropriate	2%	0	3%	5%	3%	9%	7%	4%	10%	6%	0%	7%
Inappropriate	22	12	14	27	24	27	25	29	29	23	40	21
Appropriate	72	85	82	57	62	64	61	63	61	65	55	64
Very appropriate	4	2	0	11	11	0	7	4	0	6	5	7

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	10	9	15	36	31	42	8	9	15	35	28	39
Very inappropriate	10%	0%	13%	0%	0%	0%	12%	0%	13%	0%	0%	0%
Inappropriate	20	33	20	22	7	12	12	33	13	26	7	13
Appropriate	70	67	67	72	90	88	75	67	73	69	89	87
Very appropriate	0	0	0	0	6	3	0	0	0	6	4	0

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	15	21	33	38	27	17	16	16	20	25	28
Very inappropriate	7%	7%	19%	3%	3%	4%	6%	6%	25%	5%	4%	4%
Inappropriate	43	47	38	15	10	15	41	31	25	10	12	29
Appropriate	43	47	43	70	71	82	47	50	50	80	76	68
Very appropriate	7	0	0	12	16	0	6	12	0	5	8	0

Table 5.29

Rate specific VOICE PRIVACY conditions around your particular desk location:
** response wording changed

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED				LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	R	T2	T3	T1	T2	T3
n=	45	40	57	37	38	45	27	33	28	31	17	21	14
Bad	20%	17%	33%	38%	24%	40%	30%	33%	25%	39%	53%	43%	29%
Acceptable	42	32	32	40	50	31	52	26	57	42	47	48	50
Good	38	50	35	22	26	29	18	40	18	19	0	9	21

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	9	9	15	36	31	42	7	9	15	35	28	39
Bad	89%	78%	88%	3%	0%	14%	86%	78%	73%	9%	0%	18%
Acceptable	11	11	7	50	39	40	14	11	20	51	39	36
Good	0	11	7	47	61	45	0	11	7	40	61	46

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	16	21	31	38	27	17	17	16	19	24	28
Bad	100%	69%	35%	16%	8%	19%	88%	53%	56%	21%	21%	32%
Acceptable	0	31	19	52	50	44	6	35	19	58	42	36
Good	0	0	14	32	42	37	6	12	25	21	37	32

Table 5.30

Rate specific VISUAL PRIVACY conditions around your particular desk location:
** response wording changed

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED				LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	R	T2	T3	T1	T2	T3
n=	46	40	57	37	38	45	28	33	28	31	17	21	14
Bad	8%	17%	24%	38%	13%	18%	28%	14%	11%	16%	41%	38%	28%
Acceptable	65	50	39	24	45	49	28	54	53	61	41	38	36
Good	21	32	37	38	42	33	43	32	36	23	18	24	36

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	10	9	15	36	31	42	8	9	15	35	28	39
Bad	40%	56%	53%	0%	6%	14%	50%	56%	47%	0%	7%	15%
Acceptable	60	33	33	67	55	41	50	33	40	67	57	41
Good	0	11	13	33	39	44	0	11	13	31	36	44

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	16	21	33	39	27	17	17	16	20	25	28
Bad	100%	44%	38%	15%	0%	4%	88%	41%	25%	20%	0%	18%
Acceptable	0	44	43	30	38	55	6	35	50	30	44	46
Good	0	12	19	55	61	41	6	24	25	50	56	36

Table 5.31

Rate specific LOCATION OF ELECTRICAL OUTLETS around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		40	40		38	31		28	30		21	10
Poorly located		45%	47%		58%	52%		57%	35%		57%	10%
Adequately located		50	52		37	48		36	65		38	20
Well located		5	0		5	0		7	0		5	70

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		9	10		31	30		9	8		28	29
Poorly located		44%	50%		45%	47%		44%	50%		39%	41%
Adequately located		33	50		55	53		33	50		61	59
Well located		22	0		0	0		22	0		0	0

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		16	12		38	20		17	11		25	19
Poorly located		69%	58%		45%	45%		65%	64%		44%	47%
Adequately located		25	42		45	55		29	36		48	53
Well located		6	0		10	0		6	0		8	0

Table 5.32

Rate specific NUMBER OF ELECTRICAL OUTLETS around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		40	57		38	44		28	30		21	14
Very inadequate		13%	5%		24%	11%		18%	10%		10%	14%
Inadequate		32	35		42	39		46	30		33	36
Adequate		62	58		34	48		36	57		57	50
Very adequate		0	2		0	2		0	3		0	0
	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		9	15		31	42		9	15		28	39
Very inadequate		0%	7%		6%	5%		0%	7%		4%	5%
Inadequate		22	33		35	36		22	33		32	33
Adequate		78	60		58	57		78	60		64	59
Very adequate		0	0		0	2		0	0		0	3
	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		16	21		38	26		17	16		25	27
Very inadequate		25%	14%		18%	11%		35%	19%		16%	11%
Inadequate		44	48		37	27		29	50		44	30
Adequate		31	33		42	61		35	31		40	56
Very adequate		0	5		3	0		0	0		0	4

Table 5.33

Rate specific LOCATION OF ELECTRICAL CORDS around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			55		37	41		25	31		18	13
Very inappropriate			5%		8%	10%		12%	10%		11%	0%
Inappropriate			29		43	17		44	32		22	23
Appropriate			65		27	39		36	55		61	77
Very appropriate			0		22	34		8	3		6	0
	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			14			41			14			38
Very inappropriate			7%			5%			0%			5%
Inappropriate			21			32			29			26
Appropriate			71			63			71			68
Very appropriate			0			0			0			0
	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			20			27			15			28
Very inappropriate			15%			11%			27%			7%
Inappropriate			40			18			33			29
Appropriate			45			67			40			61
Very appropriate			0			4			0			4

Table 5.34

Rate specific DATA CABLING around your particular desk location:

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED			LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			33		36	38		24	24		17	10
Poorly located			9%		37%	15%		36%	17%		23%	10%
Adequately located			42		39	42		50	50		59	70
Well located			49		25	42		12	33		18	20

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=			7			26			7			25
Poorly located			14%			8%			14%			8%
Adequately located			14			50			0			56
Well located			71			42			86			36

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=		14	18		29	21		13	13		21	23
Poorly located		50%	28%		24%	9%		46%	31%		24%	13%
Adequately located		36	33		45	48		23	31		52	48
Well located		14	39		31	43		31	38		24	39

Table 5.35

Everything considered, how would you rate the EFFECT OF THE PHYSICAL CHARACTERISTICS OF YOUR WORK SPACE ON YOUR ABILITY TO DO YOUR WORK?

	TRANSITIONAL			ACTIVE OCS			CONCENTRATED				LONG-TERM USERS		
	T1	T2	T3	T1	T2	T3	T1	R	T2	T3	T1	T2	T3
n=	44	37	57	36	38	42	27	33	28	29	16	21	13
Negative	20%	13%	33%	31%	40%	43%	26%	33%	47%	38%	37%	28%	54%
No effect	30	38	39	28	24	33	26	33	32	41	37	47	38
Positive	50	49	28	42	37	23	48	33	21	21	25	24	8

	TRANSITIONAL GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	10	6	15	34	31	42	8	6	15	33	28	39
Negative	30%	17%	47%	18%	13%	29%	25%	17%	47%	21%	14%	28%
No effect	30	50	40	29	35	38	25	50	40	30	32	36
Positive	40	33	13	53	52	33	50	33	13	49	54	36

	ACTIVE OCS USER GROUP											
	OPEN OFFICE			ENCLOSED			SUPPORT STAFF			OFFICERS		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
n=	14	15	18	31	38	27	17	16	14	18	25	27
Negative	43%	73%	67%	23%	18%	26%	41%	44%	43%	22%	32%	37%
No effect	43	27	28	26	21	37	41	25	43	28	20	30
Positive	14	0	6	52	61	37	18	31	14	50	48	33

Table 5.36

RANKING OF ENVIRONMENTAL PROBLEMS
IN OPEN VERSUS ENCLOSED OFFICES
AMONG ACTIVE OCS USERS AT POSTTEST

This table ranks environmental problems only as reported by open office respondents versus those reported by enclosed office repondents on the posttest questionnaire. **67%** of all open office occupants versus **26%** of enclosed office occupants rate the effect of the physical characteristics of their individual workstation as having a negative effect on their individual ability to do their work.

OPEN OFFICES	ENCLOSED OFFICES
90% inadequate work storage space	
81% still air	81% stale air
81% inadequate work surfaces	
76% stale air	
76% noise distractions	
76% noise from printers	
76% inadequate space for total workspace	
72% inadequate space for doc. handling	
	69% still air
	67% low humidity
63% inadequate space for ref. docs.	
62% noise from other office equipment	
62% insufficient electrical outlets	
62% low humidity	
60% bad ventilation	
58% poorly located electrical outlets	58% reflections on VDT
57% inappropriate furniture arrangement	
	55% noise from printers
52% temperatures too warm	52% temperatures too warm
52% reflections on VDT screen	
	50% inadequate space for doc. handl.
47% brightness diff. document/screen	
	45% poorly located electric. outlets
	45% noise from other office equipmt.
	42% frequent temperature shifts
	42% brightness diff. doc./screen
	41% bad ventilation
38% lack of visual privacy	38% insufficient electrical outlets
37% poorly located electrical cords	37% inadequate work storage space
35% poor voice privacy	
	33% inadequate ref. doc. space

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6 HEALTH

Occupational health and safety must also be a primary concern during times of technological change. Although it is difficult to ascertain definitive causation in the initial stages of the computer age, the well-being of users depends on the early detection of health hazards. Current research has examined the impacts of VDTs (visual display terminals) on a variety of factors ranging from physical problems such as eye strain and lower back pain to psychological symptoms of stress, sleeplessness and tiredness.

Analogous to the work attitudes component of this study, health measurements were included on self-administered questionnaires distributed prior to, during and following the implementation of an integrated electronic network. This chapter examines the relationships between computerization and the frequencey with which workers experience headaches, eye strain, neck and shoulder pain, and stress.[1]

We will begin by presenting the competing perspectives on health issues that appear in the existing literature. Following this discussion, we will then outline operational definitions and present the research findings.

6.1 Competing Perspectives

The three perspectives for this chapter are comparable to those specified for the previous work attitudes component. The first perspective maintains that VDTs are designed in such a way that they are dangerous to the user. In direct contrast, the second perspective holds that the health risks of VDT usage are minimal or non-existent. The third and final perspective emphasizes the differential effects of computerization and identifies quality of working life and ergonomic considerations as significant intervening variables.

6.1.1 Negative Perspective

Within the negative perspective, most attention has been paid to eye strain and musculo-skeletal discomfort. The design of visual display terminals may directly contribute to increased health problems. Although job content and work station design can mediate the severity of the consequences of VDT usage, there is some indication that this new equipment imposes eye and musculo-skeletal strain. Bennett reports that the evidence suggests that VDT operators as a group

1 Although we recognize the importance of investigating the effects of VDT emissions, such hazards are beyond the scope of this study. At the site under study, all terminals were tested and emissions were found to be well within industry standards.

suffer from a higher incidence of visual disturbances (1984:202). In addition to eye problems, the constrained posture demanded for visual distancing is also linked to many musculo-skeletal complaints (Bennett, 1984:203; Laubli et al., 1981:942). The user must be positioned a certain distance from the screen for character clarity, and this leaves little flexibility for movement and muscular relief. The design of computer equipment can then directly contribute to health problems among users.

6.1.2 Positive Perspective

Although little empirical evidence exists to support the second scenario of minimal or reduced health problems, there is some speculation that electronic information processing may decrease stress levels. In the secretarial field, for example, time pressures may decline as word processing diminishes the difficulty of document revision.

6.1.3 Indirect Perspectives

While the first two perspectives on health issues concentrate on the consistent negative and positive implications of computer usage, the third approach examines the possibility of differential impacts which are contingent upon particular characteristics of the host organization (Smith, 1984b:198; Smith et al., 1981). Similar to our discussion of work attitudes, the first set of intervening variables includes considerations surrounding the labour process. However, much attention is also accorded environmental factors such as lighting, heating, ventilation and work station design. Both structural and environmental conditions can play a pronounced role in determining the health related consequences of computerization.

a) The Labour Process

Turning first to structural aspects, one must examine the effects of technological change from an understanding of preexisting work processes and computer related changes. If the installation of an electronic network is used as a means of increasing job specialization and polarization, one can expect negative repercussions. If, on the other hand, the installation of a computer system leads to decentralization, one might expect improvements in health factors to accompany positive changes in the general quality of working life. Thus, management strategies and resultant work structures may be important considerations in examining the link between technological change and occupational health and safety.

If employers follow a fragmentation approach, an increasing number of workers will be placed in specialized computer or word processing positions. In many instances, this management strategy is accompanied by a polarization of work roles and the imposition of constant supervision or monitoring. The establishment of word processing pools in the office is one example of how computerization has been used to

increase management control. If such detrimental changes in the quality of working life are concurrent with the introduction of a computer network, they may intensify health problems irrespective of any direct effects of the equipment. Some previous studies already have found that the health related consequences of computer usage may be tied to the nature of the job (Smith, 1984b; Canadian Labour Congress 1982). The results of a Canadian Labour Congress survey show that reported health problems vary in accordance with measures of autonomy and job satisfaction (1982:xiv). Thus, there may be no one consistent impact of computer usage. Reported health problems instead may be closely linked to particular job design features.

b) Environmental Conditions

The extent to which health problems are aggravated or intensified by the introduction of electronic procedures may also be dependent upon the adequacy of existing physical surroundings, equipment design and the extent to which the work area is customized to suit VDT work (Stammerjohn et al., 1981; Smith, 1984b). As mentioned in the chapter on environmental impacts, most heating, ventilation and lighting systems are not designed to compensate for the added strain created by the introduction of computerized equipment. Therefore, these new machines can have many side effects in terms of increased noise, visual fatigue and muscular strain if they are not accompanied by appropriate revisions to the work area.

It is obvious that the current literature on technological change provides no definitive answers to questions concerning the health related consequences of technological change. The hypotheses generated from each of the aforementioned perspectives, in fact, would be quite different.

6.2 Impact Assessment Context

Following the first negative perspective, one would hypothesize increased health complaints following the installation of computerized equipment. As previously described in the methodology section, long-term users had access to computerized office equipment both prior to and during the field trial. OCS participants received the local area network six months before the interim data collection and continued to use such equipment until the posttest period. The transitional group, as the title suggests, was only moving toward computerization at the time of the posttest. Thus, respondents in the long-term users group would be expected to have the greatest number of health complaints throughout the entire project, whereas the frequency of health problems would only increase for OCS participants during the interim and posttest, and for the transitional group at the time of the posttest.

In contrast to this pessimistic scenario, the positive perspective holds that stress levels may decline as a consequence of office automation. If this is true, the reverse of the above hypotheses would be expected. The frequency of health related complaints would

decline rather than increase following the implementation of computerized processes.

The number and complexity of the intervening variables associated with the health related consequences of technological change make it difficult to precisely predict the indirect effects for this particular implementation project. Both structural and environmental changes have been described in other chapters, and it is clear that these two sets of factors may have counteracting influences in the area of health.

From a structural viewpoint, informal mechanisms created some modifications in the allocation of tasks among OCS participants. By the time of the posttest data collection, officers were performing much of their own text entry and editing, leaving support staff free to perform more administrative functions. Given this change, one might expect the health of support staff in this group to improve, while officers would instead experience more typing related discomforts such as eye strain, and neck and shoulder pain. With respect to the transitional group, no significant changes would be expected in health related factors because equipment installation was not accompanied by a reallocation of job duties.

On the environmental side, OCS management personnel attempted to diminish negative repercussions by installing tilt and swivel monitors, anti-glare screens and functionally designed work stations; however, the usefulness of these features was diminished by pervasively poor lighting, ventilation and heating systems. Computers were introduced into the transitional group with virtually no consideration of environmental issues. Thus, the health implications of VDT usage may differ somewhat for the two primary groups under study.

In this chapter we will examine the effects of environmental, system usage and relevant work attitude variables in relation to experienced headaches, eye strain, neck and shoulder pain, and stress. Can intervening variables make a difference with respect to health problems, or are the consequences of VDT installation predetermined?

6.3 Measurement Techniques

The findings to be reported in this study refer to respondents' subjective assessments of various health factors. Self-administered questionnaires utilized prior to, during and following the implementation of the OCS network included questions asking people to specify the frequency with which they experienced a number of symptoms ranging from headaches and eye strain to sleeplessness and irritability. Operational definitions of the concepts and Cronbach's alphas for the indices are given in Figure 6.1.

6.4 Analytical Procedures

Similar to other chapters, analysis of variance techniques have been utilized to assess any changes in health factors that occurred during the field trial period. In presenting the results, six analysis of variance tables have been included for the health measures. The first table examines the health variables for all three groups over the pretest, interim and posttest data collections (Table 6.1). The second table refers to comparisons between the transitional and OCS participant groups (Tables 6.2). The third table concentrates on active users to establish if certain trends are particularly pronounced among those members of the affected work groups who actually used a computer in their daily work (Tables 6.3). Although the people who declined to adopt new electronic procedures form an interesting group, there were insufficient cases in this category to perform any statistical analyses. The fourth and fifth tables reconstruct the analyses for continuous and discontinuous respondents to determine if the responses of stable employees differed from those of their more mobile counterparts (Tables 6.4 and 6.5). Finally, officers are selected for separate analyses in the sixth table (Table 6.6). This procedure could not be repeated for support staff because the number of cases was insufficient to permit such analyses. Tables 6.2 through 6.6 refer to only the transitional and OCS participant groups because the number of cases in the long-term users group was too small for further breakdowns.

To supplement the analysis of variance results, means tables have been included displaying the average health scores for the transitional group, OCS participants and long-term users at all three data collection points (Tables 6.7 through 6.10). Any discrepancies between these results and the trends exhibited within the continuous, discontinuous or active user sub-categories will be precisely stipulated in the text. Tables 6.11 through 6.14 also present the mean scores on all health variables for support staff and officers. Even though the number of cases is insufficient to perform statistical analyses for the support component of the work force, these means tables permit some general comparisons between the two job types. Although inconclusive, this may highlight what could prove to be some interesting contrasts for future research.

In addition to conducting these time series analyses, Table 6.16 also shows the correlations between selected environmental, computer usage and work attitude variables and health problems. These correlations will aid in exploring the importance of various types of factors in determining the health of the work force.

6.5 Findings

The results presented in Tables 6.1 through 6.6 show significant differences in the relative health of the three groups under study. Without exception, the transitional group exhibits the lowest frequency of all health complaints (Tables 6.7 through 6.10). The long-term users, on the other hand, report more headaches, eye strain,

neck and shoulder pain, and stress (Tables 6.7 through 6.10). Likewise, these long-term users are the most likely to feel that their work is a significant contributor to their experienced health symptoms (Table 6.15). If the distinctively high frequency of problems among long-term users is related to the duration of computer usage, one would expect a significant interaction to appear when the other two groups adopted electronic procedures. As no such trend is in evidence, it seems more probable that these group differences have arisen from conditions only indirectly related to computerization. The findings reported in chapters 4 and 5 show that the long-term users not only exhibit poor health but also work under constant deadlines with restricted physical movement and poor environmental conditions. These circumstances, rather than computer usage, may have lead to the high frequency of health problems.

The strength of the indirect perspective on technological change is also enhanced through the results presented in Table 6.16. Duration of computer usage does not show a significant association with any of the health factors. On the other hand, a number of environmental conditions stand out as important in this area. Respondents who are bothered by a brightness difference between document and screen are much more likely to experience all four health problems. Similarly, people who observe VDT reflections report more frequent eye strain and stress. While these considerations focus on lighting, it is clear that problems with temperature, ventilation and work space allocation can also have detrimental effects in the area of health. Although the space variable is unrelated to headaches and eye strain, it significantly contributes to neck and shoulder pain and stress. Given an inadequate area for work, it is probably difficult to maintain proper posture, and the close proximity of objects and people may be very stressful. It appears that health problems are most closely linked to characteristics of the physical environment rather than computer usage.

Having described these general findings, we would now like to elaborate on some interesting differences that have come to light between support staff and officers. Although there are insufficient cases to conduct analysis of variance procedures, eye strain appears to decline among support staff and intensify for officers in the OCS participant group at the time of the posttest data collection (Table 6.12). Neck and shoulder pain is also increasing among officers (Table 6.13). Thus, the indirect structural perspective on the consequences of technological change may be of some value in interpreting these results. Reduced demands for transcription may have diminished health complaints among secretaries, whereas officers may be experiencing more of these difficulties as they adopt text entry and editing responsibilities.

6.6 **Conclusion**

The results of this impact assessment provide no evidence that computerization has had either a direct negative or a direct positive effect on the health of the users. The physical environment, rather

than equipment usage, tends to have the most significant impact on the frequency of experiencing headaches, eye strain, neck and shoulder pain, and stress.

Even though users were not directly affected by the installation of OCS, related changes in job duties may have indirectly shifted some health problems from support staff to officers by the time of the final data collection. Officers were conducting much of their own text entry and editing, thus relieving support staff of these responsibilities. Perhaps as a consequence of this change, eye strain and neck and shoulder pain had increased for officers while decreasing for support staff.

Figure 6.1

Operational Definitions of Concepts for Health Chapter

Health Items

All of the health variables discussed in this chapter were derived from responses to the following question: "How frequently do you experience: headaches, neck and shoulder pain, eye strain, general tiredness, sleeplessness, irritability and general feelings of stress?" Each item was rated on a 5 point scale with 1 meaning almost never and 5 meaning every day.

Headaches, Eye strain, and Neck and Shoulder Pain represent individual variables.

Stress: A stress index was formed by summing the respondent's ratings on the following:

- general tiredness
- sleeplessness
- irritability
- general feelings of stress

Standardized Cronbach's alpha: pretest = .84, interim = .84, posttest = .70.

Contribution of Work to Health Problems: This variable was formed from responses to the following question: "To what extent, if any, do you feel your work has caused these health problems?". Three response categories were provided: 1) work was the primary cause, 2) work contributed to the health problems along with other factors, 3) the health problems were unrelated to work.

Environmental Conditions

Temperature, Ventilation: Assessments of temperature and ventilation were derived from responses to the following question:

- In general how would you rate the following conditions around your particular desk area:
  - temperature
  - ventilation

Response categories ranged from 1) very bad to 5) very good.

Work Space: A space index was formed by summing responses to the following three indicators:

- Now, how would you rate the more specific conditions around your particular desk location:
  - space for total work space
  - space for work storage
  - amount of work surfaces

Response categories ranged from 1) very inadequate to 5) very spacious. Standardized Chronbach's alpha posttest = .91

Brightness Difference Between Document and Screen, Reflections on VDT Screen: These two variables were derived from responses to the following question:

- How well have the following aspects of computer installation been accommodated in your work space?
  - reflection on VDT screen
  - brightness difference between document and screen

Response categories ranged from 1) very bothersome to 3) not at all bothersome.

Distraction from Printers, Distractions from other Office Equipment: People were asked to rate both of these factors with reference to their own desk location. Responses ranged from 1) very distracting to 3) not at all distracting

Environmental Effect on Job Performance: This variable refers to reponses to the following question:

- Everything considered, how would you rate the effect of the physical characteristics of your work space on your ability to do your work?

Response categories ranged from 1) very negative effect to 4) very positive effect.

Duration of Usage

Percentage of Work Day Spent Using a Computer: This system usage variable refers to the following question:

- On average, what percentage of your work day do you spend using a computer or word processor?

The categories for this variable range from 0, for those people who do not use a computer in the daily work, to 5, for those people who spend more than 75 percent of their working time using a computer.

Years of Computer Usage: The following question was used as the total length of time for which respondents had used a computer:

- When did you first use a computer or word processor in any job?

Response categories ranged from 1) less than one year ago to 5) four or more years ago.

Work Attitudes

Control Over Movement: The control over movement variable was derived from responses to the following statement:

- if I wanted to leave my work for half an hour I would have to tell my superior or make record of it

Responses to this statement were reverse scored to assure that the highest number always represented the most positive situation. Thus, 1 means strongly agree and 4 means strongly disagree.

Time Pressure: Feelings of time pressures were derived from ratings on the following statement:

- I feel I have to work too fast most of the time

The answers to this question were also reverse scored to assure that the highest number reflected the most positive situation, with 1 meaning strongly agree and 4 meaning strongly disagree.

General Job Satisfaction: The general job satisfaction measure was derived for the following question:

- All in all, how satisfied would you say you are with your current job?

Response categories ranged from 1 meaning very dissatisfied to 4 meaning very satisfied.

Task Variety: This variable was assessed on a seven point scale with 1 meaning very little variety and 7 meaning very much variety. The specific question wording was as follows:

- How much variety is there in your job? That is, to what extent does the job require you to do many different things at work, using a variety of your skills and talents?

Table 6.1

Factorial Analysis of Variance for Health Items
Transitional Group, OCS Participants and Long-term Users

	time	group	time X group	within	within df
Headaches					
MS	.772	2.171	.644	1.099	306
F	.702	1.976	.586		
Eye Strain					
MS	2.680	8.202	.973	1.734	306
F	1.545	4.729**	.561		
Neck and Shoulder Pain					
MS	4.199	10.293	.345	1.353	306
F	3.104*	7.610***	.255		
Stress					
MS	32.178	58.962	6.720	11.923	302
F	2.699	4.945**	.564		

Between df = 2 for time, 2 for group and 4 for time X group

* $p < .05$ * $p < .01$ ** $p < .001$

Table 6.2

Factorial Analysis of Variance for Health Items
Transitional Group and OCS Participants

	time	group	time X group	within	within df
Headaches					
MS	.377	.186	1.042	1.039	262
F	.362	.179	1.033		
Eye Strain					
MS	1.722	1.854	.185	1.670	262
F	1.031	1.110	.111		
Neck and Shoulder Pain					
MS	4.489	8.540	.596	1.238	262
F	3.626*	6.898**	.482		
Stress					
MS	27.786	9.588	9.705	11.891	260
F	2.337	.806	.816		

Between df = 2 for time, 1 for group and 2 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 6.3

Factorial Analysis of Variance for Health Items
Transitional Group and OCS Participants - Active Users Only

	time	group	time X group	within	within df
Headaches					
MS	.576	.392	.714	1.000	225
F	.576	.392	.714		
Eye Strain					
MS	1.398	2.085	.386	1.671	225
F	.837	1.247	.231		
Neck and Shoulder Pain					
MS	3.684	5.265	.293	1.232	225
F	2.992*	4.275*	.238		
Stress					
MS	22.573	3.937	6.185	12.283	223
F	1.838	.320	.503		

Between df = 2 for time, 1 for group and 2 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 6.4

Factorial Analysis of Variance for Health Items
Transitional Group and OCS Participants - Continuous Respondents Only

	time	group	time X group	within	within df
Headaches					
MS	.116	1.311	.358	.648	92
F	.178	2.023	.552		
Eye Strain					
MS	.417	.457	.095	1.037	92
F	.402	.440	.091		
Neck and Shoulder Pain					
MS	.595	8.268	.725	.687	92
F	.866	12.032***	1.055		
Stress					
MS	4.551	36.722	2.453	11.486	90
F	.396	3.197	.214		

Between df = 2 for time, 1 for group and 2 for time X group

* p < .05 ** p < .01 *** p < .001

Table 6.5

Factorial Analysis of Variance for Health Items
Transitional Group and OCS Participants - Discontinuous Respondents Only

	time	group	time X group	within	within df
Headaches					
MS	.109	.484	.902	1.261	164
F	.087	.384	.715		
Eye Strain					
MS	.657	.214	.867	2.015	164
F	.326	.106	.430		
Neck and Shoulder Pain					
MS	3.118	1.353	.520	1.556	164
F	2.004	.870	.334		
Stress					
MS	27.837	4.153	13.665	11.943	164
F	2.331	.348	1.144		

Between df = 2 for time, 1 for group and 2 for time X group

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 6.6

Factorial Analysis of Variance for Health Items
Transitional Group and OCS Participants - Officers Only

	time	group	time X group	within	within df
Headaches					
MS	.714	2.396	.206	.840	158
F	.850	2.853	.246		
Eye Strain					
MS	3.089	7.062	.121	1.422	158
F	2.173	4.967*	.085		
Neck and Shoulder Pain					
MS	5.376	6.310	1.515	1.213	158
F	4.432**	5.201*	1.249		
Stress					
MS	22.881	39.592	15.427	10.520	156
F	2.175	3.764*	1.467		

Between df = 2 for time, 1 for group and 2 for time X group

* p < .05 ** < p = .01 *** p < .001

Table 6.7

Headaches - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	1.56	1.81	1.77	1.72
	SD	.77	1.08	1.08	
	N	(36)	(37)	(56)	
OCS participants	M	1.82	1.62	1.85	1.76
	SD	1.06	1.00	1.04	
	N	(44)	(48)	(47)	
long-term users	M	1.87	2.11	2.21	2.06
	SD	.99	1.32	1.25	
	N	(15)	(18)	(14)	
column mean		1.73	1.78	1.86	1.79

Table 6.8

Eye Strain - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	1.94	2.06	2.23	2.10
	SD	1.01	1.29	1.27	
	N	(36)	(36)	(57)	
OCS participants	M	2.20	2.12	2.40	2.24
	SD	1.46	1.35	1.30	
	N	(44)	(48)	(47)	
long-term users	M	2.33	3.06	2.93	2.79
	SD	1.34	1.55	1.44	
	N	(15)	(18)	(14)	
column mean		2.13	2.26	2.38	2.27

Table 6.9

Neck and Shoulder Pain - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	1.33	1.58	1.68	1.56
	SD	.86	1.08	1.14	
	N	(36)	(36)	(57)	
OCS participants	M	1.68	1.79	2.21	1.90
	SD	1.07	1.03	1.37	
	N	(44)	(48)	(47)	
long-term users	M	2.00	2.33	2.50	2.28
	SD	1.36	1.50	1.40	
	N	(15)	(18)	(14)	
column mean		1.60	1.81	1.99	1.82

Table 6.10

Stress - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	8.06	8.58	8.60	8.44
	SD	2.91	3.75	2.86	
	N	(35)	(36)	(57)	
OCS participants	M	8.02	8.65	9.72	8.82
	SD	3.31	4.08	3.65	
	N	(43)	(48)	(47)	
long-term users	M	9.27	10.88	10.77	10.31
	SD	2.79	3.84	3.70	
	N	(15)	(17)	(13)	
column mean		8.24	9.00	9.29	8.88

Table 6.11

Headaches - Mean Scores for
Transitional Group and OCS Participants by Job Type

Support

group		time			
		pretest	interim	posttest	row mean
transitional group	M	1.40	2.50	2.29	2.23
	SD	.55	1.45	1.49	
	N	(5)	(12)	(14)	
OCS participants	M	1.75	1.77	1.69	1.74
	SD	1.00	1.15	1.01	
	N	(16)	(17)	(16)	
column mean		1.67	2.07	1.97	1.92

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	1.57	1.48	1.62	1.56
	SD	.82	.66	.88	
	N	(30)	(23)	(39)	
OCS participants	M	1.95	1.60	1.85	1.79
	SD	1.15	.96	1.03	
	N	(20)	(25)	(27)	
column mean		1.72	1.54	1.71	1.66

Table 6.12

Eye Strain - Mean Scores for
Transitional Group and OCS Participants by Job Type

Support

group		time			
		pretest	interim	posttest	row mean
transitional group	M	2.00	3.09	2.73	2.75
	SD	1.00	1.58	1.53	
	N	(5)	(11)	(15)	
OCS participants	M	2.19	2.47	1.94	2.20
	SD	1.56	1.55	1.06	
	N	(16)	(17)	(16)	
column mean		2.14	2.71	2.32	2.41

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	1.93	1.56	2.08	1.90
	SD	1.05	.79	1.13	
	N	(30)	(23)	(39)	
OCS participants	M	2.25	2.08	2.52	2.29
	SD	1.52	1.29	1.34	
	N	(20)	(25)	(27)	
column mean		2.06	1.83	2.26	2.07

Table 6.13

Neck and Shoulder Pain - Mean Scores for
Transitional Group and OCS Participants by Job Type

Support

group		time			
		pretest	interim	posttest	row mean
transitional group	M	1.00	1.82	1.73	1.64
	SD	0	1.40	1.16	
	N	(5)	(11)	(15)	
OCS participants	M	1.94	1.65	1.81	1.80
	SD	1.39	.93	1.28	
	N	(16)	(17)	(16)	
column mean		1.71	1.71	1.77	1.74

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	1.40	1.52	1.69	1.55
	SD	.93	.95	1.17	
	N	(30)	(23)	(39)	
OCS participants	M	1.45	1.96	2.41	1.99
	SD	.76	1.14	1.42	
	N	(20)	(25)	(27)	
column mean		1.42	1.75	1.98	1.77

Table 6.14

Stress - Mean Scores for
Transitional Group and OCS Participants by Job Type

Support

group		time			
		pretest	interim	posttest	row mean
transitional group	M	8.20	10.67	8.80	9.41
	SD	2.78	4.96	3.32	
	N	(5)	(12)	(15)	
OCS participants	M	8.07	7.88	8.50	8.15
	SD	3.37	4.15	3.12	
	N	(15)	(17)	(16)	
column mean		8.10	9.03	8.64	8.65

Officers

group		time			
		pretest	interim	posttest	row mean
transitional group	M	8.07	7.36	8.46	8.07
	SD	3.02	2.50	2.73	
	N	(29)	(22)	(39)	
OCS participants	M	7.80	9.24	9.89	9.08
	SD	3.16	4.24	3.67	
	N	(20)	(25)	(27)	
column mean		7.96	8.36	9.04	8.52

Table 6.15

Contribution of Work to Health Problems - Mean Scores for Transitional Group, OCS Participants and Long-term Users Over Time

group		time			
		pretest	interim	posttest	row mean
transitional group	M	1.77	1.85	1.89	1.85
	SD	.73	.66	.60	
	N	(35)	(34)	(55)	
OCS participants	M	1.73	1.96	2.24	1.98
	SD	.74	.79	.71	
	N	(41)	(46)	(45)	
long-term users	M	2.00	2.11	2.38	2.15
	SD	.76	.68	.51	
	N	(15)	(18)	(13)	
column mean		1.79	1.95	2.09	1.95

Analysis of Variance for Contribution of Work to Health Problems Transitional Group, OCS Participants and Long-term Users

	time	group	time x group	within	within df
Contribution of Work to Health Problems					
MS	2.21	1.83	.46	.49	293
F	4.53**	3.76*	.94		

Between df = 2 for time, 2 for group and 4 for time X group

* $p < .05$ ** $p > .01$

Table 6.16

Correlations Between Environmental Conditions, Duration of Usage, Work Attitudes and the Frequency of Experiencing Health Problems - Posttest

	Pearson's Product Moment Correlation Coefficients							
	headaches		eye strain		neck and shoulder pain		stress	
	r	n	r	n	r	n	r	n
Environmental Conditions								
temperature	-.27**	(117)	-.09	(118)	-.13	(118)	-.12	(117)
ventilation	-.36***	(116)	-.24**	(117)	-.26**	(117)	-.27**	(116)
work space	-.07	(117)	-.08	(118)	-.21**	(118)	-.18*	(117)
brightness difference between document and screen	-.22*	(88)	-.33***	(88)	-.25**	(88)	-.27**	(88)
reflections on VDT	-.16	(90)	-.36***	(90)	-.16	(90)	-.24**	(90)
distraction from printers	.13	(117)	-.01	(118)	.11	(118)	.03	(117)
distractions from other office equipment	.01	(116)	-.09	(117)	-.04	(117)	-.10	(116)
environmental effect on job performance	-.16*	(114)	-.20**	(115)	-.11	(115)	-.26**	(114)
Duration of Usage								
percentage of work day spent using a computer	.08	(116)	.11	(117)	.08	(117)	.07	(116)
years of computer usage	.09	(116)	.09	(117)	.07	(117)	.04	(116)
Work Attitudes								
control over movement	.11	(115)	-.04	(116)	.12	(116)	.11	(115)
time pressure	.03	(116)	-.09	(117)	.02	(117)	-.17*	(116)
general job satisfaction	.04	(115)	.03	(116)	-.03	(116)	-.08	(106)
task variety	.12	(116)	.08	(117)	-.03	(117)	-.02	(107)

* $p < .05$ ** $p < .01$ *** $p < .001$

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7 WORK PROCESSES AND PROCEDURES

Similar to the industrial revolution of the nineteenth century which aimed at increasing productivity in the manufacturing sector, computerization is now being heralded as the solution to spiraling office costs of the 20th century (Hamrin, 1981:25; Kettle, 1981:51; Mick, 1983:229; Russel, 1982:6; Benjamin, 1976; Brunet, 1980; Goldfield, 1980:129). The office wage bill of the eighties is estimated as consuming one-half of the operating costs for corporations and three-quarters of the operating costs for government and service industries (Automating, 1981:31). Such increases in labour related expenditures, coupled with the existing recession, have enhanced management's receptivity to technological change (Menzies, 1982:20; Belanger, 1983:32; Braverman, 1976:35; Coates, 1982:21). The diffusion of computers and word processors is occurring more rapidly than any earlier technological innovations. Therefore, the pertinent question that must immediately be considered is: "does the implementation of computerized equipment actually deliver anticipated productivity gains?" Although research has begun to focus on this area, the development of an answer is by no means straight forward. Assessments of the relationship between computerization and productivity are closely tied to competing theoretical, conceptual and methodological orientations. Before we discuss the design of this particular study, we will present the primary perspectives currently formulated in the literature.

7.1 Theoretical Orientations

Considerations of organizational structure, as outlined in the quality of working life and health chapters, continue to play an important role in the area of productivity. While some people believe that there is a direct link between technological change and productivity, the majority argue that organizational structure constitutes a significant intervening variable. The design of the labour process is recognized as a primary determinant of computer related productivity gains. However, there is a great divergence of opinion on the identification of appropriate work processes and relevant implementation schemes.

Some executives are promoting increased specialization and a tightening of top down control (Green, 1982). This follows the traditional vein of thought that advocates scientific management principles as the most effective means of fulfilling demands for increased productivity. One example of such a scenario is the establishment of word processing pools where operators perform specialized text entry and editing tasks, and output is closely measured either through constant supervision or electronic monitoring.

In direct contrast, an alternative perspective holds that improvements in productivity are most pronounced when decentralized management strategies are utilized (Gordon, 1976:25; Russel, 1982:15). "If this

[second] analysis is correct, the first place to look for productivity gains would be in the replacement of specialists with generalists, who would find their expertise programmed into their workstation computers" (Russel, 1982:16). It is obvious that this group would directly oppose the development of word processing positions, and would instead promote computers as a tool to consolidate all relevant entry and editing procedures in the hands of the author or originator of the action.

The relative validity of these competing theoretical orientations can only be evaluated through comprehensive research that examines equipment usage within specific organizational contexts (Gillis, 1983:13). Therefore, we will proceed with a discussion of the various means of conceptualizing and measuring productivity in an office environment.

7.2 Conceptual and Methodological Orientations

Research findings are, to a large extent, contingent upon the methodology utilized. The results produced by one measurement technique could support the specialization perspective, while the findings derived from a different approach could lead to completely contradictory conclusions. In his article entitled "Conceptual Impediments to Productivity" Taylor outlines two distinct ways of examining productivity, a particle and an activity orientation (1983:21).

> The difference between the two terms is this: in simulating some system one can either track the path of the entities which are processed by the system - the particles - or one can follow the behavior of organizational units which are responsible for processing (Taylor, 1983:21).

Approaching productivity from an activity standpoint, one might examine the impacts of computerization on the execution of a specific task. For example, it is quite consistently held that electronic word processing functions reduce the time requirements for text entry and revision (Belanger, 1983:42). Based on this finding, managers have often constructed word processing pools which allow extensive or, in extreme cases, around the clock equipment usage. Subsequent measures of key strokes or pages of output tend to reinforce initial expectations and perpetuate this way of conducting work. However, a holistic view of the production process might lead to some very different conclusions concerning the relative value of centralized word processing facilities. By tracking a document from conception to completion, one might find that total production time is actually increased rather than decreased by the formation of specialized word processing positions. Although evidence suggests that electronic text processing enables faster input and editing, there is also an indication that the separation of composer and typist creates the necessity for more frequent and detailed revisions (Buchanan and Boddy 1982:6). It is not surprising that documents require more corrections when they are typed by someone who is unfamiliar with the author's writing style and formatting preferences. The time consumed by these

increased modifications is further expanded by backlogs that develop because of the competing obligations of word processor operators. From this example, it is fairly obvious that conclusions pertaining to the interrelationships between computerization, work structures and productivity depend to a large extent on the method by which the problem is approached.

Productivity might be said to "come from balancing activity and particle perspectives, from a concentration on both improved techniques (an activity bent) and customer needs (a particle orientation)" (Taylor, 1983:35). Comprehensive research studies must examine not only individual tasks, but also the intricacies of the total production process.

Traditionally, productivity has been conceptualized from an activity perspective. In the area of office automation, people have looked at such features as the number of key strokes per minute or the number of input pages per hour (Belanger 1983:42). However, this may give a rather narrow view of the relationship between computerization and productivity. As the previous example illustrates, diminished time requirements for text entry may do little to improve output if revisions are simultaneously increased. Therefore, to have a comprehensive understanding of the consequences of computerization, the research for this project follows a particle orientation. Documents are tracked from conception to completion to determine precisely where the new computer system has been influential and which areas have been left unchanged.

To this point, we have been discussing the speed of output; however, one must also consider the area of qualitative change. The problem is that quality is a rather nebulous concept. One of the obstacles confronting productivity measurement in an office environment is the belief that one cannot adequately assess the quality of information products.

7.3 Methodology

Elliot Cole identifies three distinct, and in many ways incremental, levels of diffusion: organizational, individual and task specific (1983:237-238). Technological dispersion is monitored most frequently at the organizational level by counting the number of establishments that purchase or acquire access to a computer; however, such knowledge gives little indication of the types of jobs affected or the variety of tasks that are being performed electronically.

The study under discussion in this report focuses on the second and third levels of diffusion within one specific organizational setting. The very nature of such an endeavour, dictates the need for a longitudinal design. One must be able to monitor changes in the number of people using the computer system, the types of jobs affected and the tasks that are converted to electronic procedures. For these purposes, technological change can best be understood as an

evolutionary process where the short and long-term impacts on productivity may differ substantially.

Unlike the findings presented throughout the other chapters, this discussion of productivity related changes is primarily based on results derived from personal interviews rather than self-administered questionnaires. An interview format was chosen for this component of the research because of the complexity and comprehensiveness of the issues to be covered. However, the length of time required to conduct interviews meant that such a data collection technique could not be utilized for the entire study population. Instead, respondents were confined to the concentrated user group with less than 25 cases for any one observation period (see Methodology 3.5.5). Because of the small size of the respondent group, the results for this chapter will follow a qualitative rather than a quantitative presentation. Numbers were intentionally excluded to protect the confidentiality of the individuals and to prevent the sensationalization of figures based on such few cases. However, the participants for this part of the research were carefully selected to represent various job types, and the discussion provides important qualitative information on concrete changes in work processes that occurred over the observation period.

The results to be presented in this chapter are based on pretest, interim and posttest interviews that were conducted at three critical points in the evolutionary sequence (see Methodology chapter for more detail). In the final analysis, this methodology enabled monitoring of the relationship between work procedures and productivity over a three-year period which included the implementation of an integrated computer system.

A supplementary text entitled "Impact Assessment Data Collection Instruments" contains the interviews used for each of the three phases. Although these instruments followed a structured format to ensure consistency, many open questions were included to gather the depth of information required. In order to pursue a particle as well as an activity perspective, respondents were asked to recollect all of the various stages involved in the processing of a specific document. One-half of the officers were questioned about the last short document (three pages or less) they completed, while the other half were questioned about the last long document (more than three pages) they completed. A wide variety of materials were selected ranging from memoranda to ministerial correspondence to extensive research reports.

Figure 7.1 was used to assist people in conceptualizing the movement of documents through the system. Although this visual representation proved very useful in the collection and analysis of the results, the reader should bear in mind that the divisions between the stages are not really as distinct as they appear on paper. Information gathering, creation and revision stages may overlap or be repeated during the production process. For each of the specified stages, respondents were asked to comment on the amount of time required, the means of conducting the work and the types of equipment used.

Additional questions also probed the perceived quality of the materials and the impacts of the new computer system.

7.4 Findings

As previously mentioned, this component of the research represents a localized pilot project within the larger case study. Therefore, the aim of this chapter is not to provide definitive answers to questions of productivity enhancement, but instead to describe the consequences of implementing an integrated computer network within one particular setting. Even though we cannot provide definite answers at this time, we hope that the information derived from this project will serve to point out fruitful areas for future research on computerization and productivity.

As it is necessary to consider every facet of document production when using a particle orientation, the discussion will include both active and inactive components. The active segments refer to periods when people are actually working on the particular document under examination; for example, gathering information, writing a first draft, reviewing previously written materials, making revisions, translating, or printing the final copy. Alternatively, the inactive segments represent periods when the document is laying idle waiting for someone to perform a certain task such as editing or printing.

Following from Figure 7.1, document processing can be described as encompassing the following five stages:

1 - lapsed time between conception and execution
2 - information collection
3 - creation
4 - review and revision
5 - finalization and storage

If one follows the production process from the time of conception to completion, the lapsed time for most of these stages includes both active and inactive components. Under document creation, a letter could have an inactive period of four days sitting on someone's desk and an active period of one hour when the recipient composed a response. As previously mentioned, the most comprehensive picture of the relationship between computerization and productivity can probably be obtained by examining both the active and inactive areas. The following sections will elaborate on all aspects of the production process prior to, during and following the introduction of OCS. Particular attention will be accorded differences in task allocations, procedures, time requirements and the quality of output.

7.4.1 Stage 1 - Lapsed Time between Conception and Execution

While the activity orientation precludes consideration of the inactive components of the production process, the particle perspective incorporates all facets of the sequence from beginning to end. One significant, although seldom considered, component of document production is the waiting period prior to commencement of work. Final

output is obviously delayed if personnel are unable to devote their immediate attention to a request.

In government offices, as in other large organizations, the lapsed time preceding document processing is determined not only by individual workloads, but also by senior management priorities. This structure creates a zero sum situation. If workloads were the only consideration, the amount of time consumed before an officer could devote his/her attention to a particular task would depend upon the number of documents waiting to be processed. However, when officers are directed to execute "rush jobs" all other work falls behind. Constant changes in workloads and ministerial priorities make it difficult to assess the unique impacts of computerization. The following discussion, therefore, will elaborate on the inter-relationships among the various factors that determine the length of Stage 1.

Pretest interviews revealed expectations of increased efficiency. Most officers thought the computer system would enable them to process documents more quickly, and reduce the constant backlog of correspondence. This would then be expected to diminish the time period prior to creation of any specific document. Interviews conducted six months after implementation revealed no such trend. Although most people felt they could process work more quickly, ministerial and policy changes had led to an influx of correspondence, perpetuating the original median waiting time of two to three days. In contrast, such preliminary delays were substantially diminished after the computer network had been in place for approximately 1 1/2 years. By this point, Stage 1 tended to range from a few minutes to one day. This was seen as a result not only of diminished backlogs but also reduced procrastination. Some officers felt that the ease of access to similar preexisting electronically stored materials encouraged immediate attention to short documents because initial drafts could be produced very quickly. This leads us to the next topic of information collection.

7.4.2 Stage 2 - Information Collection

The preparatory phase of document processing gives a clear illustration of the gradual nature of the diffusion process. Pretest interviews uncovered fairly extensive expectations for computer related improvements in the ease of collecting information and the timeliness of the contents. Although respondents expressed only frustration in this area during the second interview, internal electronic files and some external databases were being utilized by the time of the third data collection. There is also every reason to believe that this trend will continue if fostered by the provision of technical and management support.

In order to identify computer related changes in this stage, officers were asked to rate the relative frequency with which they relied on various sources of information prior to the introduction of OCS. At that time, the three most frequently mentioned sources of information

were: written materials within the Department, face to face consultations with colleagues in the Department and telephone conversations with people outside the department. In the area of printed documentation, complaints were made about the content and accessibility of necessary materials. Because the department under study had little means of electronically manipulating data internally, officers were forced to rely on statistics produced by outside agencies, and such tabulations did not exactly match the policy issues of relevance to their work. In addition, even internal articles and reports were difficult to access because of cumbersome filing and retrieval structures. Overall, pretest results left much room for improvement in the availability of pertinent information.
Six months after the introduction of the computer network, there was little indication of any change in either the means of compiling information or the time requirements for this stage. On the other hand, pronounced modifications in work procedures surfaced after 20 months of usage. By this point, a substantial majority of the respondents felt that electronic procedures had not only decreased time requirements but also improved the quality of the information being compiled. The two most frequently mentioned reasons for this change were the enhanced ease of retrieving previously written materials and the ability to personally conduct required statistical analyses.

From the beginning of this project it was clear that officers typically relied on previously produced documents to guide their formation of new memoranda and correspondence. For example, when a letter was sent to the Department requesting information or expressing a particular complaint, the response was usually generated by referring to a previous reply that had been composed on a similar issue. Although this technique did not change with the introduction of the computer network, it did become more systematized. Frequently used paragraphs or quotations were catalogued, stored and retrieved electronically. This new method was deemed to have many advantages both in the areas of time savings and content. Firstly, electronic storage permitted efficient and immediate access; secondly, it allowed the extraction of already perfected materials; and thirdly it reduced proof reading and revisions because the existing content had already been approved in another context.

Although there was some movement toward accessing external databases at the time of the interim data collection, such procedures were not in full operation until much later. By the time of the posttest interview, databases had been down loaded from an outside mainframe onto the OCS network, and this greatly enhanced manipulation potential and the timeliness of the output. Because many analyses could be conducted in-house, the generated information more closely approximated the needs of the Department. People were also eager to further increase electronic networking and analysis capabilities, but they were restricted by the 80 column screen width, disk space allocations and the lack of technical support.

All this discussion of change, however, is not to say that people had abandoned verbal and printed sources of gathering information. Face

to face consultations remained an important means of exchanging ideas and reinforcing personal ties, and the restrictiveness of external computer connections forced a continued reliance on printed books and periodicals. Even some internal paper documentation was thought to be preferable to electronic copies because of the availability of appended information such as brochures and appendices.

Although some breakthroughs were made, the vast potential of electronic information access still remained untapped after 20 months of usage. In one respect we can recognize this as a gradual evolution, however, all too often the process of diffusion and expansion is retarded by the lack of continued support for the implementation project. In the beginning of this particular study, for example, the Department instituted a four day training program with four full-time user support personnel. This meant that help was readily available and people could ask for assistance with their own particular interests and projects. By the time of the third data collection, the support team had been reduced to one person who had many competing obligations. What happens under such circumstances is that interest dwindles because of poor technical servicing, new employees are not as strongly encouraged to become users and there is little assistance for staff who may have innovative ideas on how they would like to improve or expand system applications. While many participants would be ready to surge ahead with the expansion of electronic applications, their initiative is thwarted by the lack of continued support. Looking toward the future, it is encouraging to discover that this particular organization is currently planning to bring in a number of new software packages that were designed as a result of constructive criticisms and suggestions from the user population. These functional improvements are also part of a larger plan to promote system compatibility and increased training and user support within the Department. Under such conditions, there is renewed hope for the continued diffusion of electronic practices on the task level.

7.4.3 Stage 3 - Creation

The most immediate and widespread computer related changes in document processing appeared in the area of initial draft creation. Over the three year observation period, there was a marked trend away from reliance on centralized word processing facilities to more autonomous work procedures.

Prior to the introduction of the integrated OCS network, most respondents composed their first drafts in hand written form, with only a very few people using typewriters. Items under three pages were then typed by branch secretaries, while more lengthy materials were routed to the word processing center. Corrections were inevitably required before documents could be sent out for review, and such typing, retyping and editing often consumed more time than the initial composition. Frequent complaints were made concerning word processing blockages and equipment related problems. Not only did competing demands slow down turnaround times, but severe delays were

created because of the incompatibility of existing machines. As a consequence of these difficulties, most people looked forward to the day when they could personally have access to an electronic system which would give them more control over their work.

By the time of the second data collection, general expectations in this area had been realized, to a large extent, through the provision of a text processing function. Time requirements for document creation were virtually cut in half by the reduced reliance on branch secretaries and word processor operators. Bottlenecks previously created by the competing demands placed upon word processor operators were eliminated because most officers personally entered their first drafts.

Although general system usage continued to expand over the next year, a polarization effect was clearly in evidence at the third data collection. While the majority of participants had moved to more extensive and sophisticated system usage, a few people had totally rejected electronic work procedures. Not surprisingly, there was also a divergence of opinion between these two groups, with the users envisaging expanded electronic potential while the non-users felt such applications were very limited in an office environment.

Those people still using the system at the time of the posttest tended to compose and edit directly on the screen, thus eliminating the time consumed in the production of hand-written drafts. The ability to modify and reuse existing documents also diminished entry time. This could represent a continued refinement in the evolutionary process. While decreased reliance on support personnel reduced the lapsed time for Stage 3, subsequent changes diminished the actual working time required for composition.

From a more subjective perspective, most officers and managers felt the computer network had not only improved the speed of production but also the quality of first drafts. The ease of editing encouraged users to rework materials more than they had done previously. Likewise, respondents felt they could get a better overview of their documents once they appeared in printed form and that this total perspective enabled improvements in original style and composition. Merging capabilities also facilitated the processing of cooperative projects as sections from numerous authors could easily be combined and reordered to produce the final version. In summarizing the user perspective, we would have to say there was every indication that computerization had enhanced both the speed and quality of composition.

Very different opinions were expressed by those professional personnel who did not adopt the electronic information processing functions. The most frequently mentioned obstacle to usage was the lack of typing skills. In most cases, these people felt that text entry should remain with secretaries because they were more efficient in this area. Payoffs in terms of possible long-term time savings were not believed to compensate for the initial learning period which included development of touch typing as well as computer related skills. While

active users tended to believe that computerization had a role to play at all organization levels, non-users were more likely to recognize applications as restricted to support functions.

In conclusion, text entry changed from a predominantly support task to an integral component of initial draft creation. Although some officers and managers felt typing was an inefficient use of their time, the majority found that personal text entry and editing improved both the quality and speed of first draft production. Support staff also expressed a preference for the new way of conducting their work. By the time of the final data collection, secretaries reported that their jobs had expanded in the area of administrative duties while the typing component had declined.

7.4.4 Stage 4 - Review and Revision

The fourth stage of document processing encompasses two separate, although inter-related parts: review and revision (Figure 7.1). When the first draft of a memo, letter or report is completed, it must be circulated throughout the various levels of the organization for approval. The usual scenario is that revisions will be requested at each level, necessitating many modifications before final sign off is reached in the Minister's office or the appropriate level given the nature of the document.

a) Review

Pretest interviews revealed some systematic variations in review procedures. First and second level management personnel tended to work on a fairly informal demand driven basis, whereas senior management approval followed much more structured processes. The first two approval steps were typified by personal consultations, while formal written submissions and comments were required as materials moved upward toward the top of the hierarchy. Lapsed time also increased at each level, with reviews by senior management sometimes taking up to three or four weeks. This finding is not surprising given the bottleneck effect created by bureaucratic structures. Overall, the review stage frequently consumed a larger proportion of production time than all of the other stages combined.

Although this component of document processing represented an obvious niche for computer related time savings, there were only limited indications of any such changes throughout the implementation project. Initial system specifications were designed to facilitate the development of electronic intra-departmental communication networks. The local area network provided the dual capability of individual processing and joint interaction. Unfortunately, this particular application was thwarted by problems in software development and a lack of consistent commitment and usage throughout the organization.

By the time of the second data collection, about half of all documents were being electronically transmitted to first level managers, but this proportion dwindled as materials moved toward senior management.

People typically did not want to review documents electronically because they found them cumbersome to read, there was no means of making marginal comments and they felt VDTs hampered skimming.

After 20 months of system usage, a clear polarization effect was in evidence for review as well as creation procedures. Although a number of people were enthusiastic about the potential of electronic information networks, in actual operation the system proved to be only as strong as its weakest link. Even though the field trial project was originally designed to connect those individuals who frequently interacted, high turnover, software problems and sporadic usage served to undermine the whole communication potential. People who attempted to transmit documents through the computer system found that their work was not reviewed because higher level managers did not read electronically relayed messages. Unlike the creation stage, where respondents experienced substantial changes, virtually no one felt the local area network contributed to either the quality or speed of review processes. Whereas improvements in all of the other components of production can be accomplished to some extent on an individual bases, changes in communication patterns require a more comprehensive commitment.

Two divergent views were expressed by respondents on the means of improving the existing review and approval situation. One set of recommendations centered around the development of a reliable network among those people who were highly committed to the transition to electronic information processing. Alternatively, others felt the basic obstacles to productivity gains were embedded in the bureaucratic structure and, therefore, could not be corrected by any system that mimicked existing procedures. This brings us to the question of whether computerization alone can increase efficiency or whether such improvements can only develop through a revamping of the entire work process.

b) Revisions

As a consequence of existing approval processes each document requires numerous revisions before it is finalized. In contrast to the review component of Stage 4, computerization has made pronounced improvements in the area of revisions.

Prior to the implementation of the local area network, officers tended to rely on secretarial or word processing personnel for the input of all recommended changes. Similar to the creation stage, substantial delays were experienced in making revisions because of competing demands, equipment incompatibility and the repetition of typographical errors. It was not uncommon for a document to pass through the word processing center six or seven times before all officers and managers were satisfied with the content. Thus, the aforementioned word processing delays were confronted many times during the total production cycle. Under such circumstances, it is not surprising that many officers looked forward to personal computing as a way of circumventing this time consuming process.

Although the interim data collection revealed some positive developments in this area, the most significant improvements did not come to light until the final interview was conducted after approximately 1 1/2 years of usage. For the interim period, people still tended to hand write their changes on hard copy and then pass these modifications to a secretary for input on the computer. While this was undoubtedly more expedient than retyping or utilizing centralized word processing facilities, it was vastly improved upon by the time of the posttest data collection. Through the final interview results, it was evident that document production had become a much more autonomous process. As officers became proficient in computer usage they took on a higher proportion of their own editing requirements. Rather than waiting for secretaries to have time to input necessary corrections, officers frequently made their own changes electronically. In some cases management personnel even made direct edits on first drafts as they found this to be a more efficient and cooperative way of communicating their recommendations.

While most people agreed that the local area network greatly facilitated the speed of revisions, officers and managers frequently expressed a difference of opinion on the topic of quality enhancement. As hypothesized by some theorists, the ease of editing encouraged more frequent and substantial requests for changes. Because management personnel tended to be the initiators of these requests, they saw such detailed modifications as improving the quality of the final document. On the other hand, officers sometimes felt frustrated because of the perceived insignificance of new wordings or paragraph placements.

7.4.5 Finalization and Storage

Even though officers took increased responsibility for initial draft creation and editing over the observation period, they continued to rely on secretaries for final copy production. Once the content of a document had been approved it was typically transmitted to support staff for formatting and final printing. This manner of conducting work developed as a consequence of the complexity of formatting guidelines and the short supply of letter quality printers.

Upon completion of many documents, the contents had to be translated and the bilingual text typed side-by-side with paragraph alignment. Unfortunately, the text processing package available on OCS was not capable of accepting such column entry. Therefore, virtually all major documents eventually had to be transmitted to AES machines in the word processing center. This was particularly problematic because the disk transfer created corrupt segments and inappropriate formatting. Even at the time of the posttest, a duplication of effort was still occurring because retyping on AES was deemed preferable to cross system transfers.

The final link in the production cycle, of course, is the storage of created information. Although an official electronic archiving function was developed, many people found it cumbersome and time consuming to operate. As a result of the difficulties experienced

with the formal archiving mechanism, officers usually relied on informal methods of storing information. While some frequently used materials were stored in personal electronic space or copied to diskettes for future retrieval, many paper files also continued to be maintained.

7.5 Overview

Whereas the preceding sections have given a descriptive account of computer related changes within each of the specific stages of document processing, a complete understanding of the productivity question can only be obtained from a more holistic perspective. In this final section we will elaborate on the proportional allocation of time across the various stages of production and identify those areas in which computerization has already, or could potentially, have an impact.

Figure 7.2 illustrates the subdivision of processing time into the various components of document production. The statistics for these diagrams were calculated as an average of the proportional time allocations derived from the 1986 particle tracking interviews. Lapsed times for information collection, creation and review stages include both active and inactive components. Shaded areas represent active components when the author was involved in tasks specifically related to the completion of the one document under discussion. Conversely, unshaded areas refer to inactive or waiting periods. Before we discuss the interpretation of these charts, we must reiterate some necessary precautions. The results are based on a very small sample of five short and five long documents. The figures represent the recollections of the authors and should not be considered as precise time sequences. Furthermore, the restriction of interviews to officers precludes any measurement of the proportion of the review stage that was actually spent working on the document. Having made these qualifications, we must still be struck by dramatic differences in the allocation of time among the various stages and the similarities between the two charts.

One of the most pronounced features of both charts is the relatively small size of the shaded areas. According to these findings approximately 13 percent of the production time for short documents and 31 percent of the production time for long documents, is spent creating, editing or otherwise improving the text. The remaining proportion consists of waiting periods which occur because of review requirements and competing demands. Although the methodology did not permit an estimation of the amount of time management personnel spent working on the documents, general interview questions revealed that these activities consumed a relatively inconsequential portion of total production time. Thus, the vast majority of processsing time is concentrated in inactive rather than active features. The length of waiting periods, to a large extent, are determined by departmental priorities and the bulk of documents that are simultaneously flowing through the system. As previously mentioned, the bottleneck effect also causes an increase in lapsed time at each progressive level of

the review process. These findings clearly illustrate the limitations of the activity orientation. The actual tasks involved in document production represent only a very small proportion of total processing time.

From the particle orientation, let us now recapitulate the impacts of computerization to date and identify areas for possible future developments. Over the three year observation period, computer related time savings were evident in both the active and inactive components of the information collection, creation and revision stages; however, little change occurred with respect to the review stage. The reason computerization resulted in productivity enhancement in some areas but not in others is closely tied to the differing sources of such changes. Although electronic functions can create direct improvements within the active segments of document production, comparable time savings in the inactive segments depend more on a restructuring of work processes than on technological change. For example, on the active level of the revision component, the introduction of a text processing function could dramatically decrease the amount of time required for editing and retyping. However, the inactive component or waiting time for the revisions could be left unaffected or even increased if authors continued to rely on the services of a typing pool or word processing center. The most direct way to make a substantial difference in this inactive part would be to institute more autonomous work procedures with authors entering and editing their own materials, thus eliminating delays created by backlogs in centralized facilities. Given this perspective on the underlying dimensions of the production cycle, let us now reconsider the findings presented in this study.

The most immediate and comprehensive changes that occurred as a result of computerization were concentrated in the active components of document processing. The OCS network enabled more efficient access of stored information, officers could create correspondence and memoranda more quickly because of the ease of accessing previously entered materials and the time required for retyping was virtually eliminated by electronic editing. Although respondents unanimously recognized these changes as improving their work, in total, such activities consumed only a small portion of the total time required to complete a document (Figure 7.2).

Some positive changes also occurred with respect to the inactive components of the productive process, but there is much room for continued improvement. After approximately 1 1/2 years of computer usage, the respective roles of officers and support staff had been modified to create more autonomous work procedures. However, the impacts of these changes were restricted to the information collection, creation and revision stages, leaving review procedures virtually unaffected. The amount of time consumed by the inactive component of information collection was substantially reduced by the development of in-house databases which enabled officers to manipulate their own data rather than waiting for the necessary statistics to be provided by other government departments or outside agencies. Time savings were also evident in the inactive component of the creation

and revision stages. With the expanded access made possible by the integrated OCS network, officers entered and edited most of their own text, thus diminishing delays that had previously been created by waiting for secretaries or word processor operators to type and retype documents. Although it is clear that these new procedures improved overall production time, OCS had virtually no impact on the review segment, which consumed the highest proportion of processing time for both short and long documents. Even at the time of the final data collection, 20 months after the installation of OCS, review procedures still accounted for 46 percent of the processing time for short documents and 43 percent of the processing time for long documents (Figure 7.2). Improvements in this area, to a large extent, depend upon the development of more autonomous work procedures. Bottlenecks created by the hierarchical nature of the bureaucracy can only be diminished through a flattening of the organization. However, such an outcome requires dramatic changes in the entire administrative structure.

7.6 **Conclusion**

The results of this research project demonstrate that computerization can offer pronounced improvements for many components of document production. Electronic text processing, computing and storage functions have generated marked improvements in the areas of information retrieval, text creation and editing. However, the largest proportion of lapsed time, from beginning to completion of a document, is consumed by delays which occur because the document is waiting to be typed, edited or reviewed. Reductions in this inactive component of the production cycle can only be accomplished through the development of more autonomous work processes and a flattening of the bureaucratic structure. Thus, pronounced productivity gains require not only technological but also organizational change.

Figure 7.1

STAGES OF DOCUMENT PROCESSING

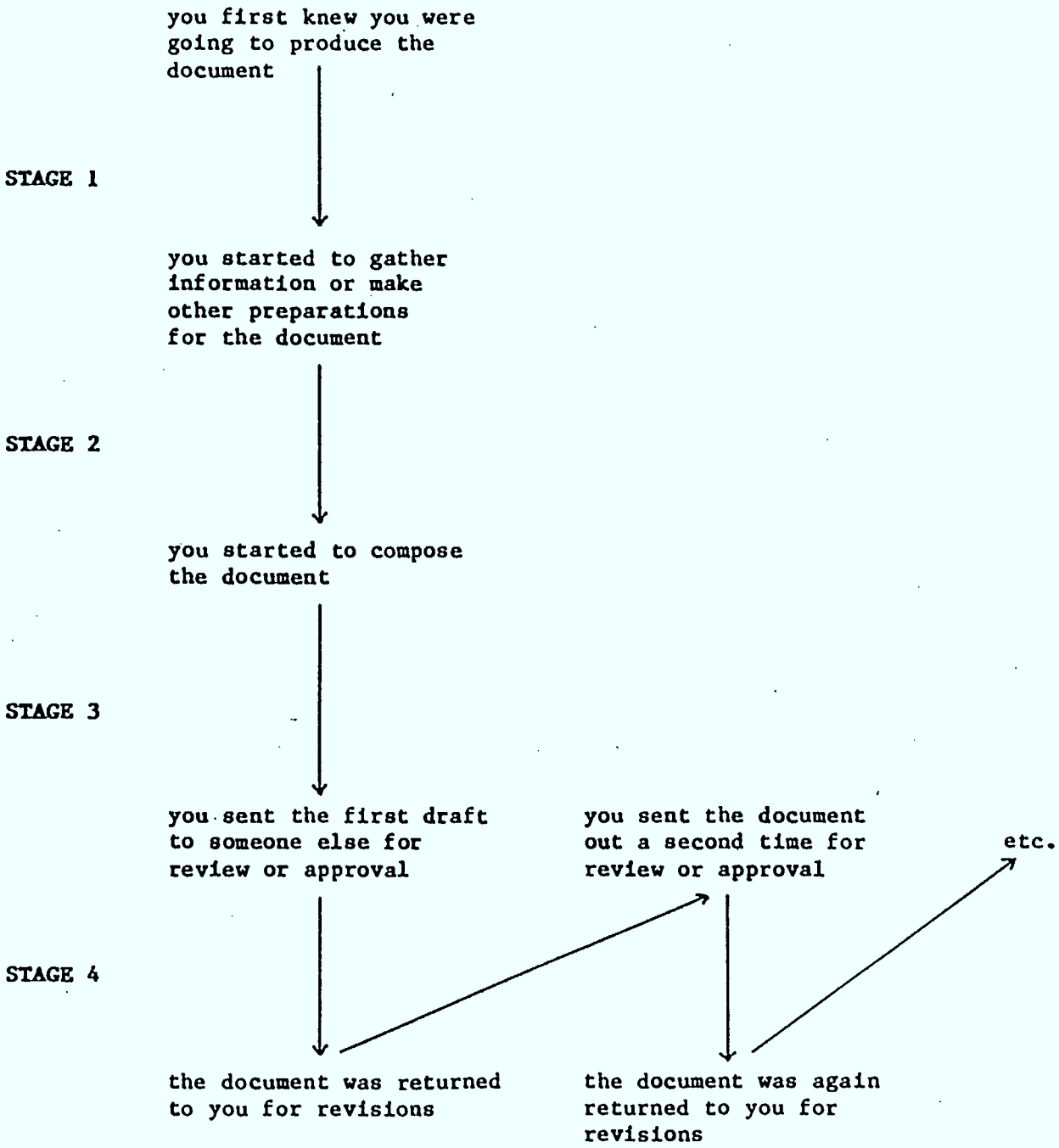
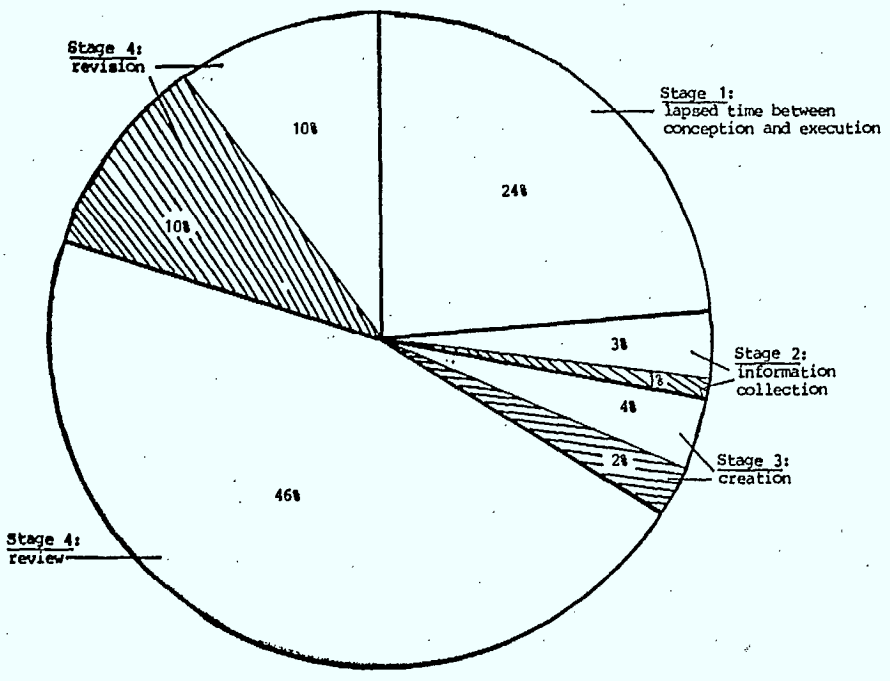


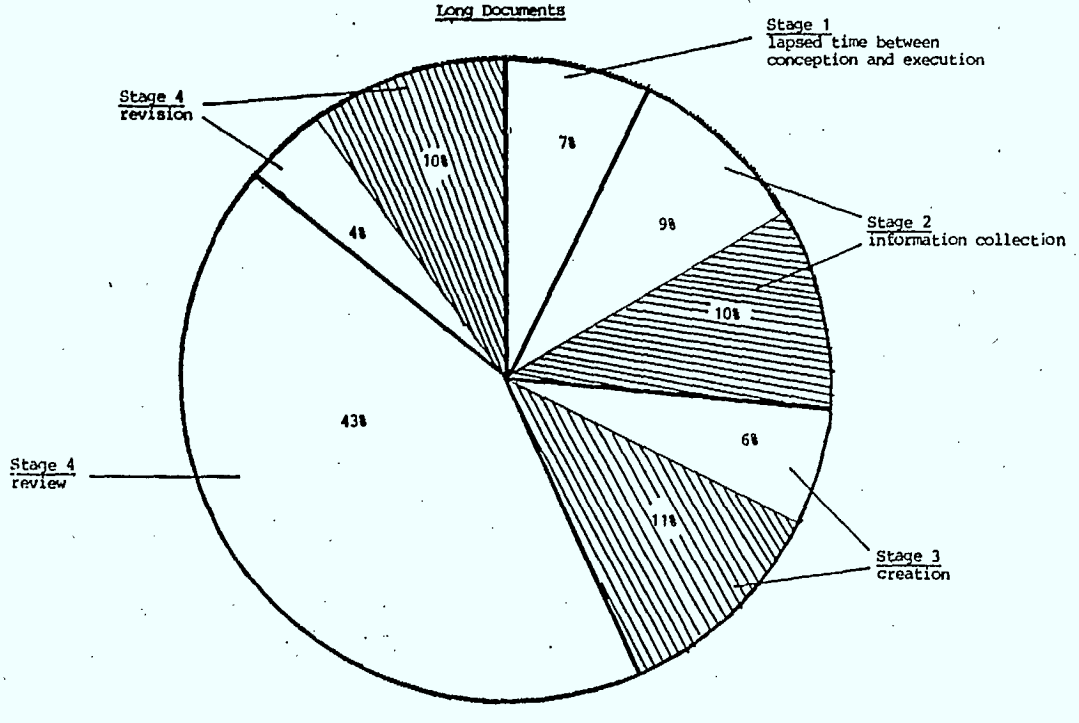
Figure 7.2

Breakdown of Total Processing Time Into
the Various Stages of Document Production

Short Documents



Long Documents



Shaded = Active
Unshaded = Inactive

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8 USER ACCEPTANCE

Chapters 4 through 7 cover the effects of technological change on work attitudes, health, work processes and the physical environment. However, the consequences of computerization depend not only on the installation of the equipment but also on the attitudinal and behavioral responses of the recipients. If workers dislike or refuse to use new electronic procedures, little can be accomplished in the area of productivity enhancement and such resistance, in turn, can have adverse impacts on general morale within the organization. This chapter examines the factors that may influence workers' reactions to the introduction of electronic processes. Particular consideration will be given to job type, work attitudes, demographic characteristics, environmental conditions and implementation procedures.

The chapter will begin with a literature review and then move on to a discussion of analysis techniques and the findings for this particular study. Given the longitudinal nature of the project, it is possible to distinguish between short and long-term reactions to computerization. Certain variables, for instance, may have an impact on initial receptivity or adaptability to the system, but other considerations may become more significant in the determination of responses once the electronic network is fully operational.

8.1 Background Literature

Before presenting the existing theoretical and empirical work in the area of user acceptance, it is necessary to clearly distinguish between the attitudinal and behavioral components of the issue. The attitudinal component refers to the opinions of the user population. Do the users feel computerization has had either a positive or negative impact on their work and the organization as a whole? By contrast, the behavioral component refers to how much time people actually spend using the computer for their daily work. Throughout the presentation it will become clear that the two facets of user acceptance are by no means synonymous. The amount of time spent using a computer is not always a matter of choice. While some individudals may make extensive use of a system because they find the electronic applications useful for their tasks, others who do not personally recognize the value of computers may spend equally as much time using such functions because of some external condition such as a management directive. Likewise, managers may give positive assessments of the value of computers even though they do not wish to use the equipment themselves. Thus, system usage is not always a function of opinions or personal preferences. The relationships between attitudinal and behavioural measures of user acceptance and selected independent variables may differ substantially, or even be completely contradictory in some instances.

To date, the literature dealing with the acceptance of new office technologies has been confined primarily to investigations of implementation processes (Brunet, 1980:19; Ranney, 1982; Bikson and Gutek, 1983). Training methods and the degree to which users are kept informed of system related issues are thought to be key determinants of the extent to which people like and will use the equipment (Kantrow, 1982:5; Cockroft, 1979:32-33; Mick, 1983). Although this chapter includes measures of information dissemination and satisfaction with training, we have also expanded the examination to incorporate such considerations as job type, preexisting work attitudes, environmental conditions and demographic characteristics. Reactions to computerization logically depend on not only the means of conducting the change but also on the conditions into which such changes are introduced. Respecting the chronological sequence of events, we will begin by discussing job type, prior attitudes, demographic factors and environmental assessments and then move on to a consideration of the implementation process.

8.1.1 Job Type

Throughout the existing literature, there is much discussion surrounding the differential impacts of technological change on various segments of the labour force (Tucker and Taylor, 1984; Hald, 1981; Labour Canada, 1982; Belanger, 1983; Broom, 1970; Diacon, 1981; Menzies, 1982; Regan, 1981). Some theorists are predicting a polarization effect with professional jobs being upgraded while support positions are increasingly fragmented and deskilled (Armstrong, 1983; Braverman, 1974). Contrasting perspectives maintain that the support role will be enhanced rather than diminished through computerization (Carlisle, 1979:73).

Although the empirical work in this area is rather limited, there is some indication that both attitudinal and behavioral responses to computerization may vary across occupational groups. With respect to attitudes, Bikson and Gutek reported that "text-oriented professional groups were strikingly more positive than others" (1983:135). On the behavioral side, these researchers also found that executives were the least likely to use a computer in their work (Bikson and Gutek, 1983:139). Only 36 percent of executives, as compared to 70 to 80 percent of professionals and support staff, used any type of computer equipment (Bikson and Gutek, 1983:139). Thus, it appears that particular job types may differ in terms of their opinions and system usage.

8.1.2 Work Attitudes

Although little empirical work is available to test the relationship between work attitudes and reactions to technological change, many theorists emphasize the relevance of job specialization, centralization and autonomy in examining the impacts of computerization (Broom, 1970:22; Dubin, 1970:16; Menzies, 1982:62; Science Council of Canada, 1982:44). The most beneficial results are

thought to be derived when electronic procedures are introduced into autonomous, intrinsically rewarding work environments (Brunet, 1980; Diacon, 1981; Belanger, 1983). If computerized devices are used in highly specialized repetitive jobs where people have little control over their work, one might expect a less than favourable response. Generally negative evaluations of working conditions could spill over or be displaced to attitudes about the installation of the new equipment. Alternatively, favourable work assessments could encourage a more ready acceptance of new procedures.

The hypothesized positive correlations between preexisting work attitudes and attitudinal measures of user acceptance, however, are dependent upon the retention of similar work structures throughout the implementation process. If jobs are redesigned in conjunction with computerization, reactions to the equipment could be influenced by simultaneous changes in job duties (Shepard, 1969b:185-190; Touraine, 1965). Under conditions of job enhancement the user population could give positive assessments of electronic procedures; whereas, conditions of degradation and deskilling could produce the opposite result. Thus, responses to technological change may be more dependent upon concurrent rather than preexisting work attitudes. Whatever the circumstances, it is important to investigate the relationship between general work attitudes and the acceptance of technological change.

Although satisfying jobs are obviously recognized as the most favourable situation, it is possible that behavioral measures of user acceptance may be negatively correlated with the degree of personal control exercised. "The person who has a choice may simply reject an 'unfriendly' system in favor of tried-and-true methods that do not involve computers" (Gutek, 1984:165). Within an employment context, the extent to which people use new technologies may be governed not only by their personal preferences but also by their ability to resist given their place within the organizational hierarchy. This scenario provides a clear illustration of why it is necessary to consider both attitudinal and behavioral responses to the introduction of a computer network. System usage may depend as much on organizational factors as on the individual's opinions of the new procedures.

8.1.3 Demographic Characteristics

During the computer age, as in other times of change, concern has arisen that opportunities to move into technologically advanced positions may be governed more by prejudices than by actual skill requirements (Communicado Associates, 1982). With respect to computerization, particular attention has been accorded age and educational considerations. Arguments have sometimes been made that less well educated or older employees will find it difficult to adapt to new electronic processes. As part of this chapter, therefore, we have included measures of age and educational attainment to assess the actual significance of such factors in influencing attitudinal and behavioral responses to the introduction of an integrated electronic information processing network.

Although the existing literature has not dealt with linguistic issues in the area of user acceptance, all Canadian Federal Government offices must function in both official languages. This bilingual requirement is particularly significant because, in most cases, the available software packages are American products developed in the United States for unilingual English applications. Given this situation, it is important to identify any differences in user acceptance that may exist between French and English participants.

8.1.4 Environmental Conditions

While researchers in the social sciences tend to concentrate on the organizational and inter-personal conditions influencing user acceptance, physical surroundings also form an important area of investigation (Canadian Labour Congress, 1982:5; Labour Canada, 1982:13-14). If the work environment is overcrowded and uncomfortable prior to the implementation of a computer system, the added space requirements, intensified heat and noise created by the equipment could result in unfavourable attitudes and deter system usage. Inappropriate installation could also lead to unacceptable conditions and negative attitudes in an otherwise suitable work area.

8.1.5 Implementation Procedures

While preexisting conditions set the stage for technological change, the final outcome can also be influenced by the manner of introduction and the training and information given the employees (Brunet, 1980:18-19). As Ranney has stipulated: "the critical challenge in instituting effective office automation involves socioemotional issues, such as training, participation, interest building, commitment to a new system and pacing the changeover" (1982:74).

User acceptance, in both attitudinal and behavioral terms, can depend on the success of information dissemination mechanisms and teaching methods (Kantrow, 1982:5; Cockroft, 1979:32-33; Mick, 1983). Consistent with long standing recommendations, organizational theorists continue to promote the importance of democratic principles during times of change (Coates, 1982:6-7; Mick, 1983). If management personnel want to develop a comprehensive and functional electronic network, they must involve potential users at all stages of the implementation process (Coates, 1982; Brunet, 1980). Likewise, training must be recognized as a significant on-going endeavour (Brunet, 1980:18; Coates, 1982:6-7). Short or inappropriate training programs may not only deter extensive and efficient system usage but may also do little to foster positive opinions about new electronic processes.

Overall, the adoption or rejection of technological change may be determined by a wide range of organizational, attitudinal, environmental and demographic variables. While each of these types of factors can make certain unique contributions, the final outcome in terms of user acceptance is undoubtedly dependent upon the interaction

or additive effect of a variety of preexisting conditions and implementation procedures.

8.2 Measurement Techniques

The findings to be reported in this chapter were drawn from the results of pretest, training, interim and posttest self-administered questionnaires. A detailed description of the instruments and data gathering techniques can be found in the methodology chapter. Operational definitions for the concepts are given in Figure 8.1. The interim questionnaire included only one behavioral and one attitudinal measure of user acceptance. Although the posttest instrument also had only one behavioral variable, the attitudinal component was expanded from one to three indices.

The three separate attitudinal indices included: the general usefulness of OCS, the impact of OCS on job quality and career opportunities, and the impact of OCS on work procedures. Whereas the first two indices were included for only the posttest data collection, the third index was used for the pretest, interim and posttest. 'The general usefulness of OCS' refers to the respondent's assessments of the value of the computer as a tool for support staff, officers and managers. 'The impact of OCS on job quality and career opportunities' measures the perceived effects of the new computer system on the intrinsic component of the job, career potential and the integration of the respondent's job within the organization as a whole. 'The impact of OCS on work procedures' covers changes the respondent has experienced in the specific content, quality and ease of his/her own job.

Unlike previous studies that simply consider a dichotomy of usage or non-usage for a computer system, the behavioral measure utilized in this project refers to the percentage of the work day the respondent spent using a computer (Figure 8.1). The various gradations range from "0" meaning the respondent had access to but did not use the equipment to "4" meaning the respondent spent more than 75 percent of his/her time on computer related activities.

In contrast to the behavioral measure that included a zero category, attitudinal questions were confined to active users. Respondents were only asked if the computer had improved or made their job easier on the condition that they used the equipment for their daily work. Although the pretest measure referred to the expectations of all individuals who were designated to receive OCS, the interim and posttest measures were restricted to the actual user group. This situation creates a metholological bias and could contribute to any observed changes in the "impact on work procedures" index. However, Table 8.1 demonstrates no significant change in this attitudinal measure of user acceptance over time. It is also unlikely that the exclusion of these people could have distorted our examination of differences by job type as the inactive OCS participants were equally distributed between support staff and officers (Table 8.2). Although it would have been interesting to examine the reactions of those who

did not use OCS, there were too few continuous cases to warrant such analyses. There were 9 interim respondents and 3 posttest respondents who had access to but did not use the computer network. A discussion of the initial responses for the 9 inactive participants can be found in an earlier Quality of Working Life Impact Assessment report, but little can be said about the 3 people who were still not using the equipment at the time of the posttest.

8.3 Analytical Procedures

Within this chapter, the findings exclusively focus on the OCS participant group. Although most members of the transitional group also had received computer equipment by the time of the posttest data collection, measures pertaining to user acceptance were specifically designed for the OCS application which provided a consistent longitudinal perspective.

Similar to the other chapters, analysis of variance techniques are utilized to assess any changes in user acceptance that occurred throughout the observation period. These analyses are presented for the user population in general, and then more specifically for support staff versus officers (Tables 8.1 through 8.3).

Having completed the examination by job type, the concluding tables turn to correlation procedures to identify those factors that are related to both short and long-term reactions to the introduction of a computer system. Table 8.4 reports correlations between pretest work attitude, demographic and environmental variables and interim measures of user acceptance. Table 8.5 utilizes interim measures of both the independent and dependent variables, and Table 8.6 repeats these correlations for the posttest. Unfortunately, there were insufficient continuous cases to permit analyses using independent pretest and dependent posttest variables. From the training questionnaire, Table 8.6 displays associations between certain implementation factors and user acceptance. Although multivariate procedures would have provided the most succinct understanding of the relative strengths of the independent variables, such analyses were disallowed because of the small number of cases under consideration.

8.4 Findings

As outlined in the literature review, there are a wide variety of predictors that are hypothesized to have a significant association with the acceptance of technological change; however, little is known about differential effects over time. This indepth longitudinal project provides a useful opportunity to examine the various phases through which technological change progresses and the reactions of the users at each stage.

8.4.1 General Response to the Introduction of OCS by Job Type

The results presented in the other chapters of this report suggest that both behavioral and attitudinal measures of user acceptance may vary between 6 and 20 months of system usage. Throughout the discussion of work attitudes, there were a number of indications that the general morale of support staff declined during the initial implementation period. If, in fact, the negative attitudes expressed by support staff were related to the introduction of OCS, one would expect a similar decline in their assessments of the equipment given during the interim data collection. On the other hand, if support staff had favourable assessments of OCS for the interim data collection it would be highly unlikely that their comparatively negative work attitudes could have been caused by technological change. Furthermore, these negative reactions would be expected to improve after more lengthy system usage because of the subsequent positive changes that occurred in work processes and job satisfaction.

Although there was no change in the attitudinal measure of user acceptance for the total participant group over the field trial period, there was a significant increase in the behavioral indicator between the interim and posttest data collections (Tables 8.1 and 8.2). The mean score for computer usage, 6 months after the installation of OCS, was 1.67 (SD=1.226, N=48) and this had risen to 2.17 (SD=1.078 B=48) after 20 months of usage. Thus, it is clear that people were continuing to expand electronic applications as a result of more lengthy exposure to the equipment. By the time of the final data collection, respondents were using the computer, on average, slightly more than 50 percent of their working time.

A breakdown by job type also demonstrates some substantial attitudinal differences in user acceptance between support staff, officers and managers. Although support staff originally expressed the most favourable expectations about the new computer system, this situation reversed during the initial implementation period (Table 8.2). At the time of the interim data collection, support staff were the least likely to feel that OCS had either improved or made their jobs easier. This finding is consistent with observations reported in the work attitudes and work processes chapters. Support staff appear to have experienced the most strain during the first few months of computer usage because the new electronic functions were immediately applicable to their job tasks. Secretaries were given little choice in the adoption of new electronic procedures because of the removal of typewriters. During the implementation period, some secretaries felt that the expectations of managers and officers exceeded what they were able to accomplish given that they were still learning to use the new system and there were a number of difficulties with the computers themselves. On the other hand, officers and managers could exercise more discretion in their application of the electronic functions. Even if an officer or manager had performed the initial text entry, he/she often would rely on support staff for formatting and printing, and these were precisely the areas in which the majority of bugs and glitches existed. Thus, it is not surprising that support staff

demonstrated a relatively negative reaction on the attitudinal measure of user acceptance for the interim data collection.

In direct opposition to these initially negative responses, the attitudes of support staff toward OCS had again become the most positive by the time of the posttest data collection (Table 8.2). This finding is also consistent with other general work attitude and job content indicators. Although support staff experienced few positive changes in their jobs during the implementation phase, long-term computer usage led to a reorganization of work processes with officers performing most of their own text entry and editing requirements. As a result of these changes, support staff were relieved of many relatively repetitive tasks to perform other office work that they found more interesting and rewarding. Personal interviews for the posttest data collection revealed that support staff had increased their work in such areas as budgeting, expense claim processing, statistical calculation and tabulation, and proof reading. Assessments of intrinsic job content, supervisory practices and promotional opportunites also had improved substantially after 20 months of system usage. Thus, the long-term consequences for support staff appear to be quite favourable, and this is reflected by an improvement in their assessments of OCS.

On the behavioral side of user acceptance, Table 8.3 shows a significant increase in computer usage for support staff and officers over the interim and posttest data collections. Both of these groups tended to make more extensive use of electronic functions as they became increasingly familiar with the new procedures and the bugs and glitches were corrected. In contrast to attitudinal distinctions, officers and support staff were spending approximately the same proportion of time using OCS six months after installation. Therefore, negative attitudinal reactions appear to have arisen among support staff not so much as a result of more extensive usage but instead perhaps as a consequence of the lack of control and flexibility experienced in the areas of application.

Although there were insufficient cases to tabulate the responses of managers, this group originally reported the lowest system usage and their computer applications continued to decline over the field trial period. Some management personnel made an initial attempt to use OCS, but they found the system to be unsuitable for their particular job duties. Complaints were made concerning the difficulty of skimming materials, the inability to make marginal comments and the lack of hardware portability. In addition, the software package that was to be used for approval and review processes never became fully operational.

In general terms, the response to OCS has been very favourable; however, it is clear that the degree of user acceptance differs across the various job types under study. Officers, who were primarily responsible for text creation, made extensive use of the electronic functions and also felt that the new system both improved and made their jobs easier. For support staff, computer related changes in job content eventually lead to very favourable assessments of OCS;

however, initial reactions were comparatively negative because of pressures experienced during the implementation phase. In contrast to both of these groups, management personnel made very little use of the new computer network. Although managers tended to feel that OCS was a beneficial tool for support staff and officers, they did not see the new functions as being applicable for their particular tasks.

Some interesting comparisons can be drawn between the results of this study and the findings reported by Bikson and Gutek (1983). From both studies it is clear that managers or executives are the least likely to use new electronic functions. However, Bikson and Gutek also found text oriented professionals to express the most positive opinions about computerization. Although this was true during the implementation phase of this project, support staff gave comparably higher assessments of OCS after more extensive system usage. Hypotheses formulated specifically by job type are rather simplistic. Reactions of various segments of the work force may depend upon the degree of control they are able to exercise over the application of the new equipment and related changes in work procedures. In addition, opinions expressed during initial implementation may differ significantly from responses once the system has stabilized.

8.4.2 Work Attitudes

The relationships between work attitudes and user acceptance differ in accordance with attitudinal and behavioral indicators and the duration of system access. The index referring to opportunity for promotion exhibits the only consistent positive correlation with attitudinal measures of user acceptance. Assessments of supervisory practices, intrinsic job content and the perceived value of the job are significantly correlated with initial responses to computerization, but these factors are inconsequential after approximately 1 1/2 years of computer access. On the behavioral side, the element of control seems to be an important determinant of initial system usage; however, the relevance of this variable also diminishes following lengthy exposure.

Of all the variables under examination, the availability of promotional opportunities exhibits the strongest association with attitudinal measures of user acceptance for both the interim and posttest data collections (Tables 8.4 through 8.6). Those people who felt the department offered good potential for career advancement were more likely to give a favourable assessment of computerization than those who felt the department offered poor mobility prospects. However, the time sequence for this association is not clear. The availability of advancement prospects could have encouraged more favourable assessments of the computer system or a positive response to technological change could have been perceived as an asset for upward mobility. Although the results presented in Tables 8.5 and 8.6 refer to simultaneous measurements of the independent and dependent variables, the pretest assessment of promotional opportunities shows a similar relationship with interim user acceptance (Table 8.4). Thus, it appears that preceding evaluations of advancement prospects play at least some role in determining attitudinal reactions to

computerization. This does not preclude the possibility that negative opinions about the new system may have also affected the respondent's perception of his/her advancement potential.

To understand the implications of any organizational change, one must first examine internal reward structures. Within the federal government, as in most other large establishments, there is substantial room for horizontal and vertical movement. Information derived from pretest questionnaires showed that the vast majority of people expected to remain within the federal government but not in the same job. Eighty-four percent of respondents reported that they expected to still be working for the federal government in three years' time and sixty-seven percent said that individuals in jobs such as theirs were sometimes or frequently promoted. Under such circumstances, mobility appears to become a prominent concern. As a consequence of this situation, those workers who see themselves as being "stuck" develop attitudes that are markedly different, and often more negative, than their co-workers (Kanter, 1977).

If people recognize their promotional opportunities as blocked by either insufficient openings or unfair evaluation practices, they may be less likely to derive any personal gain from learning new procedures. Alternatively, respondents who give a favourable account of promotional opportunities may see the development of computer related skills as an asset in the realization of their career plans. Even if such mobile respondents are not originally enthusiastic about computerization, they may make more of an effort to adopt new procedures because the failure to do such could jeopardize their advancement potential.

While we can understand the relevance of promotional considerations within this particular setting, such factors may not prove as important in other organizations. Responses to technological change in small establishments may be influenced by quite different considerations because of the relative lack of internal career ladders. An understanding of the differential responses to the new computer based technologies, therefore, requires detailed preliminary examinations of internal reward structures.

In addition to promotional opportunities, evaluations of intrinsic job content and supervisory practices also exhibit significant correlations with opinions about the computer system expressed during the initial implementation period (Table 8.5). If people are critical of their supervision and cannot see any value or challenge in their work, they tend to be less receptive to change. Workers who are critical of their superiors can be particularly resistent to the adoption of new procedures if they recognize computerization as a management directive.

Whereas associations between work attitudes and assessments of the computer system were generally positive, the opposite was true of system usage six months after installation (Table 8.5). From a behavioral stance, people who gave positive evaluations of their jobs tended to take longer to develop their computer competency than did

those who expressed more negative attitudes. The key to understanding these results may be within the area of control. As mentioned in the literature review, when people are given a choice they may decide not to use a computer if they are dissatisfied with its performance. The results presented in Table 8.5 would tend to reinforce this hypothesis. During the first six months of application, when there were still a number of bugs and glitches in the system, those respondents who reported the most control over the content of their jobs used the new computer network the least. However, this element of control appears to have had no effect on computer usage after a more lengthy period of exposure when original problems were resolved (Table 8.6). The adoption of electronic processes may be a more gradual process for those workers who are able to govern their own work procedures, but the area of control over work speed stands out as having a positive influence in the long-term. Even after twenty months of computer access, those respondents who experienced constant time pressures made the least use of electronic procedures. Unless people are able to devote time to becoming proficient with the new system they may continue to rely on tried and true methods. Thus, positive long-term results in the area of computer usage may depend upon the allocation of time during working hours for practicing electronic applications. In all too many cases, people are expected to learn how to use a computer while maintaining their regular workload, and if they are already overtaxed in terms of time pressures they may fall back to a reliance on paper and pen.

Overall, it appears that positive work attitudes set the stage for the acceptance of technological change. Those people who give positive evaluations of their superiors, the intrinsic content of their work and promotional opportunities tend to adapt more readily to new procedures. However, on the behavioral side, the extent to which people make use of a system during the implementation period is closely linked to the amount of control they have over their work procedures. Given a high degree of autonomy, system usage does not tend to be very extensive until initial bugs and glitches have been resolved. Once the system has stabilized, computer usage is closely tied to the relaxation of time pressures.

8.4.3 Demographic Characteristics

Moving outside of the work setting to considerations of individual attributes, we see that neither age nor education bear any relation to initial user acceptance (Table 8.4). In contrast, the variables pertaining to language usage and preference exhibit some significant correlations. Generally speaking, bilingual and French participants used the computer system less than unilingual English participants and were less likely to give a favourable accounting of the value of OCS during the initial implementation period.

Because the association between language and attitudinal measures of user acceptance was only significant during the implementation period, it is possible that initial correlations could have been spurious and dependent instead upon the varying effects of job type. Controlling

for the support versus officers distinction, however, does not disallow the reported relationships for either attitudinal or behavioral measures. All four of the statistically significant language correlations reported in Tables 8.4 and 8.6 remain significant even when controlling job type.

The behavioral distinction between unilingual English and bilingual or French speaking participants remains consistent throughout both short and long-term usage of the system. Respondents who worked in French or both official languages tended to use the OCS system less than their unilingual English counterparts. This may be linked to certain features of the system that made bilingual work more difficult than English composition. For example, the text processsing system could not facilitate column entry or paragraph alignment for side-by-side French and English materials. It should be noted, however, that recommendations from the users have been taken into consideration and this feature will be available on a new text processing package to be introduced in the near future.

On the attitudinal side of the user acceptance issue, linguistic distinctions were more influential during the initial implementation period than after lengthy system usage. This finding is reinforced by further examination of the attitudes of new staff. A number of people entered the department between the interim and posttest data collections and, therefore, were trained to use OCS at a later date. These new participants also exhibited significant negative associations between language variables and measures of the impact of OCS on work procedures and the overall value of office automation. Thus, it appears that the relevance of linguistic distinctions for the attitudinal component of user acceptance is particularly pronounced during the initial learning period. This finding may relate to the fact that software and instructional materials were originally designed in English and then translated into French. During training sessions, some Francophones commented that French manuals, menus and commands were difficult to understand and they preferred to use the English equivalents. Unlike the behavioral indicator of user acceptance, the negative effect of language on attitudinal measures of user acceptance appears to decline as people gain familiarity with the system.

In summation of the relevance of demographic factors, it is clear that the common wisdom concerning age and educational variables has received no support in our research. However, there is evidence that linguistic considerations deserve closer scrutiny.

8.4.4 Environmental Conditions

As outlined in Chapter 5 and more detailed departmental reports on the impact assessment, a number of environmental deficiencies were exacerbated by the installation of OCS. The difficulties that arose from these environmental problems were intensified because of an earlier movement from enclosed to open offices. Under such stressful circumstances, it appears that those people who gave negative

evaluations of their working conditions were also less favourably disposed toward the new computer network.

For the interim data collection, respondents who perceived their work area as being uncomfortable due to poor temperature, ventilation and work space also gave negative assessments of the value of OCS (Table 8.5). Similar problems appeared when people were bothered by the visual contrast between paper documents and VDT screens. As most of the environmental conditions were aggravated by the introduction of OCS and concurrent changes in space allocations, it is not surprising that pretest environmental measures were essentually unrelated to user acceptance (Table 8.4)

A trial work unit was introduced prior to the installation of OCS to accommodate the new computer equipment and to provide more individualized control over lighting, heating and ventilation. Unfortunately, these control mechanisms could not override pervasively negative conditions in the general work area and in addition many occupants complained about the inadequacy of storage and general space allocations. The existence of this relatively negative atmosphere obviously did not act as any incentive for acceptance of the new computer system which tended to intensify existing heating, ventilation and space problems.

As demonstrated in Table 8.6, the impacts of environmental factors on user acceptance had substantially reduced by the time of the posttest data collection. Ventilation is the only variable that retained a significant positive correlation with assessments of OCS even after lengthy exposure. Those respondents who felt their work areas were poorly ventilated were less likely to believe that the new computer network had a positive impact on work procedures.

Overall, it appears that environmental factors were more influential for user acceptance during the short rather than the long-term. This finding, however, may not be generalizable to other contexts because of the unique conditions that made environmental issues particularly salient and stressful within the implementation period of this project.

8.4.5 Implementation Procedures

As previously mentioned, most of the literature to date has emphasized the influence of implementation procedures in relation to attitudinal and behavioral responses to the introduction of a computer system (Brunet, 1980:18-19; Ranney, 1982:74; Kantrow, 1982:5). The success of this technological change is thought to rest upon extensive participant involvement and the development of a comprehensive training program.

Although information dissemination prior to training bears no relation to user acceptance in this study, the subsequent provision of information pertaining to system and procedural changes does exhibit a

positive correlation (Table 8.7). Continued involvement and feedback is an important component of satisfaction within the user population.

It is also interesting to note that both of the training variables show significant positive correlations with the behavioral measure of user acceptance (Table 8.7). Those respondents who felt they had received sufficient training and found the instruction easy to apply to their daily activities used the computer network much more extensively than their co-workers who expressed dissatisfaction with the training program. In addition, ease of application was also positively correlated with attitudes toward electronic work procedures. The design of the training program may be an important determinant of both behavioral and attitudinal responses to the equipment.

The success or failure of technological change may hinge on the very human concerns of training and participant involvement. Findings from this study concur with earlier recommendations that employers must realize that the installation of highly sophisticated computers is of little avail if users resist the adoption of new electric functions (Hill, 1970:370).

8.5 Conclusion

The results presented in this chapter reinforce the importance of distinguishing between attitudinal and behavioral measures of user acceptance. The factors that promote positive opinions about computerization may differ substantially from the conditions under which extensive system usage will develop.

In general, the response to computerization among OCS participants was quite favourable in both attitudinal and behavioral terms. Even though a few respondents did not use the system at all, others spent over 75 percent of their time on electronic procedures. The final data collection showed that people were spending, on average, more than 50 percent of their working time using OCS. In addition, the vast majority of respondents felt the total impact of this technological change had been positive.

In the federal government context under discussion, promotional opportunities stand out as having the strongest and most consistent effect on attitudinal measures of user acceptance. Those individuals who felt their jobs offered little room for advancement were the least likely to believe the new computer system had made a positive impact on their work. Thus, the willingness to adopt new procedures may be dependent upon the existence of incentives.

Although assessments of intrinsic job content, supervisory practices and environmental conditions formed significant predictors for initial attitudinal responses to OCS, the relevance of these considerations declined after more lengthy exposure. The implementation period created stress for both organizational and environmental structures, and those people who confronted the changes

with generally positive attitudes were better able to cope with the additional strain. The evaluation of supervisory practices is one clear illustration of how a negative predisposition can result in a less than favourable assessment of the introduction of new electronic procedures. If people are generally dissatisfied with their superiors, they may reject computerization because they see this as simply another management directive over which they have no control.

In general, the associations between work attitudes, environmental conditions and system usage were negative rather than positive, and the most significant indicators were in the area of control. During the implementation period, respondents who had the most control over their work procedures used the new electronic functions the least. Given the choice, people may not make extensive use of a new system until most of the bugs and glitches have been corrected. Once the computer network was relatively stable, 20 months after installation, control over work speed was the only factor that stood out as having a significant association with computer usage. Those individuals who experienced constant time pressures used the new procedures the least. Time must be allocated for the whole learning process if people are to become proficient in the application of new procedures. It is not surprising that self-instruction on electronic processes is a low priority if people are already struggling with a heavy workload.

It is interesting to note that in contrast to work attitudes and environmental conditions, questions assessing the length of training and the ease of application of instruction demonstrate positive impacts on the percentage of time people spend using a computer. The development of a comprehensive and suitable training program may be one way to encourage the use of new technologies.

Language is the one indicator that holds a consistent association for both attitudinal and behavioral measures of user acceptance. French and bilingual participants were not only less likely to give a positive assessment of the value of OCS but were also less likely to make extensive use of the equipment. It was clear that the software was not well adapted for bilingual work.

While favourable working conditions may play an important role in encouraging positive attitudinal responses to the introduction of a computer system, this is no guarantee that people will make use of the equipment once it is in place. The extent to which people use a new computer system depends on the provision of appropriate training, the allocation of time for users to practice new procedures and the provision of software that is applicable to the linguistic and functional requirements of the implementing organization.

Figure 8.1

Operational Definitions of Concepts for User Acceptance Chapter

User Acceptance - Attitudinal

The results of a factor analysis yielded three factors of user acceptance.

General Usefulness of OCS: This index included responses to the following three statements:

- I think the OCS equipment is a useful tool for support staff
- I think the OCS equipment is a useful tool for officers
- I think the OCS equipment is a useful tool for managers

Response categories for these statements ranged from 1 meaning strongly disagree to 4 meaning strongly agree. The standardized Cronbach's alpha was .87.

Impact of OCS on Job Quality and Career Opportunities: This index included responses to the following three statements:

- the OCS equipment makes my job more interesting
- the OCS equipment gives me a greater sense of being in touch with the rest of the organization
- I believe that experience with the OCS equipment improves my career opportunities

Response categories for these statements ranged from 1 meaning strongly disagree to 4 meaning strongly agree. The standardized Cronbach's alpha was .82.

Impact of OCS on Work Procedures: This index included the following three questions:

- Has the OCS equipment made your job easier, made no difference or made your job more difficult? (MADE JOB A LOT EASIER, SOMEWHAT EASIER, NO DIFFERENCE, SOMEWHAT MORE DIFFICULT, MADE JOB A LOT MORE DIFFICULT)
- Has the OCS equipment improved, had no impact or made your job worse? (IMPROVED JOB A LOT, IMPROVED SOMEWHAT, NO IMPACT, MADE SOMEWHAT WORSE, MADE JOB A LOT WORSE)
- Overall, how do you feel about the introduction of computer related processes into the office? (STRONGLY IN FAVOUR, SOMEWHAT IN FAVOUR, INDIFFERENT, SOMEWHAT OPPOSED, STRONGLY OPPOSED)

Cronbach's alphas: interim = .78, posttest = .82.

A similar index was also formed for the pretest data collection but these questions asked people for their expectations about OCS as the system was not in place at that point.

- Do you think this new equipment will make your

job easier, make no difference or make your job more difficult?
- Do you think this new computer equipment will improve, have no impact or worsen your job?
- Overall, how do you feel about the introduction of computer related processes into the office?

The standardized Cronbach's alpha for this pretest index was .67.

User Acceptance - Behavioral

Computer Usage

The following question was used as a subjective measure of system usage:

- On average, what percentage of your work day do you spend using a computer or word processor?

Response categories ranged from 0 meaning that the person had access to, but did not use, the equipment to 4 meaning more than 75 percent of the respondent's work time was spent using the computer system. Although electronically collected usage statistics were not available at the time of the posttest data collection, such figures were gathered for the interim period. At that time, the correlation between the above questionnaire item and the system generated statistics was $r = .49$ $p < .01$. An exclusive reliance on such electronically generated system statistics was deemed insufficient because it excluded those people who had access to, but did not use, the equipment. Furthermore, these machine statistics provided no means of accounting for the time people spent using accounts other than their own.

Work Attitudes

The operational definitions for the work attitude measures can be found in Figure 4.1 of the work attitudes chapter.

Job Type

For the purposes of this chapter, job type has been defined as a dichotomous variable of support staff versus officers. Once again management personnel have been excluded from the analyses because of the small number of cases under consideration.

Demographic Characteristics

Age: Age refers to a continuous variable.

Education: Education is recorded here as the number of years of post-secondary education as 90 percent of the respondents had at least one year of training past high school.

Language: The following questions were used to determine language usage and preference:

- what language do you usually use at work?

Three response categories were provided: 1) ENGLISH PRIMARILY, 2) FRENCH PRIMARILY and 3) ENGLISH AND FRENCH ABOUT EQUALLY.

- what language would you prefer to use at work?

Four response categories were provided: 1) ENGLISH, 2) FRENCH, 3) OTHER and 4) NO PREFERENCE. A dichotomy was formed for both language usage and preference, with 1 as English and 2 as all other categories.

Environmental Assessments

VDT Installation in Work Area: This index was developed by summing the answers to four statements from the following question:

- How well have the following aspects of computer installation been accommodated in your work space:
  - data cabling
  - power cords
  - reference document space near VDT
  - space for document handling near VDT

Although the responses to each of these statements formed five point scales, 1 could mean very poorly located or very inadequate and 5 could mean very well located or very spacious. The standardized Cronbach's alpha: interim = .76, posttest = .90. See Figure 6.1 of the Health Chapter for all other operational definitions of the environmental variables.

Implementation Variables

In addition to the three major data collections that form the time series material, a brief questionnaire was also distributed three months after completion of the training program. The following four factors were derived from that questionnaire because it focused specifically on the implementation process.

Information Dissemination Prior to Training: This index was formed as a composite of responses to the following multi-dimensional question:

- Before you were trained on this new equipment were you given too much, about the right amount or not enough information on the following subjects:
  - when the system was going to be introduced
  - when the system would be fully operational
  - what functions would be available on the system
  - how the system could affect the procedures used in your work
  - how much training was required

Three possible responses were provided for each of these statements: 1) not enough, 2) about right and 3) too much. In computing the index, 1 and 3 were recoded to 0 to reflect an inappropriate amount of information and 2 was recoded to 1, to reflect an appropriate amount of information. The summation yielded an overall assessment of information dissemination with a standardized Cronbach's alpha of .78.

Information Dissemination Following Training: The design of this question was similar to the measure of prior information dissemination.

- We would also like to know if you feel you have been kept up-to-date on any additional information since the computer system was brought into the office. Do you feel you have been given too much, about the right amount, or not enough information in the following areas:
  - the changes that have been made in the system
  - how the transition is being made from paper to electronic work procedures
  - the new electronic procedures used in your work
  - the future implications of the field trial

The standardized Cronbach's alpha for this index was .71.

Assessment of Length of Training: This variable refers to responses to the following question:

- For your purposes, did you feel that too much, about the right amount, or not enough time was spent on training for this new computer system?

Ease of Application of Training: This is again a single item variable, derived from the following question:

- Did you find it very easy, easy, difficult, or very difficult to apply what you learned during the training sessions to your everyday work?

Table 8.1

Analysis of Variance for User Acceptance Over Time

	between groups	within groups	within df
Impact of OCS on Work Procedures			
MS	3.220	1.551	99
F	2.076		
Computer Usage			
MS	6.000	1.333	95
F	4.500*		

The between degrees of freedom for time equals 2 for "impact of OCS on work procedures" and 1 for "computer usage". Pretest measures for the attitudinal index refer to expectations pertaining to computer installation. On the other hand, the percentage of time people spend using the OCS network can only refer to questionnaires distributed after the system was already in place.

* $p < .05$ ** $p < .01$

Table 8.2

Impact of OCS on Work Procedures - Mean Scores
Over Time by Job Type

job type		time			
		pretest	interim	posttest	row mean
support staff	M	8.71	7.45	8.75	8.32
	SD	.49	1.64	.78	
	N	(7)	(11)	(16)	
officers	M	7.82	8.37	8.46	8.30
	SD	1.47	1.61	1.14	
	N	(11)	(19)	(24)	
column mean		8.17	8.03	8.58	8.31

Although there were insufficient cases in cell one to conduct an analysis of variance for job type across all three time periods, it was possible to examine the interaction effect for the interim and posttest measures. The results were as follows:

	time	job type	time x job type	within	within df
Impact of OCS on Work Procedures					
MS	7.748	1.563	5.867	1.699	66
F	4.561*	.920	3.454*		

Between df = 1 for time, 1 for job type and 1 for time X job type

* p < .05 ** p < .01 *** p < .001

Table 8.3

Computer Usage - Mean Scores Over Time by Job Type

job type		time		
		interim	posttest	row mean
support staff	M	1.65	2.19	1.91
	SD	1.41	1.05	
	N	(17)	(16)	
officers	M	1.76	2.29	2.04
	SD	1.23	1.12	
	N	(25)	(28)	
	column mean	1.71	2.25	1.99

	time	job type	time x job type	within	df
Computer Usage					
MS	5.769	.226	.001	1.446	82
F	3.989*	.156	.001		

Between df = 1 for time, 1 for job type and 1 for time by job type

* p < .05 ** p < .01 *** p < .001

Table 8.4

Correlations Between Selected Pretest Predictors and Interim Attitudinal and Behavioral Measures of User Acceptance

	Pearson's Product Moment Correlation Coefficients			
	impact of OCS on work procedures		computer usage	
	r	n	r	n
Work Attitudes				
job satisfaction				
supervision	.23	(18)	-.24	(23)
co-workers	.31	(21)	-.30	(27)
promotion opportunities	.62**	(18)	.12	(24)
intrinsic	.43*	(20)	-.16	(26)
Alienation				
perceived value of job	.19	(19)	-.15	(24)
degree of specialization	.01	(21)	-.52**	(27)
responsibility	.46*	(20)	.20	(26)
control over job content	.30	(21)	-.03	(27)
control over movement	.14	(20)	-.05	(26)
control over speed	.21	(20)	.17	(26)
Demographic Characteristics				
age	-.05	(27)	-.18	(37)
education	-.02	(27)	-.13	(37)
language usage	-.41**	(28)	-.21	(39)
language preference	-.32*	(28)	-.29*	(39)
Environmental Conditions				
temperature	-.18	(20)	-.16	(25)
ventilation	.19	(21)	-.38*	(28)
work space	.25	(22)	-.04	(29)
distractions from office equipment	-.10	(21)	-.19	(27)
environmental effect on job performance	-.21	(21)	-.06	(27)

* $p < .05$ ** $p < .01$

Table 8.5

Correlations Between Selected Interim Predictors and Interim Attitudinal and Behavioral Measures of User Acceptance

	Pearson's Product Moment Correlation Coefficients			
	impact of OCS on work procedures		computer usage	
	r	n	r	n
Work Attitudes				
job satisfaction				
supervision	.29*	(35)	.20	(48)
co-workers	.13	(37)	.14	(50)
promotion opportunities	.51***	(35)	.01	(47)
intrinsic	.46**	(37)	-.07	(50)
Alienation				
perceived value of job	.44**	(37)	.10	(48)
degree of specialization	.24	(37)	-.18	(49)
responsibility	.01	(37)	-.18	(48)
control over job content	.06	(37)	-.26*	(49)
control over movement	.08	(37)	-.22*	(49)
control over speed	-.18	(35)	-.01	(46)
Environmental Conditions				
temperature	.37*	(31)	-.20	(42)
ventilation	.45**	(31)	.07	(43)
work space	.61***	(31)	-.18	(43)
VDT installation in work area	.05	(28)	-.23	(35)
brightness difference between document and screen	.42*	(29)	.07	(38)
distractions from printers	.07	(31)	-.10	(43)
distractions from other office equipment	.05	(31)	-.17	(43)
environmental effect on job performance	.06	(31)	-.10	(42)

* $p < .05$ ** $p < .01$

Table 8.6

Correlations Between Selected Posttest Predictors and Posttest Attitudinal and Behavioral Measures of User Acceptance

Pearson's Product Moment Correlation Coefficients

	Attitudinal						Behavioral	
	general usefulness of OCS		impact of OCS on job quality and career opportunities		impact of OCS on work procedures		computer usage	
	r	n	r	n	r	n	r	n
Work Attitudes								
Job Satisfaction								
supervision	.11	(42)	.01	(41)	.13	(41)	.15	(42)
co-workers	.10	(45)	.14	(45)	.22	(44)	.10	(46)
promotion opportunities	.26*	(44)	.27*	(44)	.29*	(42)	-.22	(44)
intrinsic	-.05	(44)	.06	(44)	.20	(43)	-.05	(45)
Alienation								
perceived value of job	.12	(45)	.16	(44)	.17	(43)	-.01	(45)
degree of specialization	-.01	(45)	.16	(45)	.08	(44)	-.09	(46)
responsibility	.15	(45)	-.22	(45)	-.07	(44)	.11	(46)
control over job content	.03	(45)	.08	(45)	.19	(44)	-.05	(46)
control over movement	.07	(45)	-.05	(45)	.01	(44)	-.01	(46)
control over speed	.06	(45)	.09	(45)	.07	(44)	.26*	(46)
Demographic Characteristics								
language usage	.14	(46)	.23	(46)	.15	(45)	-.31*	(47)
language preference	-.17	(46)	.10	(46)	-.23	(45)	-.22	(47)
Environmental Conditions								
temperature	-.11	(47)	.05	(47)	.04	(46)	.15	(48)
ventilation	.05	(46)	.10	(46)	.28*	(45)	-.01	(47)
work space	-.12	(47)	-.24*	(47)	-.07	(46)	.09	(48)
VDT installation in work area	.01	(39)	.06	(39)	.21	(38)	-.09	(40)
brightness difference between document and screen	-.02	(42)	.08	(42)	.10	(41)	.02	(43)
reflections on VDT	-.19	(44)	-.02	(44)	.06	(43)	.06	(45)
distractions from printers	-.23	(47)	-.14	(47)	-.27*	(46)	-.16	(48)
distractions from other office equipment	-.20	(47)	-.10	(47)	.01	(46)	-.12	(48)
environmental effect on job performance	-.02	(44)	-.18	(44)	-.06	(43)	.03	(45)

* $p < .05$

Table 8.7

Correlations Between Selected Implementation Variables and Attitudinal and Behavioral Measures of User Acceptance - Training Questionnaire

	Pearson's Product Moment Correlation Coefficient			
	impact of OCS on work procedures		computer usage	
	r	n	r	n
Information Dissemination				
prior to training	-.01	(24)	.25	(34)
following training	.34*	(25)	.22	(34)
Training				
assessment of length	.02	(26)	.27*	(37)
ease of application	.49**	(26)	.43**	(35)

* $p < .05$ ** $p < .01$

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9 DISCUSSION

To conclude this report, we will restate some of the findings that could be helpful in the design of future studies in the area technological change. Particular attention will be given to the following five considerations:

1 An examination of indirect effects;
2 Longitudinal research design;
3 Indepth examination of the organizational context prior to, during and following computerization;
4 Holistic approach to productivity measurement;
5 Interdisciplinary approach.

9.1 An Examination of Indirect Effects

The most pronounced changes in all areas of this study appear to have arisen, not as a direct result of the new technology, but instead as a consequence of indirectly related changes in the structure of work processes. After more than a year of system access, the content of both clerical and professional roles had been modified. Officers had taken responsibility for most of their own text entry and editing, leaving more time for support staff to perform administrative duties. Although both types of jobs appeared to have been enlarged through this process, only support staff demonstrated a corresponding increase in work attitudes. This differential result may be attributable to social definitions of the value of certain capabilities and skills. Because our society has traditionally downgraded the importance of secretarial skills, officers may not see text entry and editing responsibilities as making their jobs more satisfying. In addition, it appears that increased typing and editing may actually have had an adverse effect on the health of officers. The posttest data collection indicated that eye strain was increasing among officers while decreasing for support staff. Thus, changes in job content, rather than the introduction of a computer system, appear to have had the strongest influence on attitudinal and health indicators. These examples illustrate the necessity of exploring the indirect effects of the current technological change through a detailed assessment of the implementation context. If one were to consider only the direct effects of computerization by looking at an amalgamation of all computer users, many important distinctions would be obscured.

9.2 Longitudinal Research Design

Partially as a consequence of the indirect nature of the effects of computerization, many results of the current technological revolution may take a long time to surface. The changes in job content, work attitudes and health factors outlined in the previous sections did not appear until the OCS network had been in place for more than a year. The interim data collection, conducted only six months after

installation of the system, demonstrated quite the opposite reaction to these long-term consequences. Throughout the initial implementation period, support staff expressed comparatively negative opinions about the new equipment, the manner of supervision, pay and promotional opportunities. Although everyone experienced time constraints, support staff were in a particularly vulnerable position during the learning phase. Unlike officers, support staff had virtually no control over the functions for which they used the new computer system. Typewriters were removed and replaced by terminals, and support staff tried to maintain their regular workload irrespective of their inexperience and the existence of many bugs and glitches. These increased demands and insecurities coupled with the lack of compensatory pay raises may have been responsible for the relatively negative assessments of supervisory practices, promotional opportunities and pay equity given by support staff after brief exposure to OCS. While changes in job content led to substantial improvements for the support role in the long-term, negative reactions were experienced during the first few months of usage. Thus, the point of this discussion is that an accurate examination of technological change requires a longitudinal research design. The short and long-term consequences of computerization may differ substantially, and the combination of these two phases, or the selection of one time-period for study as opposed to another, would provide only a partial or misleading understanding of the total picture.

9.3 Indepth Examination of the Organizational Context Prior to, During and Following Computerization

It is impossible to collect all necessary contextual information through an exclusive reliance on questionnaires. In many cases, the interpretation of quantitative findings requires indepth knowledge of the organizational setting. The research team for this study utilized a vast array of data collection techniques to assure a comprehensive understanding of the structural and implementation factors that could influence the consequences of introducing the OCS network.

The need for such background information is illustrated by the prominence of promotional opportunities in the examination of user acceptance. For the population under study, those respondents who perceived themselves as having good opportunities for advancement were substantially more likely to give a favourable assessment of the new computer system. Promotion is a prominent concern for federal government employees because of high mobility within the existing organizational structure. In other smaller establishments, where career ladders are minimal or non-existent, assessments of promotional opportunities would probably have little influence on user acceptance. Therefore, it is important to understand internal reward structures prior to computerization because the success or failure of the new system may depend upon the provision of incentives.

A second illustration of the need for comprehensive contextual information arises in the area of changes in job content. A lengthy

period of time is often required for the modification of official job descriptions; therefore, such records should not be taken as an accurate depiction of the content of particular positions during times of change. Even though reclassifications and salary reassessments did not occur as a consequence of introducing OCS, other observations demonstrated substantial changes in the content of both officer and support positions. Thus, research in this area requires an examination of both formal and informal aspects of the organizational context for change.

9.4. Holistic Approach to Productivity Measurement

Productivity is one area in which the conceptualization for this study differs substantially from traditional perspectives. To date, productivity has been approached primarily from an activity orientation, that is, measuring such aspects as how many pages can be typed per hour. In comparison, the particle orientation adopted for this study permits a holistic view of the productive process by tracking particular entities from conception to completion. As a result of this conceptualization, we have examined not only the periods when people were actually working on a document, but also the time consumed because the document was waiting for someone's attention.

Through the use of a particle framework, we have found that the most substantial time savings have arisen not as a direct result of increased mechanical capabilities, but instead through the development of more autonomous work processes. The output time for first drafts was cut in half after the introduction of OCS because officers could input and edit their own text. Prior to the installation of the local area network, long documents were typed by a centralized word processing facility, and delays arose not only waiting for initial inputting but also sending the document for subsequent modifications. If measurement is confined to specific activities, many areas for time savings can be overlooked. However, we must again reiterate the important distinction between direct and indirect effects. Changes in the lapsed time required for production may be more closely tied to the organization of work processes than to the introduction of new technologies.

As a final note, we should also mention the importance of examining not only output but also product quality. Throughout this project, we have explored the quality issue from the perspective of various members of the user population and the results show some substantial differences. While managers felt OCS had improved the quality of documents because it eased revisions, officers and support staff sometimes felt that the increased management requests for changes that arose from this situation did little to enhance the content of the final document. Thus, the whole quality issue may be perceived quite differently by particular segments of the organization.

9.5 Interdisciplinary Approach

The topics surrounding technological change cut across many disciplinary boundaries. A comprehensive understanding of the consequences of computerization can only be obtained by examining the interrelationships among a variety of variables such as user well-being, organizational structure and environmental conditions. In exploring the health related effects of the OCS installation, this report illustrates that headaches, eye strain, neck and shoulder pain, and stress are all more closely associated with environmental factors than with either the duration of system usage or other related job design features.

9.6 Conclusion

In conclusion, the study of technological change is a complex process that requires multidisciplinary research and a comprehensive understanding of the implementing organization. It is important to examine such areas as work processes, environmental conditions, work attitudes and the physical and psychological well-being of the work force, and all this must be accomplished within the context of the evolving organizational structures. Only by adopting such a methodology is it possible to understand the interrelationships among important factors and consequently the total impact of computerization on individuals and on the organization as a whole. The study of one component of technological change, to the exclusion of all others, not only provides an incomplete picture, but also precludes the identification of multiple stressors that may have qualitatively different repercussions than any one item taken alone.

Many of the effects of technological change are indirect rather than direct and therefore take a relatively long time to develop. Likewise, respondents' opinions and usage of a computer system may differ substantially between the initial implementation phase and a more lengthy period of access. The versatility of this new technology creates a rather unique situation in that change must now be viewed as an evolution with no real end to the expansion of applications. Therefore, to truly understand the impact of this technological revolution one must conduct research in such a way that it allows for a continual updating of results. In addition, changing conditions dictate the need for a longitudinal design that permits the examination of both short and long range effects.