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BASELINE IMPACT ASSESSMENT - OFFICE ENVIRONMENT

OFFICE COMMUNICATIONS SYSTEM IMPACT ASSESSMENT

FOR

DEPARTMENT OF COMMUNICATIONS FIELD TRIAL

BIBLIOTHÈQUE
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by

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DOC OCS FIELD TRIAL IMPACT ASSESSMENT

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SUMMARY OF BASELINE DATA FINDINGS OF ENVIRONMENTAL SURVEY COMPONENT DOC OCS FIELD TRIAL IMPACT ASSESSMENT

1.0 SUMMARY- OVERVIEW TO OFFICE ENVIRONMENT COMPONENT.

The DOC OCS Impact Assessment is an interdepartmental effort which has provided a unique opportunity to test and evaluate the interrelationships and impact of various environmental factors on the total stress and job satisfaction of workers in an office environment and at the workstation level before and after the transition to an office communications system. The objectives of the environmental survey component of the DOC OCS Field Trial Impact Assessment are:

To assess the impact of the introduction of office communications systems on the physical environment and on changes people perceive.

To assess environmental/ergonomic design issues and the extent to which they influence user acceptance of the technology.

To evaluate issues related to furniture design, space planning, lighting, heating, acoustics and wire management and to integrate these considerations into the installation of the OCS equipment.

The environmental survey component of the DOC OCS Impact Assessment is a joint effort by Architectural Diagnostics and the Architectural and Building Sciences Directorate, Public Works Canada (ABS,PWC). Architectural Diagnostics is responsible for the user assessment surveys and has the role of special adviser to Department of Communications OCS Field Trial team. ABS, PWC is conducting on-site measurements of environmental attributes. It has also provided an experimental workstation, the FUNDI, which it has developed and is testing.

The acronym FUNDI refers to a FUNctional and DIagnositc unit which is a monitoring tool to assist in the determination of the environmental and ergonomic needs of the new electronic office. The FUNDI, designed to be placed in an open office, is used as a mobile and flexible work enclosure with integrated desks, partitions and storage. It is serviced with environmental support systems, specifically, radiant heat panels, a fan, a task light and an indirect background light. These are regulated by thermostats which the user adjusts. The FUNDI is on castors to encourage and facilitate adaptations to the layout so work groups can easily rearrange their space to meet specific job

requirements. Information is being collected on how FUNDI users relate to their work environment and on the modifications they choose to make over time. The DOC installation of the FUNDI is also a field trial as it is the first test outside PWC.

Environmental assessment work began in August 1983, with two major baseline surveys conducted in November-December 1983 and February-April 1984. The intent of these two environmental surveys was to establish baseline levels of environmental satisfaction prior to the introduction of OCS office communications equipment. A second baseline survey was necessary due to unanticipated major layout changes which were independent of the Field Trial. This paper summarizes general findings of the environmental assessment of conditions prior to Summer 1984, including site preparation and initial installation of the OCS, but before the OCS was in use.

The environmental impact assessments of both this OCS Field Trial, as well as of the FUNDI Field Trial, have been developmental processes in which formative evaluation is used to refocus and redirect critical aspects of the Field Trial. Wherever possible, remedial action has been recommended and implemented rather than to allow for deterioration of, or continuation of, problematic environmental conditions in the workplace which were identified in the course of the environmental assessments. To an extent these remedial actions taken in the course of the project will not allow us to assess some of our environmental hypotheses fully, but the tradeoff is to produce optimum conditions for the implementation of the Field Trial rather than to provide experimental conditions for the Impact Assessment per se. In terms of the FUNDI field trial, the data gathered and the lessons learned have been valuable in refining the FUNDI as both an environmental control and monitoring mechanism and as a work enclosure.

Section 2 of this report summarizes site-specific findings for key environmental issues that have been identified in this study, and translates these into more general environmental and facility related implications for OCS. At this stage in the assessment process, these implications are stated as preliminary recommendations which will be refined and expanded in the final report due March 1985. Both **Site-specific Findings** and **Implications for OCS** are higlighted in **bold** print and followed by more detailed discussion of findings and implications. Section 3 provides the background for the formulation of the environmental assessments, and Section 4 outlines the methodology used. Profiles of overall satisfaction/dissatisfaction with aspects of the office environment prior to the introduction of the OCS equipment are presented and discussed in the final section, Section 5.

Site-specific discussions are focused on the findings within 5NP, since that is the primary PWC test area for the environmental assessment, and the only area in which both

occupant assessments of environmental attributes and measurements of environmental attributes were conducted. This discussion includes preliminary comparisons of occupant responses with findings from on-site measurements taken by ABS, PWC.

It is critical to note that the methods of data collection by ABS, PWC have been designed to observe shifts in the performance of environmental attributes (e.g., acoustics, illumination) after physical changes are made over time. The two physical changes are: 1. alterations to the floor plan; 2. addition of OCS electronic office equipment. As the final data collection is scheduled for November/December 1984, the data presented here is only a slice of the total picture. The reader is requested to bear in mind that the data will be compared to the soon-to-be collected final field data and that the absolute value of these measurements is less significant than the observed shifts in performance.

Environmental deficiences perceived by occupants are, for the most part, typical of problems currently encountered in many office buildings. There are variations in the nature and intensity of perceptions of environmental deficiences between branches, some of which are related to differences in layout, orientation and servicing, and others of which may be more closely related to job satisfaction, managment and other factors. Wherever possible, corrective action has been taken on these deficiences to avoid their exacerbation by the introduction of office communications systems.

2.0 ENVIRONMENTAL FINDINGS, AND PRELIMINARY IMPLICATIONS FOR OCS.

2.1 Temperature and Ventilation

SITE SPECIFIC FINDING: Within DGBP accommodation, there were common building deficiences which produced inadequacies of temperature and especially ventilation. These deficiencies have been exacerbated by adaptations to layouts over time.

IMPLICATION FOR OCS: Opportunity should be taken at the time of installation of concentrations of microelectronic equipment or of any major change, particularly in open office areas, to ensure proper mechanical fit-up. This fit-up should include checking loads on HVAC zones, connecting thermostats to spaces with similar use patterns and requirements, ensuring the proper functioning of controls, and instructing users as to how to get the best performance from heating and ventilation systems.

The initial occupant rating of ventilation and temperature within the DGBP offices was similar to ratings of environmental problems in other Government office buildings. Before renovations to the DGBP office space, ventilation and temperature were rated as bad or very bad by a significant proportions of DGBP staff. These ventilation and temperature problems were confirmed through the correlation of instrument measurements undertaken by ABS, PWC and assessment of individuals' rating of thermal quality and ventilation. These ventilation and thermal comfort problems were initially brought to the attention of DGBP management in November 1984, when renovations to the DGBP space to accommodate additional staff were in the planning stage. Recommendations based on preliminary observations the environmental assessment team were made to try to improve thermal comfort and ventilation as a beneficial side-effect of the renovations which were necessary to accommodate additional staff.

These recommendations were implemented and there was a significant improvement both in terms of occupant ratings in environmental assessment surveys conducted prior to renovations in November 1983 and after renovations in February 1984 and in terms of the instrument measures taken by PWC before and after. Less than one-fifth of all DGBP staff reported bad or very bad ventilation after renovation compared to three-fifths before. Whereas prior to renovations, DGBP staff rated ventilation as a more significant problem than either DGTP or DGIS, after renovations, DGBP staff saw ventilation as a less significant problem than either of the other two groups. The improvement in thermal comfort was also significant, dropping from

ss than one-half to one-quarter of all DGBP staff rating temperature bad or very bad. These findings are discussed in detail in Section 5.3.

In addition, more information is needed on the appropriate amount of control to give users over their local environment. Capital and energy savings may be reaped by supplying office environments which are well suited to the individual. Increasing local thermal comfort and the ability to accommodate individual differences in dress, physiology and activity level may contribute to increased worker productivity and job satisfaction. Satisfaction with the office environment, and control over jobs and environment, also seem to affect satisfaction with the office technology.

With respect to the specific implications for installation of micro-electronic equipment into offices, even slight increases in output of localized heat sources may affect people's perception of both thermal comfort and ventilation quality. The space housing the central processing unit must be able to cope with the load of the equipment without overheating or overcooling the adjacent areas in which people must work. The mechanical system may be able to cope with the extra heat form the CPU by delivering cooler air. However, depending on the number and location of thermostats and reheat boxes of the air supply, other areas serviced by the same duct may then be too cold for the occupants.

5.2 Lighting

SITE SPECIFIC FINDING: Prior to the installation of OCS, lighting was the least problematic attribute of the office environment within DGBP.

IMPLICATION FOR OCS: The overhead lighting system should be reviewed and maintained as part of every major change to layout, although it is often neglected. This is especially true when VDTs are introduced. Carefully attention must be given to the quality of illumination in order to avoid adversely affecting comfort and performance of VDT operators.

In the initial survey, lighting was the least problematic attribute of the office environment within DGBP, as assessed by the occupants although the PWC measurements indicated poor quality of lighting in several areas. Less than one-fifth of all staff rated it as bad or very bad in the initial baseline survey and after renovations to the DGBP offices and the introduction of the FUNDIs, no respondents rated lighting as bad or very bad. Although the standard lighting system throughout the offices is an overhead fluorescent system, many staff, particularly those in enclosed offices already had desk lamps. Now all FUNDI occupants have two task lights which they can control and adjust. In addition, the renovations increased daylight penetration into, and views out of, most of the open office areas and made daylight and views accessible to a much higher proportion of staff. Detailed findings on lighting before and after renovations is provided in Section 5.4.

e lighting design of the FUNDI was tailored to VDT usage. In dition, recommendations were made to delamp the overhead system to match the new layout and the different lighting conditions due to renovation. Unfortunately, the system was quickly relamped by a janitor who had not been properly informed and the system has not been altered since. This problem of maintaining changes is a very real and difficult one, particularly in leased facilities.

Careful attention was given to the quality of illumination for work on VDTs, as poor illumination can create problems resulting in eye fatigue.

> "The use of VDTs in workplaces in which the lighting is designed for traditional desk-top tasks is likely to adversely affect the comfort and performance of VDT operators... Problems caused by inappropriate lighting can be classified into three general categories: (1) those caused by direct glare, (2) those caused by successive viewing of different luminances (transient adaptation), and (3) those caused by reflected glare and veiling reflections."

2.3 Acoustics

SITE SPECIFIC FINDINGS: Voice privacy and noise distractions were major concerns to respondents to the DOC environmental impact sessment survey. These acoustic issues have similarly been major ncerns to occupants of other office evaluation studies. They are lso rated by occupants as the single most important environmental contribution to job performance.

IMPLICATION FOR OCS: Acoustic considerations offer an important challenge in the introduction of microelectronic equipment into the office. Acoustic implications must be addressed at all stages in the planning, designing and implementation of new technologies.

Detailed findings on voice privacy and noise distractions are provided in Section 5.5. There were important acoustic issues within the DGBP layout both before and after renovations.

The OCS equipment will contribute to the ambient noise of the office, both by noise from the system, such as background hum from individual CPU, an on/off noise of keyclicks and noise from printers, and by changes in layout to accommodate equipment which may alter voice privacy and noise distractions. The actual effect of the added noise will vary from area to area. Generally, if there is sufficient background noise in an area, additional noise from the OCS equipment may mean that people speak louder. This secondary effect of people speaking louder would be more noticable than the root cause of noise from the equipment.

The printers add significantly to the sound level and also are a tential source of vibration which can travel through the building ructure. Part of the distraction of the printers is because noise from the printers cannot always be anticipated by most people around

it is an variable-schedule imposing noise. It is best to reduce the impact of this noise source from people. There is a trade-off between convenient location of the printers and adequate acoustic separation from people.

Although the printers in the open office areas have been provided with acoustic hoods, they may prove inconvenient to use all of the time. As much of the work is short print times of final, single feed sheets, the operator may find it faster and more efficient to leave the hood open.

2.4 Electrical

SITE SPECIFIC FINDING: Wiring and cabling for the OCS were difficult to install into the limited capacity of the existing panels, vertical shafts and in-floor conduits within the Journal Tower North.

IMPLICATIONS FOR OCS: There must be an integrated plan for wire management prior to the installation of microelectronic equipment. Electrical systems and connections should be designed to be adaptable and easy to access. Users should be informed as to how to maintain system performance.

There was little extra space on the electrical panels on the 19th floor of the Journal Tower to accommodate the additional load generated by the OCS installation. The 19th floor will accommodate the largest proportion of OCS equipment, with more than half of the 70 workstations plus the majority of printers, file servers and the central processing unit. In addition to the lack of space on the existing panels, there was little additional space in the vertical shafts to accommodate the additional wiring feeding throughout the building.

Initially it was thought that the local area network (LAN) could be fed through the floor ducts and be brought up with the electrical and telephone connections. This was not possible and therefore the LAN was fed through the suspended ceiling. This meant introducing PAC poles in open office areas just to feed the LAN to the workstation. In addition, there is some concern about the proximity of the LAN to the wiring of the overhead fluorescent lighting system which might be a potential source of disturbance.

Isolated, dedicated, grounded outlets were installed in the open area of DGBP to ensure clean power and smooth operation of the OCS equipment. Despite this action, there have been several problems with the equipment such as wavey screens and screens wiping out. By analysing the electrical current delivered through these outlets, it was found that other office equipment sent impulses thorugh the lines. In general, no equipment which draws an irregular current (e.g., kettles, heaters, coffee makers, printers and in particular typewriters) should be plugged into the same outlet as a VDT. Users need to be informed of this in order to maintain system performance.

e electrical outlets, especially when isolated, dedicated outlets e necessary, for the micro-electronic equipment become one additional constraint in layout flexibility of office space. There is normally only one outlet per workstation into which the equipment may be plugged and the lenght of the cord limits how far away the equipment and main worksurface can be located.

2.5 Safety

SITE SPECIFIC FINDING: Safety hazards were compounded as floor pedestals, cords and cables for the OCS equipment were installed within DOC.

IMPLICATION FOR OCS: Wire management and user education programs must be planned in advance of the introduction of new microelectronic systems into the office environment in order to minimize safety hazards.

The floor mounted power pedestals and various electrical and telephone cords currently in use in offices represent potential safety hazards. These hazards were compounded as the OCS equipment was installed within DGBP and elsewhere in DOC. The OCS equipment introduces new cables for power and data. Data cables often come in standardized, ltiple lengths which usually do not fit exactly to a workspace. As esult, most locations have surplus data cable coiled somewhere which eventually gets in the way. Some locations have used power bars to connect their micro-electronic equipment with power outlets. All these additions increase potentials for safety hazards.

2.6 Layout & Spatial Implications

SITE SPECIFIC FINDINGS: There are differential applications of space allocation guidelines in use within DOC. There has been a merging of individual space and group support space, which became difficult to separate in planning for change and estimating space needs for the OCS equipment. The amount of space that would be needed for the OCS equipment was underestimated, necessitating adaptations to layout within DGBP as the Field Trial progressed.

Space planning and planning for appropriate modifications to layout were complicated by the difficulties inherent in a field trial in which systems are being developed rather than being bought off the shelf. In the drive to deliver an operating OCS system within a tight timeframe, discussions on the size, configuration and certain features of equipment were overshadowed or tradeoffs made, creating subsequent problems with layout and space.

IMPLICATIONS FOR OCS: The amount of space for OCS equipment needs to estimated based on detailed analysis. The impact of OCS on the y an organization functions, and the layout implications associated with the change to OCS need to be anticipated and planned. Adequate

ace and appropriate location of equipment must be carefully tegrated into a functional layout. Requirements and principles of space allocation and layout need to be documented and understood, so that as natural and successive changes to layout occur, these needs and principles can continue to be met. These requirements and principles also need to be clearly communicated to the entire implementation team, including system designers and suppliers.

As of November 1983, the DGBP layout was primarily enclosed offices, most of which were located along the perimeter of the building, and DGBP space was 30% in excess of what the PWC Guidelines recommend for the number and type of staffing in DGBP. This was probably typical of much of the DOC accommodation. This overaccommodation was due to the large offices, most of which were 150 sq. ft., dictated by the five foot ceiling module, and which were occupied by individual officers for whom the guideline recommended only 81 sq. ft. As DGBP staffing was to expand, a request was made for additional space to accommodate additional staff but this was denied. The staff had to be accommodated within the existing space. Various layout options were considered in detail by management. Based on preliminary observations of the environmental assessment team, management used the renovation opportunity to simultaneously and very successfully reduce DGBP staff dissatisfaction with ventilation and thermal comfort, in order to reduce potential complications for the OCS program. There was concern that the introduction of the OCS equipment might aggrevate these issatisfactions. Detailed findings on accommodation and layout are ovided in Section 5.1.

Plans were made to provide some additional space for the central OCS equipment within the branch, but the space allocated had to be increased several times. Although other studies recommend increases in floor area of up to 25% per individual who receives microelectronic office equipment (ORBIT 1982), this figure is not yet acknowledged within Government space guidelines and no special provision is made to allow for extra space. This figure may be reduced through careful planning and coordinated efforts between the various persons responsible for accommodation and equipment supply. However, in the DOC OCS experience, this planning was complicated by the difficulties inherent in a field trial in which systems are being developed rather than being bought off the shelf. In delivering an operating system within a tight timeframe, discussions on the size, configuration and certain features of equipment are often overshadowed or tradeoffs made unwittingly, creating subsequent problems with layout and space.

The OCS printers are a good example of miscommunications. Many printers are to be slaved to terminals and slaved printer locations within DGBP will be dictated by a 6' maximum length of the connecting data cable. Details of the printers were not known until late in the project, after considerable rearrangements to layouts had already been implemented which anticipated greater flexibility in printer layout. The printer hoods, which were selected for their acoustic shielding ality, are also considerably larger than had been expected. In der to accommodate the slaved printers in DGBP it appears that more floor space may be needed than was anticipated. In addition, one

person may have to be relocated.

The area required for the central computing systems must be carefully determined. The initial estimates for this space requirement in DOC were much too-low. Workspaces were adjusted until the current layout was reached.

It is best to provide sufficient area to allow space between pieces of the computing equipment. A spaceous layout assists the air circulation around the equipment which reduces the possiblity of a spot heat build-up which could result in local hardware failure. As well, a few inches between the pieces will reduce the opportunity for electrical irregularities to "jump" between equipment.

Printer areas receive much traffic of people picking up their documents. Adequate circulation and "stand-around" space should be given for ease of access and for safety. As well, supplies (e.g., different papers, print ribbon, print wheels, carbon paper) and garbage must be accommodated. It is recommended that the structure of a building be reviewed to ensure that it can support this additional dead load of equipment and supplies.

File servers and other signal-enhancing equipment also require space. Although they are usually neatly placed in odd shaped corners, they do impact the workspace and need to be accessible for maintenance.

The FUNDI experiment

SITE-SPECIFIC FINDINGS: The introduction of the FUNDI became intertwined and compounded with staff shifts from enclosed offices to open office areas and was viewed by some staff as a negative consequence of the OCS Field Trial. Some staff did not appreciate the FUNDI project as a field trial process, because they could not see the benefits of participating in such a process.

Staff who had been working in open office space felt that the FUNDI offered a significantly improved workstation. For officers who had previously occupied private, enclosed offices, the layout changes and the FUNDI represented significant tradeoffs.

The experience of introducing of the FUNDI underlined the importance of clearly communicating and working with staff to the introduction of change, and that associated changes must be planned and coordinated by the Field Trial team. This FUNDI experience made the OCS team adopt a more consultative process.

IMPLICATIONS FOR OCS: Staff who are to be subjected to major facility changes, such as being moved out of enclosed offices and into open office areas, are likely to feel "demoted" or to experience anxiety to have difficulty adjusting unless they are involved in the decision to move and clearly understand the underlying rationale. Facility implications of installing OCS or comparable systems must be

planned, coordinated and introduced to users as part of the total change process.

The FUNDI was seen by ABS, PWC, as a process and monitoring tool while to its DGBP occupants, it is their workstation. PWC developed the system to identify local work environment needs and user control issues. Although considerable work had been invested in the monitoring tool functions, the FUNDI had not yet undergone industrial design refinements to enable the most effective workstation design to develop. These were to be based on findings from the DOC field test, and are in fact, in process. Initially, PWC had planned a limited testing of the FUNDI, using only four units in the DOC OCS Field Trial site. Because of staff increases for DGBP and the decision to accommodate a higher proportion of staff in new open office areas, DOC requested 17 FUNDIs, changing the scope and impact of the FUNDI field trial.

For occupants who had previously been located in open space, the FUNDI represented a significant improvement over their previous workstations. It gave them vertical screening, task lighting, and other environmental control features which they had not had before. In addition, changes to the layout gave them access to daylight and views out which had not been available previously, while improving thermal comfort and ventilation. Although these users had many constructive suggestions for improving the FUNDI, they were very positive about both the FUNDI and the layout changes which significantly improved their working environment.

For officers who had previously occupied private, enclosed offices, the layout changes and the FUNDI represented significant tradeoffs. Not all the officers who made this move from office to FUNDI were negative, but the majority had very strong opinions and were extremely vocal about their dissatisfaction. The unit was still in early stages of development by PWC as a workstation per se. These dissatisfied officers focused on real deficiences of the units, which have been valuable in the physical refinement of the unit as a work environment. However, many of their other complaints had to do with the loss of privacy inherent in current open offices. Even though many of them had been quite negative about their assessment of their private office prior to the renovations, they in retrospect viewed the offices as much better places in which to work and could see no advantage to the FUNDI. Certainly, the move underscored their place in the organization as junior officers. Detailed findings on the FUNDI are presented in sections 5.2.1, 5.4, and 5.5.

2.8 Costs and Planning

SITE-SPECIFIC FINDINGS: The ancillary costs of the facility components of OCS installation in DOC, such as electrical fit-up, were neither anticipated nor budgeted.

IMPLICATION FOR OCS: Skilled professional resources, capital costs and lead time must be provided to deal with the ancillary facility

issues of introducing new technology into an existing office environment.

As part of the initial commitment to launch a DOC OCS Field Trial, money was allocated for the delivery of the OCS system and for its evaluation. After DOC was well into the planning process, the OCS team began to realize the extent of ancillary costs of the project and the planning necessary for system installation, especially the facility costs such as electrical fit-up, design and provision of training and other special purpose facilities. These costs include expert person-years and lead time as well as capital costs. Much unanticipated time and energy of the Field Trial team was spent on dealing with the facility components of the system installation. This was very frustrating to them as they had neither anticipated this work, nor did they have the expertise to deal with the many urgent facility issues and decisions with which they were confronted.

2.9 Management of Change

SITE-SPECIFIC FINDING: Changes which occured in DGBP, such as the staffing increase and associated renovations to office areas, were perceived by staff as being associated to the OCS Field Trial. These changes, such as staff turnover or changes to layout, have impacts on the Trial.

APPLICATION FOR OCS: Field Trials, such as the OCS Field Trial, must contend with the constancy of change both within the organization and in the physical environment. Emphasis should be given to the management of the process of change. It is critical to keep users informed and involved as part of the facility change process management.

After the Field Trial was initiated and before the Office Communications System was installed, various changes occured in DGBP which were quite independent of the Field Trial. The Policy sector of the Department, and in particular DGBP, underwent reorganization. One of the results of this reorganization was an increase in DGBP staffing which led to renovations to the office accommodation. These changes in accommodation were viewed by staff as being related to the OCS Trial, since often the Field Trial staff were assisting with facility decisions because they were available and because they wished to prevent conflict with future OCS facility requirements.

The OCS Trial and the FUNDIs often became a focus for staff anxiety and frustrations stemming from the changes to the organization and the daily working environment. The changes in layout which displaced officers from private offices into FUNDIs in the open space have been linked by some staff to OCS. While it is impossible to keep these changes separate, it is possible to integrate users into the change process so that they are involved and informed, minimizing these misconceptions.

When change occurs rapidly in many different aspects of an

organization (facilities, staffing, organization, equipment), much anxiety is generated. Involvement of users keeps them informed of current decisions and their rationale, and allows them to question and contribute to decisions prior to their implementation. The cultivation of staff involvement in the introduction of change is time consuming but it is less time consuming and less enervating than dealing with irate and/or alienated staff after the fact. Staff feel they have an investment in the development and introduction of the changes rather than feeling isolated and powerless.

3.0 BACKGROUND AND ENVIRONMENTAL ASSESSMENT OBJECTIVES.

3.1 The Need for Environmental Assessment studies.

Environmental assessment is one component of the Impact Assessment studies being conducted as part of the Office Communications Systems Field Trial within the Department of Communications. The environmental assessment work is being carried out by Architectural Diagnostics and by the Architectural and Building Sciences Directorate (ABS), Public Works Canada. The rationale for including an environmental assessment component to the overall assessment studies is based on the hypothesis that wide spread installations of office electronic equipment will heighten existing environmental deficiencies that occur particularly in open plan offices. The environmental stresses experienced in modern energy-efficient office buildings have been well documented in the past few years. Building diagnostic investigations have identified issues of occupant well-being in the work place which may reduce job productivity and may have adverse effects on the mental or physical condition of the individual (Mill, 1983). Recently, the introduction of electronic office equipment (e.g., video display terminals, printers, file servers, central processing units) into some offices has heightened existing environmental deficiencies.

Furthermore, several studies, most notably the Steelcase study, have linked environmental satisfaction with office conditions to job satisfaction and productivity. A summary of major finding of the Steelcase National Study of Office Environments: Do They Work?, 1978, conducted by Louis Harris and Associates, are pertinent to this Impact Assessment effort:

> "1. Office Workers give improved working conditions credit for having improved the quality of working life over the past ten years... Improved working conditions, with a better office environment included, get equal billing with better wages and salaries as having contributed to the quality of working life...
> "2. A majority of office workers recognize that their satisfaction with their office surroundings affects their job performance a great deal..
> "3. Office workers are mobile, they have new office needs generated by the spread of electronic and data processing equipment to all areas of the office, and they need help in making sure that the less satisfying tasks of their jobs don't detract from their primary function - helping and serving people...
> "4. Overall, office workers are satisfied with their office surroundings and their own personal workspaces,

but for office workers who share their offices there is distinctly less satisfaction, and for workers in private or 'coventional' offices there is more...
"5. Privacy-related considerations are important to office workers and are, in general, the least satisfactory aspects of office workers' offices today...
"8. One measure that many office workers feel would effectively increase both their satisfaction with their office surroundings and their productivity - giving employees a greater say in office planning...

The links between environmental satisfaction and actual environmental attribute performance within office areas, between environmental satisfaction and job satisfaction, between environmental satisfaction and productivity, and the impact of new microcomputer office technology on these are central to the environmental impact assessment component of the OCS Field Trial within DOC.

Over the past three years, PWC has experienced an increase in the incidents or reportings of problems in offices relating to the environment. Les Terracces de la Chaudiere was one of the first major cases in 1980. Recommendations on corrective measures based on an understanding of the consequences of conflicts in the total performance of a specific building are the only way to effectively deal with these complex problems. However, very little data on total building performance has been collected. One way to collect this much needed data is by establishing research to priorize which conditions, and which controls are necessary at the workstation in order to alleviate the environmental stressors experienced in modern, energy-efficient office buildings. Approval in principle to proceed with this concept was granted to Public Works Canada from Treasury Board (TB submission no. 780357) in February 1982. The second part of the proposal was "to undertake further evaluations of the interrelationships and impact of various environmental factors on the total stress of employees accommodated in Les Terrasses, at an estimated cost of $100 000". From that amount, $60 000 was approved for the construction of a workstation which would aid in the testing of office environments from the workstation level, but this testing was delayed.

The interdepartmental effort organized by the Department of Communications (DOC) has provided the opportunity to test and evaluate the interrelationships and impact of various environmental factors on the total stress of workers in an office environment and at the workstation level. In particular, these interrelationships can be studied for cases where the worker uses electronic office equipment. As one part of the PWC participation in the environmental assessments of the DOC OCS Field Trial, an experimental workstation, the FUNDI, has been introduced and is being assessed.

There have been pertinent examples of existing deficiencies in

fice environments being exacerbated by introduction of VDT ipment (Stewart, 1980). There are currently no official and few consistent informal guidelines as to how to introduce VDTs into existing buildings. More information is needed on the actual impact of VDTs on environmental conditions and occupant response to these. There are several studies which indicate that satisfaction with the office environment is an important predictor of satisfaction with the office technology (Bickson and Gutek, 1983; The Productivity Center, 1983).

Studies also highlight the requirement to satisfy human needs for comfort and adaptation to fluctuations of indoor climate within office buildings (Dubin, F., 1981). This requirement has added dimensions when electronic equipment is introduced into offices:

> "VDTs have often been designed and introduced into workplaces with little attention to well-established priciples of, and existing data about, good design and practice...conducive to 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." (p. 26-27, Committee on Vision, National Research Council, 1983.)

These issues of environmental fit and individual control also assume greater significance in automated offices:

> "As the knowledge workers become the most important users of office automation, it is likely that they will want more control over their jobs and their environments which can provide a respite from their immersion into technology" (Rubin, NBS, 1983).

The environmental assessment component of the OCS Impact Assessment is aimed at assessing the impact of changes related to the installation of OCS equipment on the physical environment and on how people working in these offices perceive these changes. This will be done by surveying occupant attitudes and comparing these to measurements of components of environmental attributes of the interior environment within DOC offices in the Journal Tower North, before and after installation of the OCS equipment. The basis for the assessment is comparisons of user assessments of the environmental before and after with comparisons of measurements of specific attributes of the built environment. A further comparison will be with the environmental satisfaction of control groups in other locations.

3.2 The FUNDI experiment.

A secondary aspect of the environmental assessment is also to

rovide feedback on an experimental work enclosure for electronic ffices, known as the FUNDI, an acronym for FUNctional DIagnostic unit, which ABS is developing and monitoring. This unit was developed to facilitate local adjustments for fluctuations in environmental conditions in open office areas by providing users with local controls over lighting, heat and air circulation, as illustrated in Figure 3-1. These units were installed for staff working in open office areas of DGBP in January 1984 and will be used for the duration of the field trial.

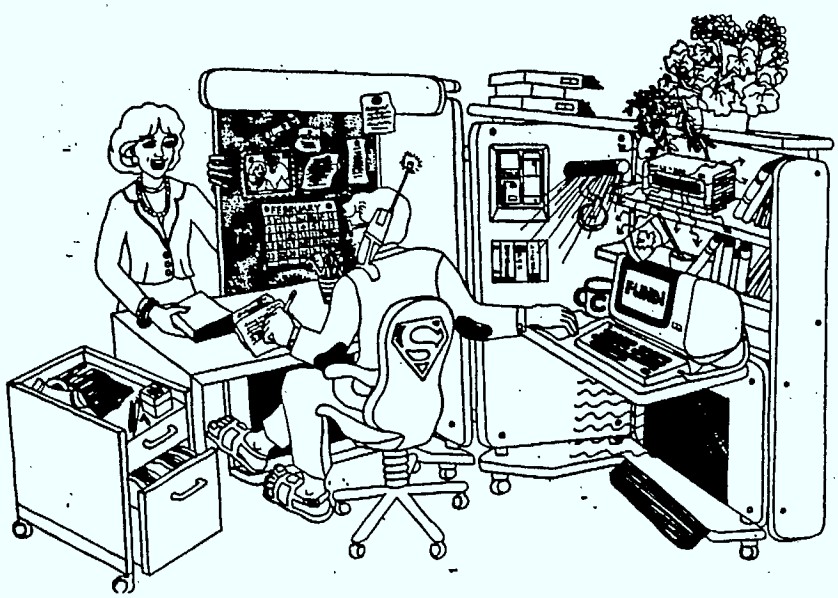


Figure 3-1. The FUNDI, a FUNctional DIagnostic work enclosure.

The FUNDI is a monitoring tool to assist in the determination of the environmental and ergonomic needs of the new electronic office. It is serviced with environmental support systems (e.g., radiant heat panels, fan, task lighting) which the user controls, thus allowing the individual to modify his/her work environment to achieve the greatest comfort, while keeping within the boundary set by the project. Built-in monitoring instruments (e.g., thermocouples, electrical current pickups) will provide objective data on the use of these FUNDI systems.

The FUNDI was designed to be used in an open office. It contains functional work surfaces, areas for work-related activities and storage. Another feature of the FUNDI is flexibility. As the unit rolls on castors, work groups can easily rearrange their space to meet specific job requirements.

The combination of monitoring tool and functional work surfaces in the FUNDI will enable ABS/PWC to collect information on how people in the new electronic office setting relate to their work vironment and on the modifications they choose to make over me. As such, the FUNDI is a vehicle through which building quality thresholds can be determined with the occupant as the

sessor.

The FUNDI addresses the interrelationships and impact of various environmental factors on the total stress of an employee at an individual workplace. Standards and guidelines exist for employee exposure to sources of environmental stress, such as thermal or acoustic. These standards are based on acute exposure, are set at the macro building scale and use broad-measurement techniques. The FUNDI is a vehicle to develop micro-environment level techniques to address the environment experienced by individuals at the workplace, as well as to address individual occupant preferences. It is the critical link to fine-tuning building system integration to meet occupant requirements.

The equipment for individual local environmental conditioning provided in the FUNDI may increase an individual's satisfaction with his/her workspace. The attribute of user control may be more significant during the period of change and adjustment inherent in the introduction of electronic office equipment. Quantitative environmental data provided by the FUNDI and objective feedback from individuals will assist in evaluating these hypotheses.

3 Environmental Assessment Hypotheses.

3.3.1. Satisfaction with the physical office environment affects job satisfaction and job performance.

3.3.2. Wide spread installation of VDT's will heighten the existing environmental deficiencies in the open plan office.

3.3.3. Office workers who have some degree of say in office planning and/or control over local environmental conditions will have increased environmental satisfaction and increased job satisfaction.

3.4 Environmental Assessment Objectives.

3.4.1. To assess the impact of the introduction of office communications systems on the physical environment and on changes people perceive.

3.4.1.1. To establish a profile of the environmental satisfaction of office workers within the designated sample group at DOC before and after the installation of the OCS sytem.

3.4.1.2. To establish a profile of the actual performance of specific attributes of the physical office environment within DGBP before and after installation of the OCS system, and compare performance of specific attributes to existing standards.

3.4.2. To assess environmental/ergonomic design issues and the extent to which they influence user acceptance of the technology.

3.4.2.1. To compare baseline user attitudes within DGBP with measured attributes of the environment in DGBP, and to identify areas for remedial action in DGBP prior to installation of the OCS system.

3.4.2.2. To explore potential links between environmental satisfaction and performance with job satisfaction and performance within the designated sample group.

3.4.3. To evaluate issues related to furniture design, space planning, lighting, heating, acoustics and wire management and to integrate these considerations into the installation of the OCS equipment.

3.4.3.1. To identify and document potential and actual environmental problems experienced by OCS users and to explore health implications.

3.4.3.2. To recommend remedial environmental actions which will facilitate, or lead to improvements in the quality of environment for, work on OCS equipment.

4.0 ENVIRONMENTAL ASSESSMENT METHODOLOGY.

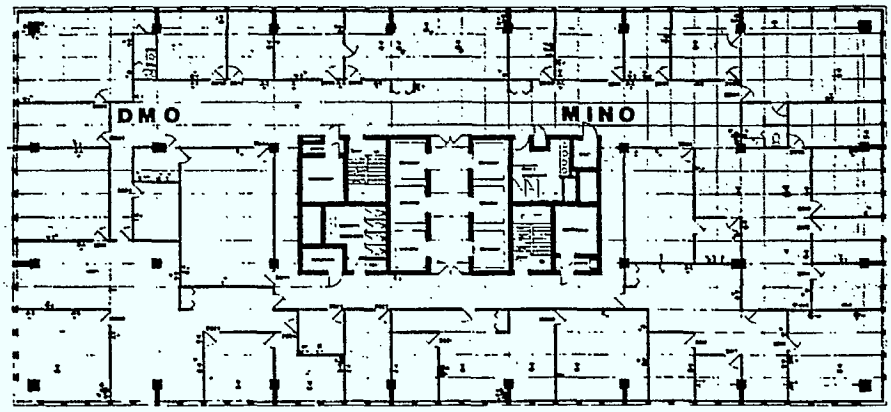
4.1 The environmental assessment sample.

The total impact assessment sample of the DOC Field Trial was initially estimated to be 140, of which 70 people were to receive electronic office equipment. The impact assessment sample consists of four groups in different locations: DGBP and DGIS on the 19th floor, DGTN on the 18th floor and the DMO and the MINO on the 20th floor of the Journal Tower North. These groups and their locations are indicated in Figure 4-1. DGTN appeared most similar to DGBP in terms of accommodation as of November 1983. DGIS appeared more similar to DGBP in terms of work patterns as well as in terms of accommodation after renovations in December 1983. All of these groups are included in the sample for user assessments of the office environment before and after installation of the OCS system.

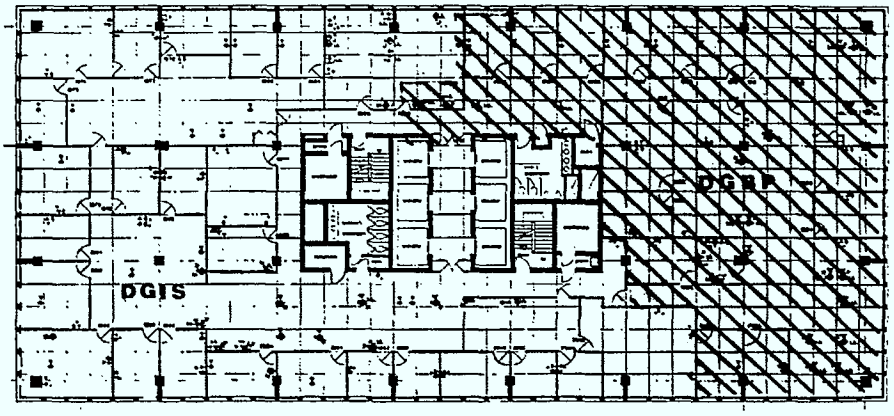
Since the largest concentration of OCS users, 32 people, were to be in DGBP, environmental assessment tests of nine attributes being conducted by ABS, PWC, are focused exclusively on that area. These tests are time consumming and require expertise and equipment which made it impossible to have tests in other areas. The actual number of test locations within DGBP varied for each specific test, although all locations are drawn from a representative sample of the type of workspaces in DGBP. The factors used to identify ABS, PWC sample locations are:

1. Interior versus perimeter;
2. Open plan versus closed office;
3. Serviced by mechanical system 1 (interior - constant volume) versus system 2 (perimeter - variable volume);
4. Workspace was to be maintained versus to be altered during the renovation;
5. Orientation of north, east or south.

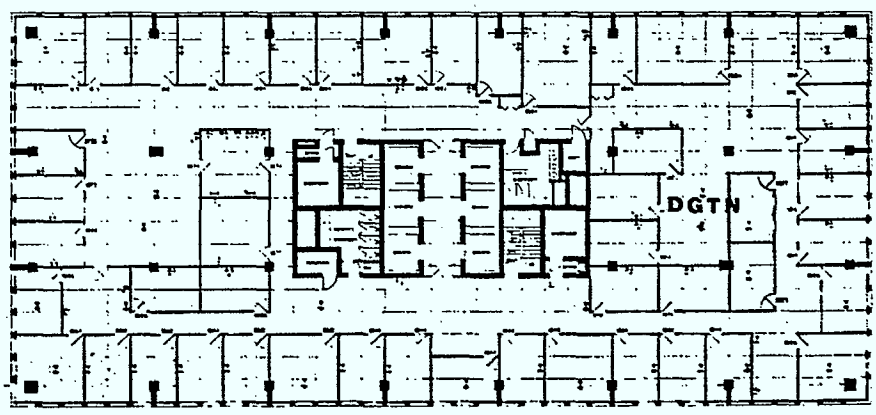
All persons occupying these PWC test locations were scheduled to receive OCS equipment and are part of the environmental assessment sample. A PWC test location could satisfy more than one of the above factors. Seven locations were selected and numbered in order of priority. The technicians who did the field tests were instructed to test at the first four locations and then at as many of the remaining as feasible. The data sets for the four priority locations are reasonably complete.



20TH FLOOR. DMO AND MINO, 26 respondents scattered in shaded areas, representing approximately 70% of total population on in that area at time of survey.



19TH FLOOR. DGIS, 30 respondents or 97% response to baseline environmental surveys within shaded area; DGBP, 100% response to baseline environmental surveys & attribute tests within hatched area.



18TH FLOOR. DGTN, 39 respondents, or 95% response to baseline environmental surveys within shaded areas.

Figure 4-1. Location of Sample Groups.

e locations of the PWC sample within DGBP, indicated on Figure 2, are as follows and satisfy the factors noted:

Location	Factors
1	perimeter; closed office to become an open plan; serviced by mechanical system 2; at the end of the run of mechanical system 2; south-east corner.
2	interior; closed office to remain as such; serviced by mechanical system 1.
3	perimeter; closed office to remain as such; serviced by mechanical system 2; at the middle of the run of mechanical system 2 and before a right-angle turn in the ducts; north elevation.
4	interior; open plan to remain as such but alterations around the workspace will affect it; serviced by mechanical system 1.
5	perimeter; closed office to remain as such; serviced by mechanical system 2; east elevation.
6	interior; open plan to remain as such but alterations around the workspace will affect it; serviced by mechanical system 1.
7	perimeter; closed office to become an open area; serviced by mechanical system 2; at the right-angle turn in the ducts; north-east corner.

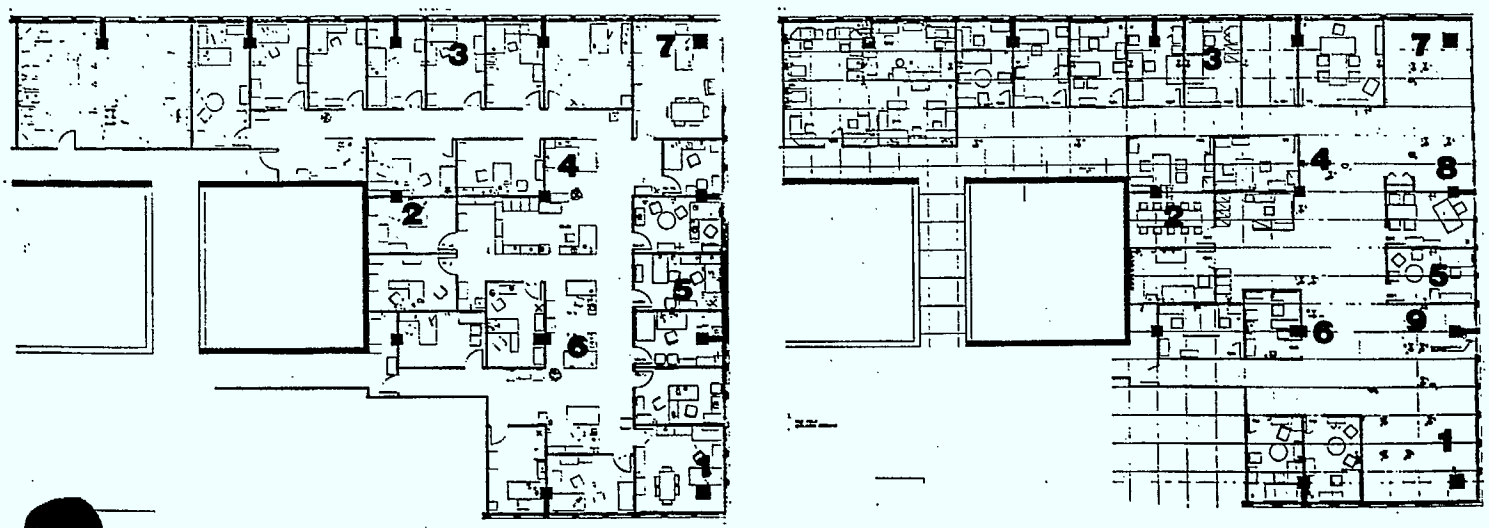


Figure 4-2. Location of ABS, PWC test sample, 11/83 and 2/84

additional 28 people in scattered locations outside were chosen to receive other OCS equipment. Approximately 70 other people in DGIS and DGTN were selected as a control group who will not receive equipment.

There were a total of 123 respondents within the sample of 133 for the November 1983 environmental questionnaire. The distribution of these respondents was as follows:

	Environmental Questionnaire, November 1983			
BRANCH	Number Distributed	Number Completed	Response Rate	% of Total Sample
MINO, DMO	32	26	81%	21%
DGTN	41	39	95%	32%
DGIS	31	30	97%	24%
DGBP	29	28	96%	23%
TOTAL	133	123	92%	100%

There was a 100% response rate to the second phase of environmental questionnaires and interviews conducted within DGBP only in February 1984. The number and location of all respondents to the baseline environmental questionnaires are indicated on the plans in Figure 4-1. Occupant responses from these surveys have been summarized and compared for the total sample, wwith special comments focusing upon the differences between DGBP, DGIS and DGTN. MINO, DMO has not been included in the comparative comments since this group actually represents several distinct organizational units spread across the 20th floor.

4.2 The environmental assessment methods.

A 5-page self-administered questionnaire was distributed to the full environmental assessment sample in November 1983. The questionnaire asks respondents to rate various aspects of their work environment, the layout and the building as well as to report actions taken to change or modity conditions. Questionnaires I.D. numbers were assigned to staff so that it will be possible to track their responses to changes over time in this before and after study. It took most respondents about 10 minutes to complete.

Environmental checklists and observations were also completed for each workstation on a precoded checklist which included clothing, type of work space, relationship to window, individual modifications and so forth. This checklist data, also coded into statistical format, will help to verify questionnaire data as well as provide specific environmental descriptions to correlate to other data.

describe and record the objective attributes of workspaces in DGBP greater detail as background for attribute testing and analysis, ABS/PWC designed a nine page workspace checklist which involves observations, photographs, detailed floor plans with furniture layout and reflected ceiling plan. This checklist was completed for each workspace in DGBP in August/83 and again in August/84. This tool allows a comparison of the specific features contained in each workspace such as floor area or number of pieces of furniture. A copy is included in Appendix A. Within the DGBP sample, lists of changes to workstation furnishings and locations have been updated at regular intervals to provide specific insight about changes over time.

In February 1984, a second baseline survey, consisting of questionnaires, interviews and environmental attribute testing, was conducted within DGBP only to reassess environmental satisfaction and conditions following modifications to the DGBP space. This reassessment of the new baseline satisfaction was required to separate the impact of the changes to DGBP layout from the impact of the electronic equipment later in the field trial.

These changes to layout were made to accommodate increases in DGBP staff which were independent of the Field Trial. In planning for these renovations, managment was sensitive to some of the concerns raised in the initial environmental survey. They tried to use the renovations as an opportunity to improve office accommodation for all rkers, and specifically to open up areas along the exterior walls to y to improve air circulation and thermal comfort for all occupants, especially those in open office areas. Additional FUNDIs were requested to accommodate the increased number of staff located in open office areas. Because of the nature of the changes, and due to management concern for accurately assessing staff response, staff in FUNDIs were interviewed and all other DGBP staff were surveyed by questionnaire in February.

Copies of both the November and February questionnaires, the February interview guide and the environmental checklists are included in Appendix A.

Architectural and Building Sciences, PWC, conducted baseline testing of environmental attributes within DGBP in November-December 1983, and in February-April, 1984. Key tests, as listed below and detailed in Appendix B., 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). Test procedures published as Standards were used with exceptions and/or innovations where necessary to measure the local environment, at the occupants' scale.

The building quality attributes which were tested and the specific

edictions on the anticipated changes are:

ATTRIBUTE: **TESTS:**

1. Acoustics and Aural Quality

Noise Criterion (NC) values for unoccupied ambient sound.
NC values for occupied ambient sound, with printers on and off.
Transmission loss through partitions.
Articulation indice for open and closed offices.
Reverberation time for open and closed offices.

2. Thermal quality

Dry bulb temperature.
Wet bulb temperature.
Globe temperature.
Operative temperature.
Air speed and direction.
Temperature of supply air.
Electonic wire tap on FUNDI radiant heat panels to monitor use of the system.

3. Illumination and Visual Quality

Horizontal illumination with body shadow (Eh).
Contrast of the task (C).
Contrast reduction at task (R).
Task luminance (LT).
Task background luminance (LB).
Luminance readings on the surrounding environment.
Electronic wire tap on FUNDI lights to monitor use of the system.

The following measurements were taken but have not yet been used in the analysis:
Equivalent sphere illumination (ESI).
Contrast rendition factor (CRF).
Lighting effectiveness factor (LEF).

4. Air: circulation

Floor plan and HVAC system drawing analysis.
Helium filled balloons.

Air: composition

Passive air sample badges (formaldehyde, organic

vapours).
MIRAN, CO_2 counter.
Bionaire negative ion meter.

6. Energy consumption

Line disturbance analyser (three channels).
Line monitors, load side of local conditioning controls in FUNDI.

In addition to the attribute testing of the office environment within DOC, ABS is also conducting various tests on the FUNDI work enclosure. The FUNDI is being field tested at DGBP, DOC, and laboratory tested at Quality Engineering Testing Establishment, Hull and National Research Council, Ottawa. As well, expert comments have been solicited as appropriate.

The field testing involves recording the use of the local conditioning systems provided with the FUNDI, including the mobility feature. The latter is done by mapping changes to the spatial layout of the open areas in DGBP. The former involves electronically tapping the load side of the rheostats and continously recording the voltage levels. As electronic wire taps are expensive and inconvenient, information on the use of the conditioning systems is also solicited through the questionnaires and interviews.

Valuable information on the use of FUNDI features is also gained through regular maintenance checks. Areas which get more use or seem less durable are noted. Users have suggested additional options and improvements. The laboratory performance testing was done in the Spring 1984, concurrent with the field tests. Controlled lab tests were done for acoustics, surface finish, thermal pattern and temperature control, air circulation, moveability and performance of the electrical system. A summary of the findings of each test is included in Appendix C.

The FUNDI concept and the unit currently in use at DOC were assessed at a one-day session attended by a panel of eight disciplinary experts. The purpose was to assess the objectives of the FUNDI project and to advise PWC if the stated objectives should be pursued through the FUNDI. The participants unanimously voted that the objectives of the FUNDI are sound and explored improvements to the FUNDI. The FUNDI appears to be in accordance with a paradigm shift in the provision of contemporary office environments.

4.3 The environmental assessment schedule.

The strategy of the time-series field data capture is to characterize the environment local to the office worker, at specific workspaces, and to look for changes in that performance as various modifications to the office environment are made. The major modifications are the redesign of DGBP layout in January 1984 and the introduction of the

S-related equipment in Summer 1984. Three major test periods for environmental assessment have been planned, as indicated in Figure 4-3.

The environmental assessments began in August 1983. There have been two phases of baseline environmental assessment prior to installation of OCS equipment. As the initial step in the environmental assessment, baseline data was collected using a self-administered questionnaire distributed in November 1983 to all staff selected as the sample group. Environmental checklists and observations were also completed. Environmental attribute testing of acoustics, thermal quality, illumination and visual quality, air circulation and air quality were conducted within DGBP.

FIGURE 4-3. TESTING SCHEDULE FOR ENVIRONMENTAL ASSESSMENT.

In February 1984, a second baseline survey, consisting of questionnaires, interviews and environmental attribute testing, was initiated within DGBP only to reassess environmental satisfaction and conditions following modifications to the DGBP space. Initial equipment was then installed at 10 locations within DGBP in February 1984 and the final OCS equipment installation was phased in from July 1984.

The final environmental assessment survey is targeted to being in November 1984. Analysis and documentation of environmental assessment findings will be complete by March 1985.

5.0 ENVIRONMENTAL ASSESSMENTS.

5.1 Accommodation and Layout.

In November 1983 when the first baseline assessment was initiated, the distribution of type of office spaces varied considerably from directorate to directorate. The proportion of total staff within each of three categories of office space are shown below:

DISTRIBUTION OF TYPE OF OFFICE SPACE BY BRANCH

BRANCH	Open Office	Shared Enclosed Office	Private Enclosed Office
DGTN	13%	8%	79%
DGIS	30%	30%	40%
DGBP, 11/83	21%	-	79%
DGBP, 2/84	45%	-	55%

Although DGBP had the same proportion of private enclosed offices as DGTN in November 1983, the changes made to layout in order to accommodate increases in staff reduced that proportion of private enclosed offices in DGBP to 55% in February 1984. In November 1983, there were 29 DGBP staff, of whom, 23 (79% of all staff) were in private offices. In February 1984, after renovations to the space, staff had increased to 33 while the proportion of people in private offices dropped to 55%. However, even the reduced proportion of staff in private enclosed offices is still considerably higher than the 39% in DGIS. On the other hand, in February, DGBP had higher proportions of staff in open office areas than either of the other two branches.

All of the DGBP staff who had been in open office areas prior to the renovations remained in open offices after renovations. In addition there were 9 staff members, 7 of whom were officers, who had been in private offices in November and who were in the open office areas in February. All DGBP staff in open office areas were accommodated in FUNDIs.

PROPORTION OF STAFF BY LOCATION OF OFFICE

BRANCH	Perimeter Open office	Interior Open office	Perimeter Enclosed Office	Interior Enclosed Office
DGTN	5%	7%	65%	16%
DGIS	-	33%	48%	18%
DGBP,11/83	-	24%	55%	21%
DGBP,2/84	29%	18%	39%	14%

There are even greater differences between types of layout when differentiation is made between open and enclosed offices in the perimeter versus the interior zones. A higher proportion of DGBP staff(68%) was in perimeter areas after renovations, reducing the proportion of DGBP staff which was in interior areas from 45% before to 32% after renovations. In contrast, only 48% of DGIS staff were in perimeter areas. Since perimeter areas have different heating and ventilation systems, as well as different illumination conditions, than interior areas, these distributions are important for later comparisons.

There are also discrepancies in the distribution of space between and within branches. The majority of private enclosed offices are approximately 150 sq. ft. although these offices are occupied primarily by officers entitled to 81 sq. ft. and some directors or senior officers entitled to 125 sq. ft. In DGBP accommodation as of November 1983 it was estimated that the people in private enclosed offices (i.e., DG, Directors and Officers) were occupying 30% more space than standard space guidelines recommend. This is probably typical of much of the DOC accommodation within the Journal Towers. This space can be redistributed onlyl by having officers share offices or by manor renovation of existing partitions. There are significant differences in the accommodation and layout of the three primary sample groups, as summarized below.

5.1.1. DGBP Accommodation and Layout.

DGBP staff is located on the 19th floor, adjacent to DGIS. In November 1983, a large majority of staff (79%) were accommodated in private enclosed offices, with all but one secretary located in wide corridor areas. Sixteen of the twenty-two private enclosed offices were located on the perimeter of the building and therefore had windows. The remaining six offices were on the interior, with no access to windows to the outside or daylight. These offices were also on interior heating, ventilating and air conditioning zones which are provided with a constant supply of air. The perimeter offices were provided with variable volume air supplies and the thermostats controlling the perimeter zones were located outside DGBP space.

As of January 1984, substantial changes had been made to the layout. Open office areas had been created in the northeast and southeast corners of DGBP space and even the expanded interior office area had

ne access to daylight and views through these two new open areas. e number of private enclosed offices was reduced from 22 to 15 with offices being removed from the perimeter. In addition, two enclosed interior rooms have shifted from use as offices to use as the OCS equipment room and a conference room. The layout plan for DGBP as of November 1983 and the modifications as of February 1984 are indicated in Figure 5-1.

5.1.2. DGIS Accommodation and Layout.

The DGIS staff surveyed occupied about one third of the 19th floor. The layout plan was significantly different from that of DGTN in that there was a lower proportion of private enclosed offices (39%) and essentially equal proportions of staff in either shared enclosed offices (31%) or open office areas (29%). The open office areas were largely screened cubicles containing one or two people each. As of November 1983, there were several pieces of office electronic equipment located in the open office areas of DGIS. The plan for DGIS, as of 11.83, is shown in Figure 5-2.

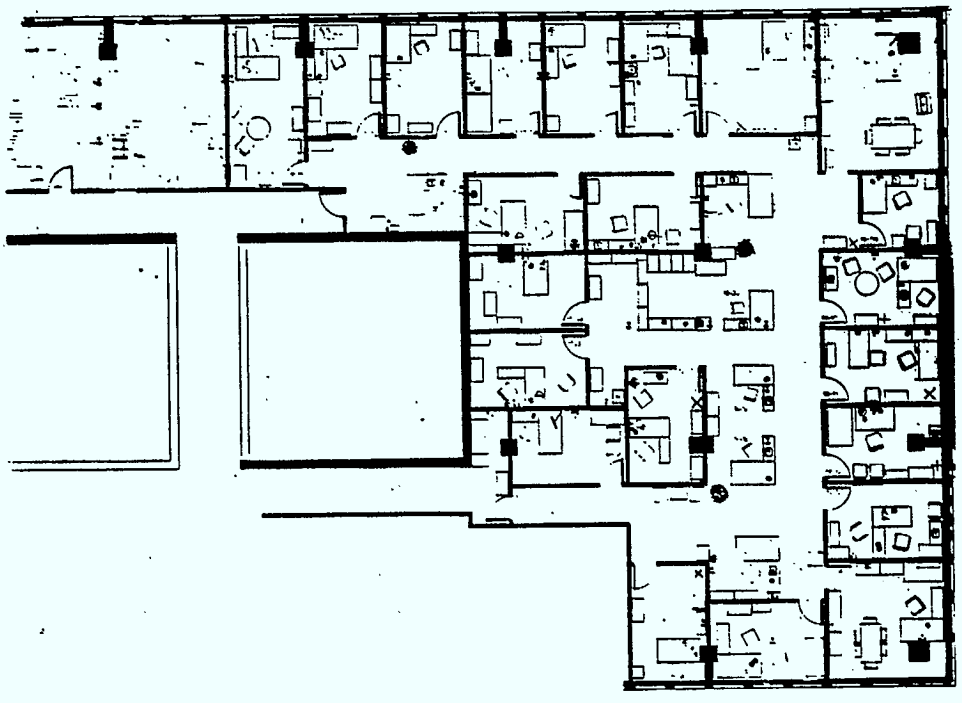
5.1.3. DGTN Accommodation and Layout.

The DGTN staff surveyed occupy much of the 18th floor, including the same portions occupied on the 19th floor by DGBP and DGIS. The layout an is essentially cellular, with individual offices provided for the jority (79%) of the staff. The only exceptions are the word processing pool, an enclosed office shared by three WP operators, and the secretaries who sit in open space along the corridors. The plan for DGTN as of 11.83 is shown in Figure 5-3.

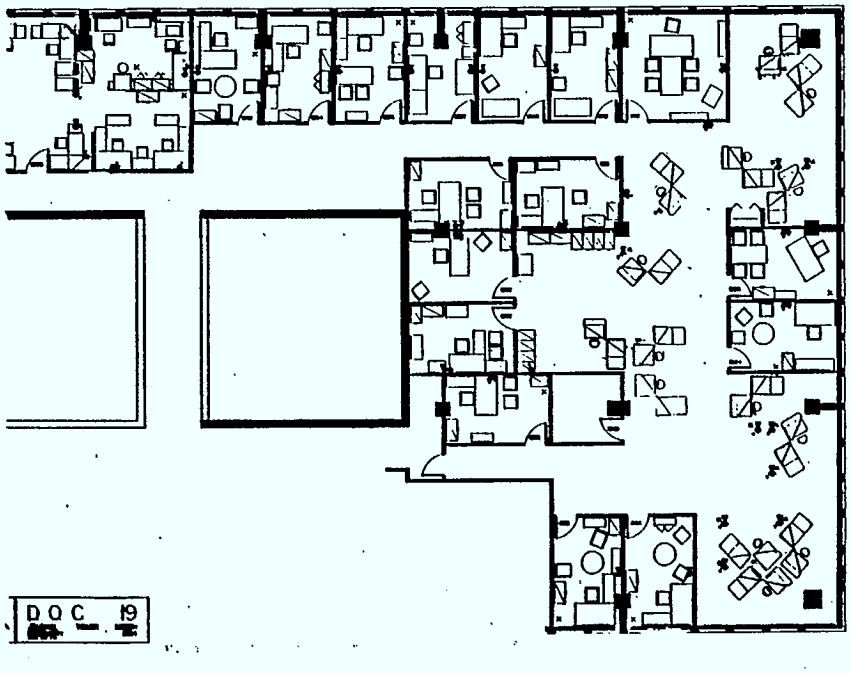
5.2 Attitudes towards Office Environment.

The questionnaire surveyed attitudes to specific environmental attributes (such as temperature, ventilation, amount of space, voice and visual privacy) around individual desk locations, attributes of branch space, and general attitudes to the building, other offices, and the work environment. The respondents were generally positive in their assessment of the building and their offices. In this section, general findings are presented and comparisons between responses highlighted. Specific responses for DGBP, DGIS and DGTN are explored. The final three sections of this chapter compare occupant ratings of environmental qualities within DGBP with general assessments based on the ABS, PWC test measurements of thermal comfort, ventilation, lighting and visual quality, and acoustics.

Slightly over half of all respondents feel that the Journal Towers is about the same as other office buildings while one third feel that it better than other office buildings as a place to work. These are line with the findings in a similar survey (BDI/ABS,PWC, 1983) in nother Government office building, in which slightly less of the respondents felt the building to be about the same as other office



PLAN OF DGBP OFFICES PRIOR TO RENOVATIONS



PLAN OF DGBP OFFICES AFTER RENOVATIONS, FEBRUARY 1984

gure 5-1. Layout plans for DGBP.

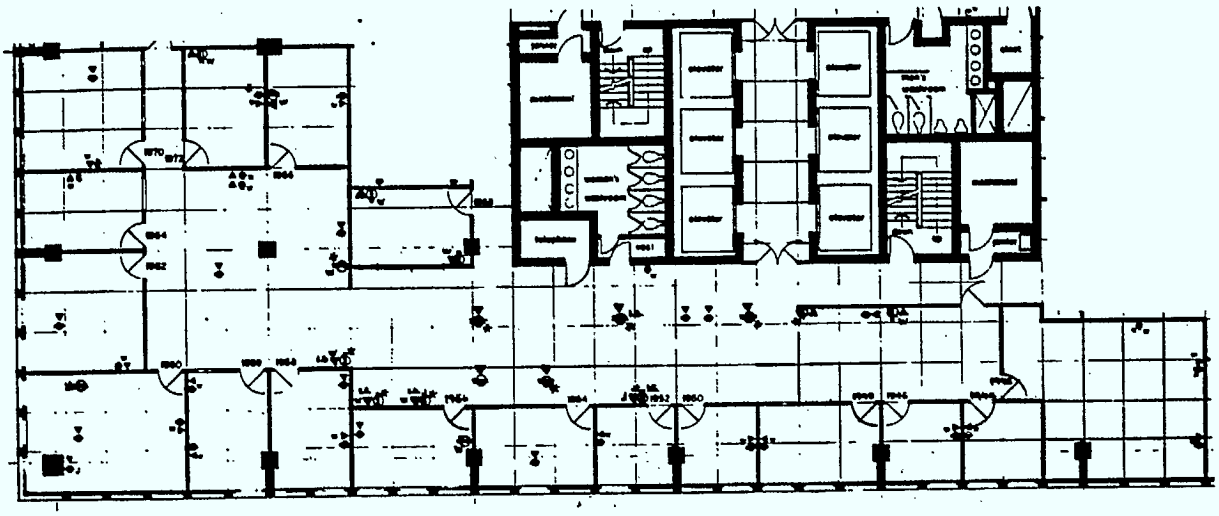


Figure 5-2. Plan of DGIS, 19th floor.

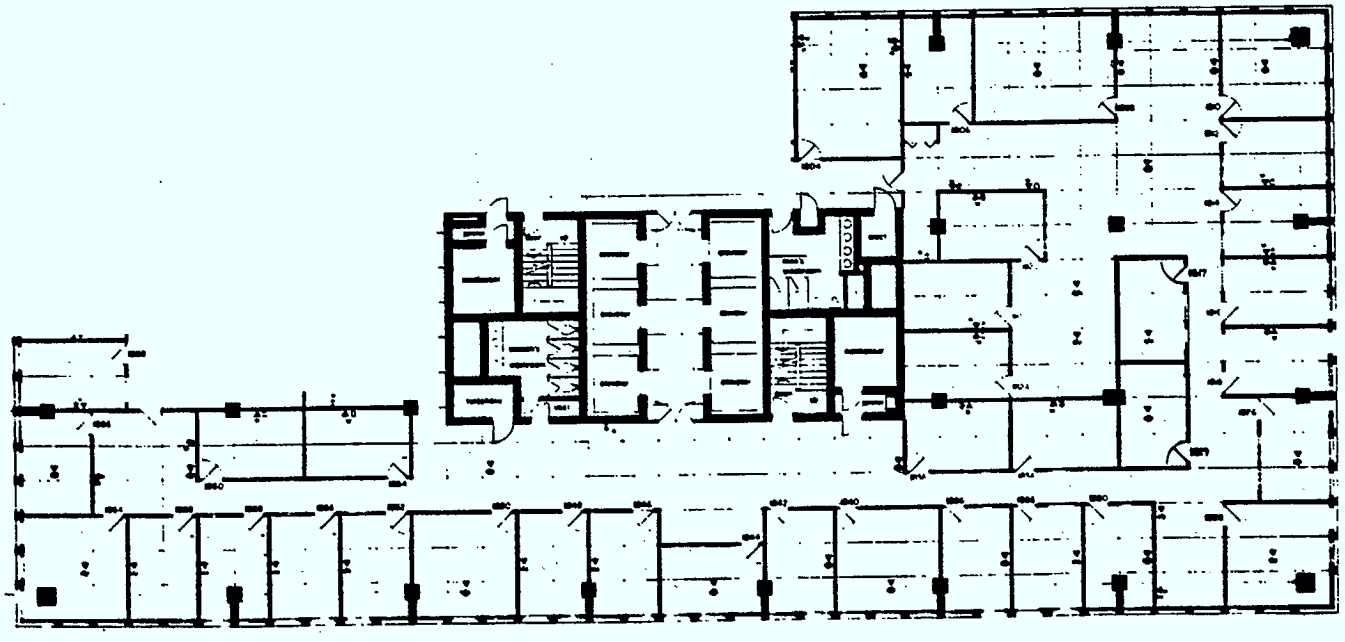


Figure 5-3. Plan of DGTN, 18th floor.

ildings while slightly more felt that their building was better. wer respondents were negative about the Journal Towers as an office building than in the Government office building surveyed by BDI/ABS, PWC. This may be due to the high proportions of vast open office areas and the larger populations per floor in the other building.

RATING OF BUILDING AS PLACE TO WORK COMPARED TO OTHER OFFICE BUILDINGS, 11.83

Rating	BDI/PWC Survey	DOC Survey Overall	DGBP	DGIS	DGTN
Better	37%	33%	36%	10%	56%
About the same	40%	55%	43%	76%	45%
Worse	25%	12%	21%	14%	-

Half of the respondents (50%) feel that their branch's space is about the same as other work group office spaces in the building, although almost one third (29%) feel that their branch's space is worse than other spaces in the building. While overall, 40% rated their individual workspace as an adequate place to work and 41% rated their workspace as good or very good place to work, there are considerable variations in response from branch to branch.

RATING OF INDIVIDUAL WORKSPACE AS A PLACE TO WORK, 11.83

Rating	BDI/PWC Survey	DOC Survey Overall	DGBP	DGIS	DGTN
Poor	26%	19%	18%	27%	5%
Adequate	34%	40%	43%	43%	33%
Good	40%	41%	39%	30%	62%

About one third of all respondents felt that the physical characteristics of their work space had no effect on their ability to do their work, while slightly more than one third felt the physical characteristics had a positive effect. In the Steelcase study on office environments, there was a similar pattern, with 74% positive responses versus about 26% dissatisfaction. The overall DOC responses are also similar to those from the BDI/PWC survey in another Government office building in which there was a much higher proportion of open offices and significantly higher populations per floor and per office area. A similar proportion of respondents felt that the physical characteristics of their work space had no effect on their ability to do their work. Within DOC, the differences in responses from branch to branch is most notable on this particular question.

EFFECT OF WORK SPACE PHYSICAL CHARACTERISTICS ON ABILITY TO DO WORK

Rating	BDI/PWC Survey	DOC Survey Overall	DGBP	DGIS	DGTN
Positive effect	34%	39%	48%	17%	67%
No effect	39%	34%	26%	31%	29%
Negative effect	27%	27%	26%	52%	5%

In the context of this overall assessment of adequate office accommodation, we find environmental qualities that are ranked above average, such as lighting, and others ranked very much lower. Staff generally felt ventilation was more of a problem than temperature or lighting, although there were localized exceptions to this. This response is typical of response patterns from surveys of other government office buildings, although it is interesting to note the variations between branches in the relative ranking of problems, as well as the impact of the renovations in DGBP on the relative ranking of problems.

RANKING OF ENVIRONMENTAL ATTRIBUTES AS PROBLEMATIC

Attribute	BDI/PWC Survey	DOC Overall	DGBP, 11.83	DGBP, 2.84	DGIS	DGTN
Voice privacy	1	1	4	1	1	4
Noise distractions	2	6	7	4	2	7
Visual privacy	3	4	5	6	5	5
Ventilation	4	2	1	5	3	1
Temperature	5	5	2	2	7	4
Electric lighting	6	7	7	7	6	6
Daylighting	7	3	3	3	4	2

These findings correspond generally to patterns of dissatisfaction with aspects of the office environment identified in other studies, most notably the Steelcase studies, which also highlight the importance of voice privacy, noise distractions, ventilation and temperature:

> "Knowing that if you produce more in a day, you'll be paid better is considered by more office workers (48%) to contribute a great deal to improvements in productivity... but a high 45% feel that more comfortable heat, air conditioning and ventilaltion would contribute a great deal to productivity and another 26% feel it would contribute somewhat.
> "Fully 71% of office workers feel that improvements in the temperature and circulation of the air in their offices would contribute to helping them produce more work in a day than they do now; 67% feel the same way about pay incentives." (p. iii, Steelcase, 1980)
> "...a great deal of attention has to be paid to the issue of limiting noise and other distractions in the

office. Not only is it considered the single most important aspect of the office in terms of contributing to job performance, but it is also one of the few functional aspects office workers now feel aren't adequate.". (p. 53, Steelcase, 1978)

It is particularly important to investigate aspects of ventilation, thermal comfort and lighting in this OCS assessment study. In a study of VDT workstations, the most frequently occuring environmental problem was thermal, followed by glare and reflections from windows and luminaires (Stewart, 1980). In another study of VDT workplaces, screen reflections occured on 42% of VDTs surveyed (Coe et al., 1980). Not only are these problems important to identify for effective VDT integration into the office environment, but they also represent problems existing in many current office environments:

"These studies... indicate that lighting and reflections do cause problems for VDT workers; however, these problems may not be unique to VDT use, but may be present in general office work." (p. 125-126, Committee on Vision, National Research Council, 1983).

As indicated in the above table, there are significant differences in responses from the three primary groups studied, DGBP, DGTN and DGIS which can be explained only in part by the apparent differences between accommodation and layout. The environmental survey findings for each of these branches is briefly summarized to provide a more complete assessment of the interaction of factors for each branch.

5.2.1. DGBP Attitudes towards the Office Environment.

Some very important findings emerged from the November survey within DGBP which provided a critical perspective for assessing the February survey. In November 1983, DGBP staff were quite negative about their office environment, even though a majority of staff were in private, enclosed offices, and this negativism was pervasive throughout all dimensions of the findings. In the February 1984 survey, there were significant shifts in environmental satisfaction with respect to temperature and ventilation, although there was severe dissatisfaction among those officers who had been displaced from private offices into an open office areas with FUNDIs.

In the November 1983 survey, DGBP staff were also quite negative about attributes of the Branch space. Only about 10% rated any of the following attributes of Branch space as being good or very good:

59% of DGBP staff rated the convenience of work group layout as poor or very poor;
37% rated the location of related work groups as poor or very poor;
36% rated location of meeting rooms as poor or very poor;
26% rated the availability of meeting rooms as poor or very poor.

After the renovations to and reorganization of DGBP offices, staff was considerably less negative about the convenience of work group layout than they had been last November. However, staff remain quite negative about many aspects of their environment. Many staff in enclosed offices have smaller offices than they had previously, although the proportion of staff rating their individual workspaces as poor to very poor places to work remained about the same as before the move. Several staff in enclosed offices rated their new offices as improvements over what they had last November.

In addition to a negative attitude towards the office environment prior to renovations, it would appear that the entire DGBP staff had been further sensitized by the concerns of those staff who felt adversely affected by being moved out of private enclosed offices to open office space, and in particularly, to working in a FUNDI. There were a number of problems perceived by these displaced employees. Some of the staff who were displaced from private enclosed offices into FUNDIs in the open office areas felt extremely negative about the open office areas and about the FUNDIs. However, not all staff who had previously been working in an enclosed office felt that the new layout and FUNDI workstations are unacceptable. There were several who accepted the new conditions and saw certain advantages to the changes. Staff who had already been working in open space felt that the changes to layout generally and more specifically, working in a FUNDI greatly improved their working conditions.

November, the general negativism of DGBP staff was reflected in their raing of the Journal Towers as an office building in which to work. DGBP staff were considerably more negative about the Journal Towers than DGIS or DGTN staff. 21% of DGBP staff rated the Journal Towers as worse than other office buildings. 36% of the DGBP staff felt that their branch's space was worse than other branches' spaces in the Journal Tower North. Although 39% rated rated their individual workspaces as good to very good places to work, 21% rated their individual workspaces as poor to very poor places to work. Although 25% of DGBP staff felt that their individual work space was better or much better than other individual work spaces in the building, 21% felt that their individual workspaces were worse or much worse. Finally, although 48% of all DGBP staff felt that the physical characteristics of their individual workspaces had a positive or very positive effect on their ability to do their work, 26% of the staff gave a negative to very negative rating. The majority of people giving this negative rating were accommodated in private enclosed offices.

5.2.2. DGIS Attitudes towards the Office Environment.

DGIS staff are dissatisfied with several specific aspects of their office environment. This dissatisfaction does not influence their rating of the Journal Towers. A majority of staff rank the Journal Towers as about the same as (76% of responses) or better than other office buildings (10% of responses). A majority of staff also rate

their individual workspaces as adequate (43% of responses) or good to very good (30% of responses). Furthermore a majority of staff also rank their individual workspaces as about the same as (60% of responses), or better than (13% of reponses) other individual workspaces in the Journal Towers North.

However there were several aspects on which DGIS staff were considerably more negative than either DGTN or DGBP staff. A majority of staff (62%) rank DGIS space as being worse or much worse than other branches' office space within the Journal Towers North. More importantly, a majority (52% of responses) feel that the physical characteristics of their workspace have a negative effect on their ability to do their work. There appear to be several factors which contribute to these negative opinions. Staff are very dissatisfied with the convenience of the work group layout within the branch. A majority (62% of reponses) rate it as poor to very poor.

Amount of space for various purposes also appears to be a significant contributor to staff's overall dissatisfaction. Personal storage was rated inadequate by 57% of the repondents. Amount of filing space was rated as inadequate by 53%. Amount of work storage space was rated inadequate by 50% and amount of space within total individual workspace was rated inadequate by 43%.

2.3. DGTN Attitudes towards the Office Environment.

Overall, DGTN staff are extremely satisfied wiwth their office environment. They are very positive about the Journal Towers as a place to work. A majority of DGTN employees (57%) feel that the Journal Towers is a better place to work than most office buildings, while the remaining employees (43%) feel it is about the same as other buildings. DGTN staff are even more positive about their individual workspaces as a place to work. Half the staff (50%) feel that their individual workspaces are better than other individual workspaces within the Journal Towers North, while most of the other staff (47%) feel their individual workspaces to be about the same as other individual workspaces in the building. A large proportion of employees (42%) feel that the DGTN branch space is better than other Branches' spaces, while 55% feel it is about the same. More importantly, a large majority of the staff (68%) feel that the physical characteristics of their workspace have either a positive or very positive effect on their ability to do their work, while most of the rest (27%) feel that the physical characteristics of their workspace have no effect on their ability to do their work.

In rating specific attributes of the Branch space, staff rated highly both the convenience of work group layout (50% rated good to very good, 37% rated adequate) and location of related work groups (49% rated good to very good, 43% rated adequate). Although staff gave positive ratings to location of meeting rooms (46% rated good to very good, 46% rated adequate), they were less satisfied with the availability of meeting rooms (24% rated poor, 37% rated adequate and

% rated good to very good).

Most staff were also satisfied with the amount of space, with only marginal dissatisfaction: 90% thought the total workspace was sufficient to spacious; 90% thought the personal storage was sufficient to very spacious; 87% thought files were sufficient or spacious.

5.3 Temperature and Ventilation.

In November 1983, DGBP staff felt ventilation was more of a problem than temperature or lighting. In February 1984, DGBP staff rated ventilation as considerably improved, and were considerably less negative about ventilation than either of the other two branches. Although more DGTN staff ranked ventilation as a problem than any other environmental attribute, only one quarter thought ranked it as bad or very bad, as compared to DGIS, where ventilation was the third ranking problem with almost two fifths of respondents rating it as bad or very bad. After the renovations in DGBP, ventilation dropped from the highest ranked problem to fifth.

In November 26% of DGBP staff rated ventilation as very bad versus none in February, 33% rated it as bad versus only 19% in February, and % rated ventilation as good in both surveys. Almost 60% of DGBP aff rated air as still and stale in November and only 25% of the staff felt that the air circulation was good with only 14% rated air as fresh. In February, 46% of all DGBP staff rated air movement as good circulation, only 28% thought the air was still although 50% still reported some degree of air staleness. Thus the objective of improving air circulation while changing layout to accommodate additional staff appears to have been achieved.

VENTILATION RATINGS

	DGBP 11/83	DGBP 2/84	DGIS	DGTN
Bad or very bad	59%	19%	39%	25%
Acceptable	26%	66%	40%	50%
Good or very good	15%	15%	21%	25%

These patterns of response on ventilation, along with the dramatic improvement in DGBP after renovations, suggest that there may be some problems with the HVAC system installation which may be due to either improper fit-up or adaptation, a lack of maintenance, or inappropriate layout which inhibits systems effectiveness.

Temperature ratings in DGBP showed a similar marked improvement tween November 1983 and February 1984 after renovations, although h in absolute and relative terms, temperature was perceived as a eater problem by DGBP staff than the staff in the other two branches. In November 1983, 46% of DGBP staff felt that temperature

s bad to very bad. In February 1984, only 25% of all DGBP staff it that temperature was bad to very bad. As well in November, there were relatively few staff in DGBP who gave good to very good ratings for temperature (25%). In February, the proportion of DGBP staff who rated temperature as acceptable increased from 29% to 57% while 18% rated it as good. Thus the changes to layout appear to have also improved thermal conditions for some staff, although DGBP staff are considerably less satisfied with temperature than staff in either of the other branches.

TEMPERATURE RATINGS

	DGBP 11/83	DGBP 2/84	DGIS	DGTN
Bad or very bad	46%	25%	17%	13%
Acceptable	39%	57%	52%	37%
Good or very good	15%	18%	31%	50%

There was good correlation between the instrument measurements and individuals' rating of the thermal qualities of the space. The instrument measurements were taken at four locations, which also gave four varying conditions. Location 1 was an enclosed office at the end run of a perimeter mechanical system. This office was removed during renovations and an open office area was created in this location. cation 2 was an internal enclosed office, on an interior mechanical he, which was not changed during renovations. Location 3 was an enclosed office fed from the mid-run off a perimeter mechanical system. This office also was not affected by renovations. Location 4 was an open office location with no screens, fed off an interior mechanical system.

The two data sets were collected at different seasons (December 1983-winter and April 1984-spring) and under different operation of the building conditioning systems. As such, the value of the measurements are less significant than the general pattern of temperature and air movement.

In both data sets, all but one measurement at location I (room 1934), meet the requirements for individual parameters as set by ASHRAE for: operative temperature, humidity, air movement, temperature cycling, temperature drifting/ramping, vertical temperature difference, radiant asymmetry and floor temperature.

In December 1983, the air at location 1 was moving faster than the standard recommends. ASHRAE sets the maximum air movement in winter to be 0.15 m/s. Three of the four heights measured at this location were above this maximum and the average air speed can be taken as 0.2 m/s. The operative temperature was measured at 21.9°C. This temperature combined with the high air speed could cause the occupant to feel cool, depending on his/her clothing and activity level at the me. In fact, the occupant complained of cool temperatures. The astest air speed (0.27 m/s) was recorded at 1100mm from the floor, which is approximately the head height of a seated person.

December 1983 measurements indicate slightly higher air movement and slightly greater fluctuation in the range of air speeds (over height and from morning to afternoon) at the perimeter than at the interior locations. This is not surprising as the perimeter is a variable volume supply and the interior is a constant volume supply. However, in April 1984 the air speeds to both zones fluctuated the same amount as had previously fluctuated in the perimeter only. Higher ratings of satisfaction were reported in February 1984 than in November 1983. Clarifying discussions with Campeau, the building manager, are needed to determine how the building conditioning systems were set.

Faster moving air, at lower temperatures at foot level might contribute to lower rating of thermal comfort in perimeter offices. Warmer air with less movement might contribute to perceptions of staleness or still air in interior zones or generally a poor rating of temperature (46% rated temperature as bad to very bad). 60% of the staff rated air as still or stale. This may be further explained by findings on air quality.

In April 1984, the operative temperature at sample 1 was slightly above the ASHRAE limit for typical winter clothing but below the upper limit for typical summer clothing. As the measurements were taken in spring and the occupant was wearing "medium" weight clothes, the conditions should be within a comfortable range.

measurements of temperature recorded, as expected, an increase in temperature with height. In December 1983, the interior zones were slightly warmer than the perimeter (by approximately 1°C) and the average of all the temperatures across DGBP, fluctuated 4.5% over the day. In April 1984, the perimeter and interior were closer in temperature and the overall temperature fluctuation for DGBP over the day was reduced to 3.5%. Once again, these slight shifts could be related to the season and the settings of the building conditioning systems.

Almost all of the temperature readings fall into the currently accepted "comfort zone" (conditions near 22°C). Recent studies suggest that offices are presently greatly overheated and that temperatures near 15-18°C would be more appropriate for clear thinking, good health and energy saving. There are also indications that lowering temperatures slightly may improve perceived ventilation (Int-Hout, 1984).

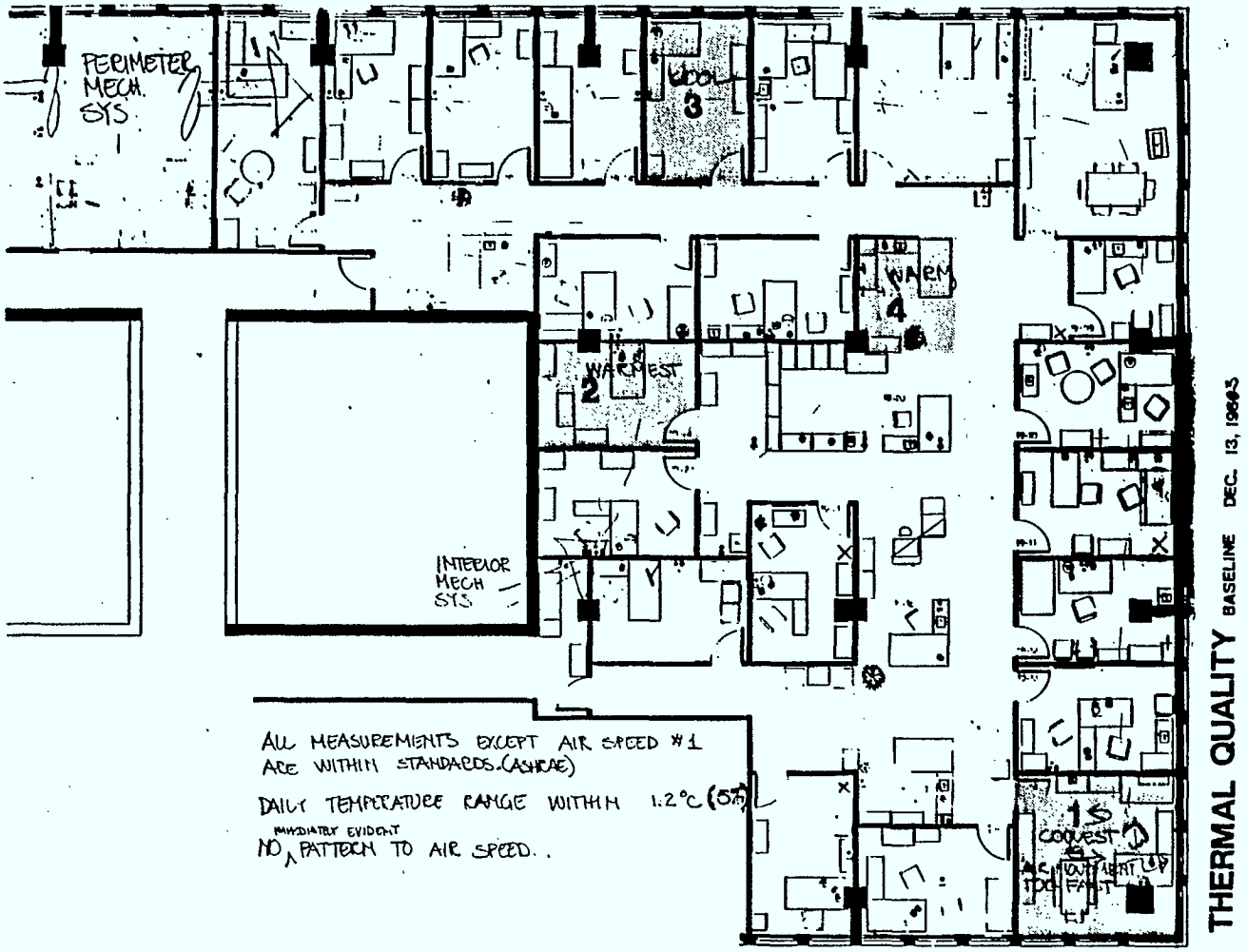


FIGURE 5-4. SUMMARY OF PWC THERMAL QUALITY FINDINGS, DECEMBER 1983

After the space had been renovated, significant thermal quality differences were measured in April 1984 as summarized in Figure 5-5. At location 3, patterns similar to the baseline patterns were recorded in terms of temperature and air speed. At location 1, there were warmer air temperatures, more in keeping with the rest of the floor. There was a much reduced air speed, which then fell within ASHRAE standards. This location should have been more thermally comfortable than it had been in December 1983.

Location 2, which had been the warmest was now the coolest and the air speed had increased. This might mean that the room has the widest range of thermal settings (i.e., warmest in the winter, coolest in the summer). Similar conditions were found at location 4, which is on the same mechanical zone.

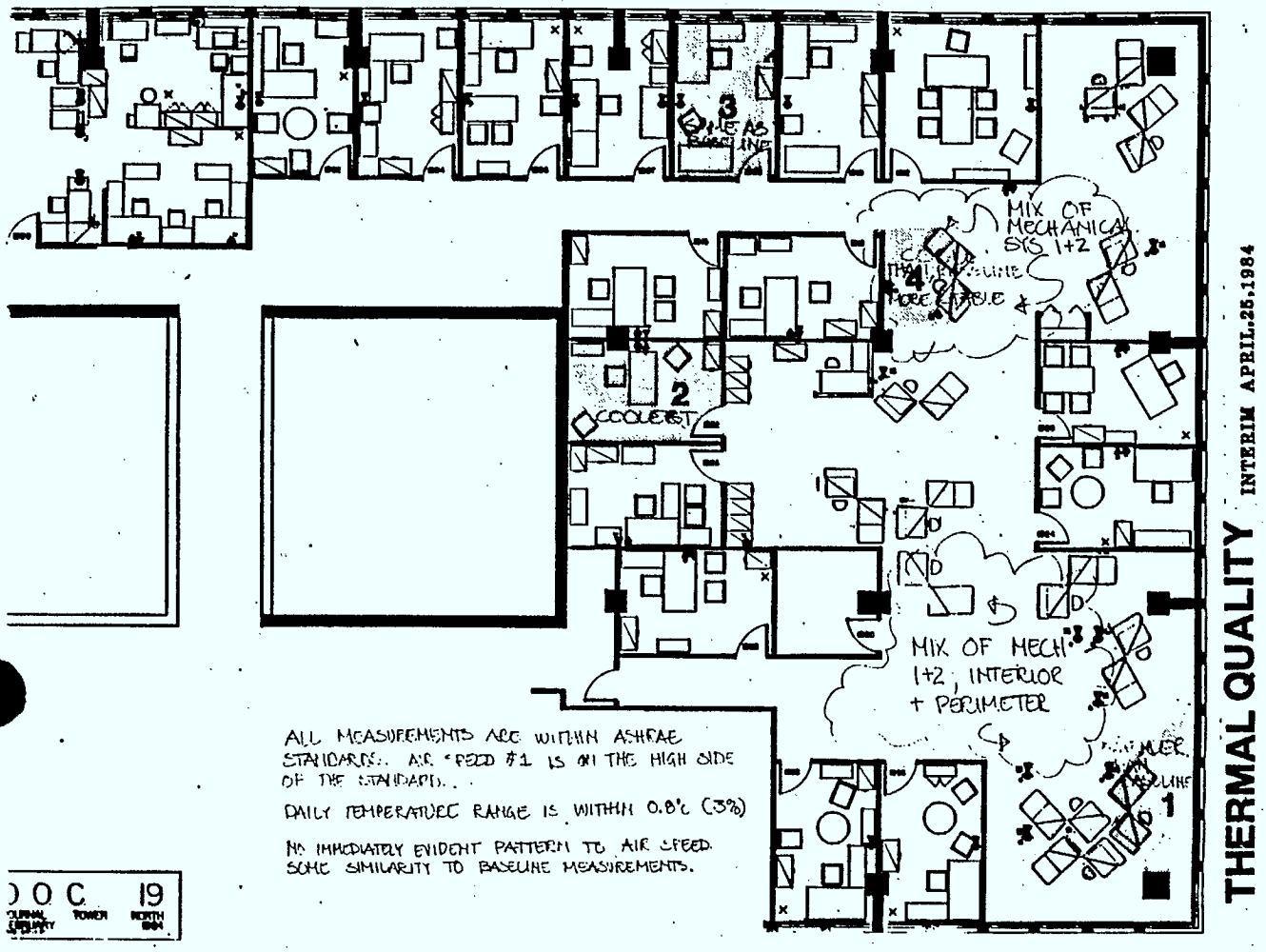


FIGURE 5-5. SUMMARY OF PWC THERMAL QUALITY FINDINGS, APRIL 1984

Air temperature was more even vertically, over the height of the space, which would contribute to improved thermal comfort. In the March 1984 survey a higher proportion of respondents rated temperature as acceptable, good or very good than had in November 1983.

Increased air speed in the interior may have contributed to higher ratings of satisfaction with ventilation in February 1984: none rated ventilation as very bad in February versus 26% in November; 19% rated it as bad versus 33% in November; 15% rated ventilation as good in both surveys. The change in layout did permit a mix of air circulation between the interior and perimeter zones.

. Absolute air speed and temperature differences are less significant than shifts of pattern. Baseline data was taken during the heating season, while interim data was taken during the spring shoulder season. The final data collections is needed to conclude improvement in thermal quality.

Although thermal comfort problems have been cited as the most frequently occuring problem in VDT workplaces, this in fact may be due to the lack of appropriate mechanical fit-up commonplace in office buildings.

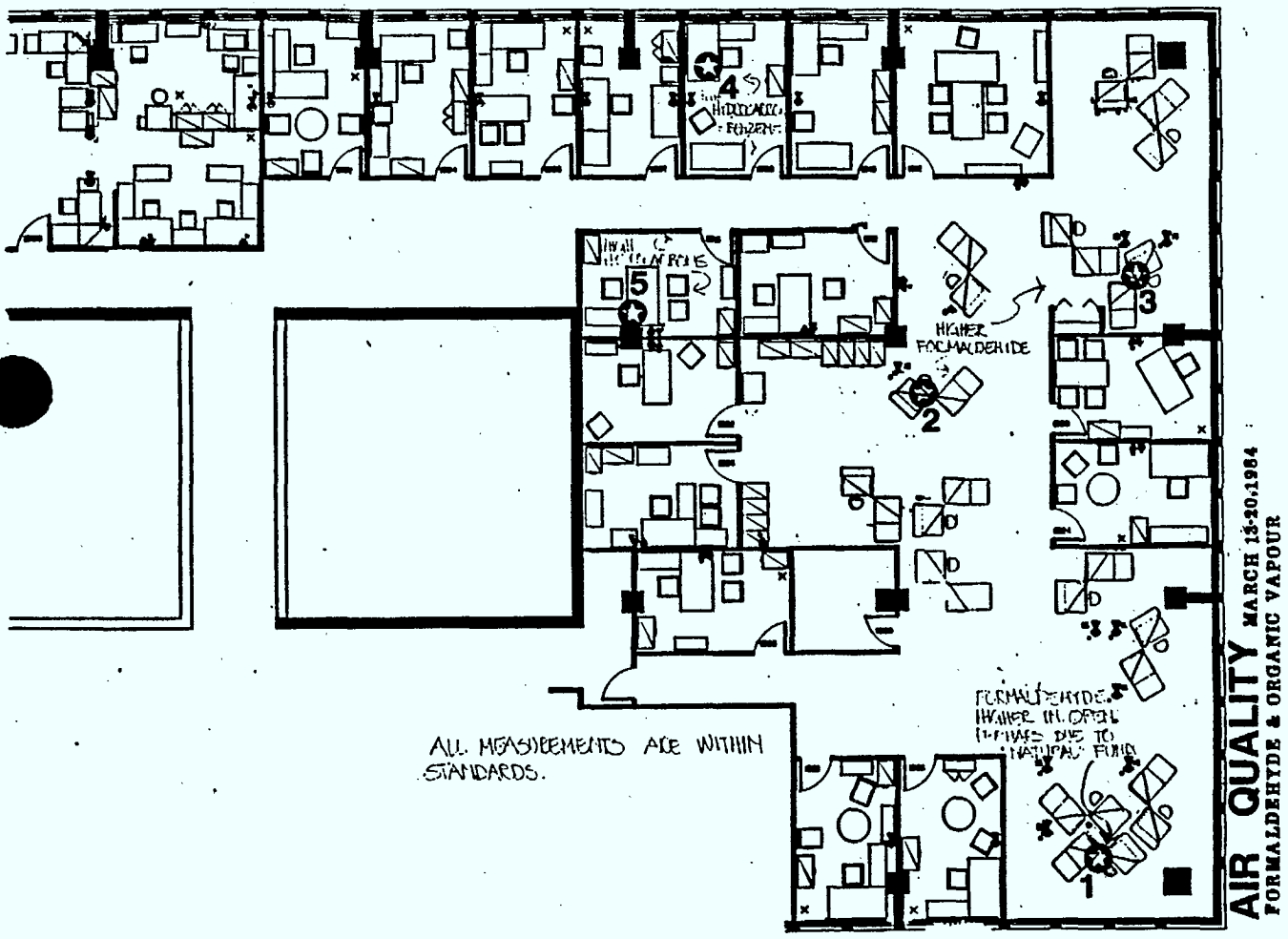


FIGURE 4-6. SUMMARY OF AIR QUALITY FINDINGS, MARCH 1984

a high percentage of staff (60% in Nov. 83, 50% in Feb. 84) reported some degree of air staleness, additional test on air quality

ll be done in the final data capture in November 1984, including CO2 nitoring and counts of ureaformadehyde and organic vapours. All air quality measurements were low and within acceptable standards, as summarized in Figure 5-6. Investigation is required to determine why total hydrocarbons are higher in the closed offices than in the open areas. Location 4 had samples which fell outside the norm of the other measurements and this location will be investigated.

5.4 Lighting

Lighting was rated by all branches as one of the least problematic environmental attributes. The majority of those who rated lighting as bad or very bad were those individuals who did not have task lights, which was mainly clerical staff in open space. Many of the desks of these individuals are not oriented optimally to take advantage of the ceiling luminaires.

GHTING	DGBP 11/83	DGBP 2/84	DGIS	DGTN
Bad or very bad	19%	-	21%	8%
Acceptable	61%	52%	31%	36%
Good or very good	19%	48%	48%	57%

Again, after the renovations to DGBP space and the introduction of the FUNDI workstations which each have two task lights, there was a significant improvement in user satisfaction with lighting within DGBP. In February, not a single DGBP staff member rated lighting as bad or very bad. The proportion of staff satisfaction was significantly higher. 52% rated it as acceptable versus 61% in November, 33% as good versus 15% in November and 15% as very good versus only 4% in November. All respondents who rated lighting as very good in February worked in FUNDIs and represented 36% of all FUNDI users. Another 27% of FUNDI users rated lighting as good.

Figure 5-7 summarizes illumination and other visual quality data from PWC measurements.

In November 1983 there were 16 perimeter closed offices with direct daylight. The 6 interior closed offices had no direct daylight but some daylight could filter through glass partitions and open doors to e 6 interior open offices. After the renovations, daylight could ter the interior zones through the 110 linear feet of window expanse made available by removing five of the perimeter offices. The number

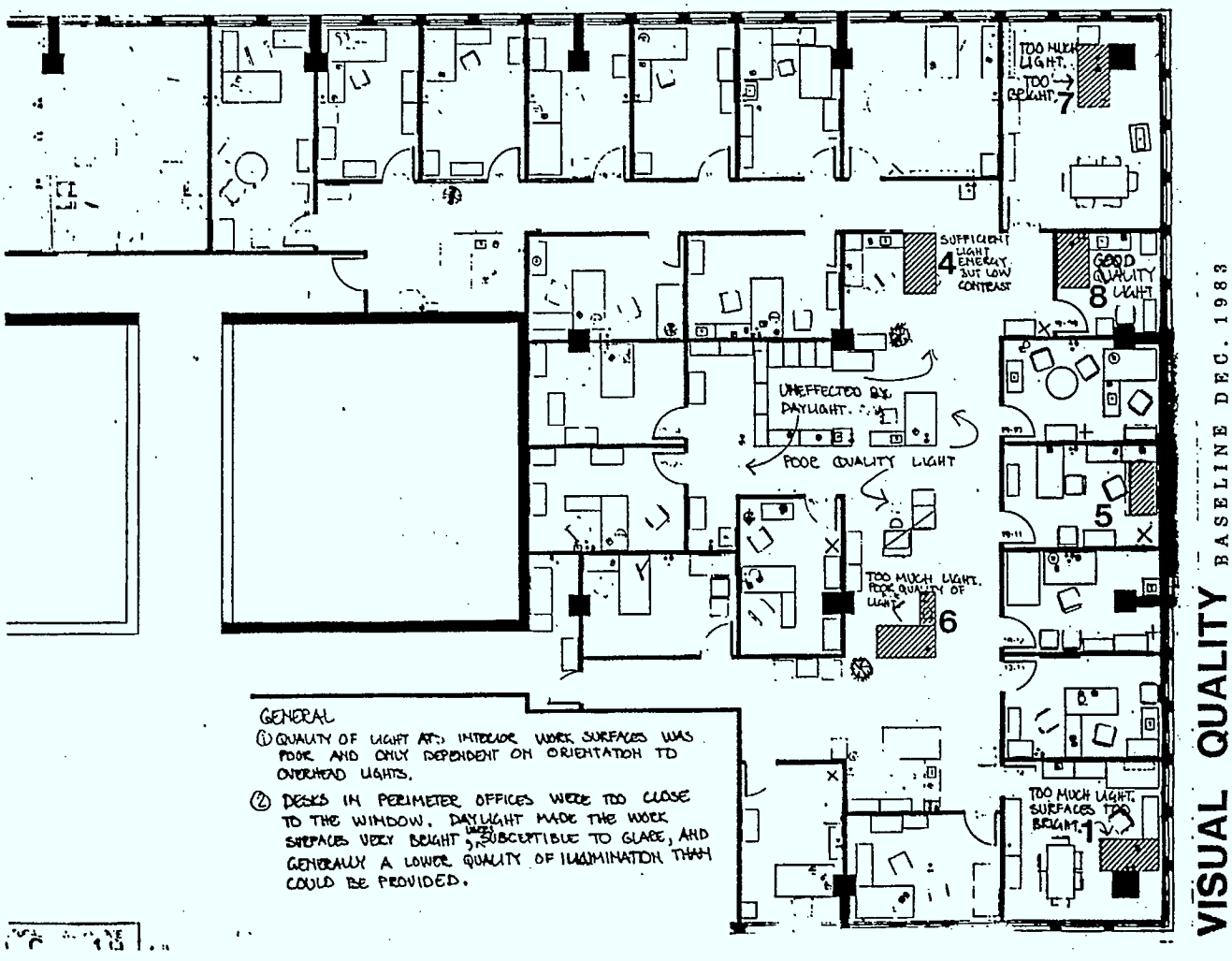


FIGURE 5-7. SUMMARY OF PWC VISUAL QUALITY FINDINGS, DECEMBER 1983

people with access to direct daylight increased from 16 (57% of the tal number of workspaces) in November 1983 to 23 (72% of workspaces) after the renovation.

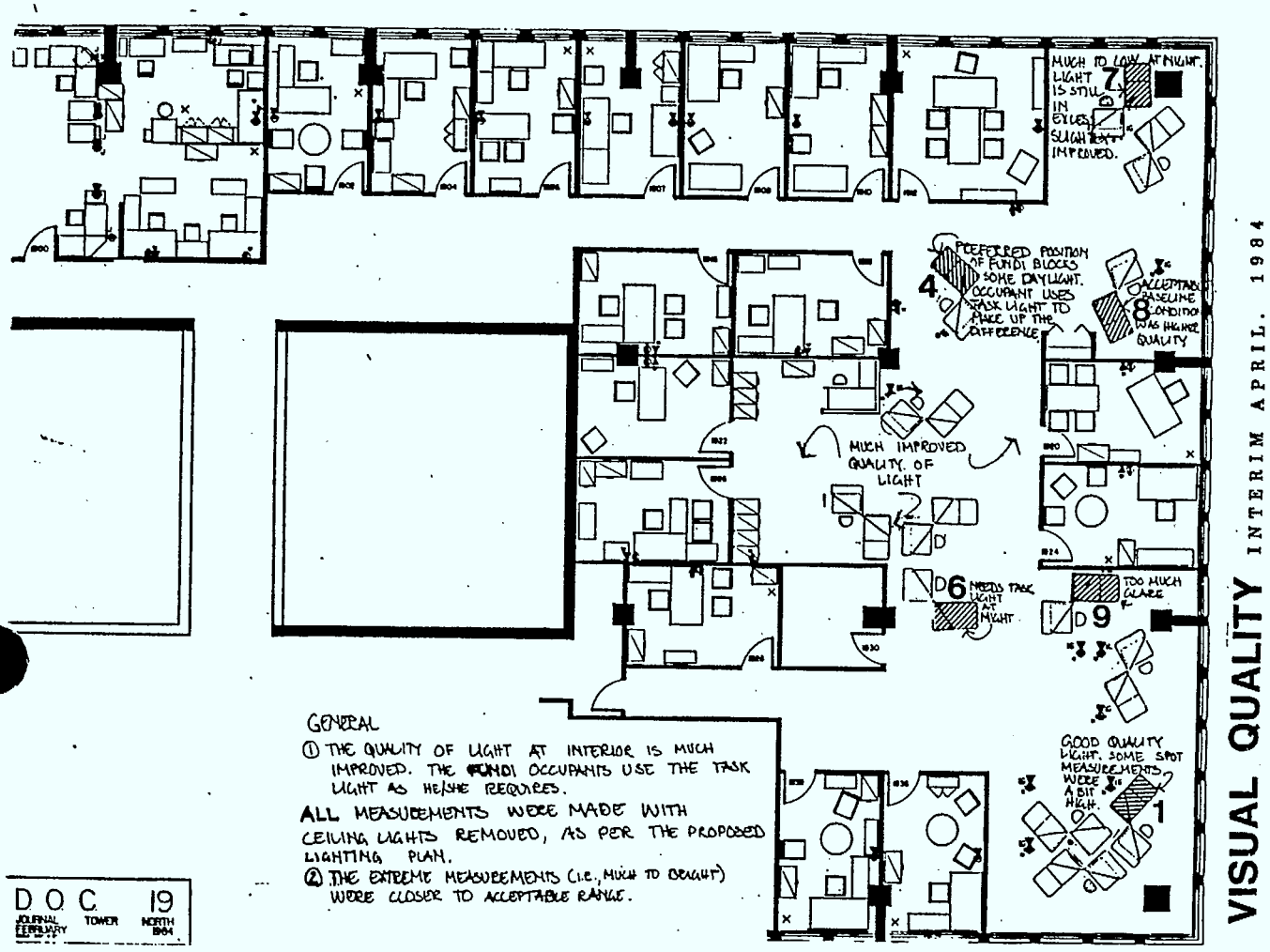


FIGURE 5-7. SUMMARY OF PWC VISUAL QUALITY FINDINGS, APRIL 1984

In December 1983, daylight made no measurable difference to the quantity of illumination in interior workspaces. The quantity of light on a worksurface depended on the location of that surface to the overhead lamps (directly overhead or to the side), the number of lamps overhead and the number of tubes in the lamp (0, 2 or 4). Most primary worksurfaces were correctly orientated for the occupant to view the narrow side of the overhead light fixture, and thus to reduce glare from the lights. However, the quality of the light was poor. In one case the quantity of light was too high and this contributed to lowering the quality of that light. The other interior workspaces had an acceptable amount of light but low contrast which would hamper reading.

After the renovation, an illumination engineer of PWC Headquarters designated connecting or disconnecting ceiling fixtures to match the new layout and the different lighting conditions due to the renovation. This process should be part of every major change to layout, although it is often neglected. Careful attention was given to the quality of illumination while working on a VDT as unneeded overhead lamps can create problems resulting in eye fatigue.

The changes to the overhead lights in the open area have been requested four times in writing (March 1, 1984, May 2, 1984, June 5, 1984, August 28, 1984) and were followed-up with conversations. No changes have been proposed for the closed offices. Prior to taking the measurements in April 1984, PWC staff altered the lamps in line with the recommended lamping plan. The April findings reflected the condition with the altered ceiling plan. However, the lamps were replaced by a janitor a few days later and have not been altered since.

In April 1984 the quality of light in the interior spaces depended on both artificial light and daylight. The quality of light was much improved, increasing the legibility of black text on white paper. The quantity of light was reduced and workers were given task lamps which they could adjust at their workspace. The combination of ambient and task light created a work space appropriate for work on a VDT or standard office work. The occupant could adjust 150 Lux over his/her work surface and had some (ideally would have more) choice as to the placement of his/her workspace with regard to the ceiling lights (directly overhead or to the side).

The workspaces on the perimeter in December 1983 required daylight to supply an acceptable amount of light energy on the work surface. This was primarily due to the close placement of the work surface to the perimeter and thus far away from the ceiling lights. It is assumed that this placement reflects the preference of the worker. With the daylight factor, the total amount of light energy on the work surface was too high. As well, the quality of light was poor. Contrast was lost because the surplus light energy greatly increased the reflection off the paper (the background to the text). It was observed that in several of the closed perimeter offices someone (presumably an occupant) had written on the ceiling light fixture "please leave off". Although the ceiling fixtures are redundant in the daytime, more effective changes can be made to improve the overall lighting quality in the closed offices.

With the proposed ceiling plan (April 1984), less artificial light energy reaches the work surface in the perimeter open areas. Still, the work surfaces meet PWC guideline for light levels when working with a VDT (between 300-500 Lux). The ample amount of daylight can place too much light on a work surface. By slightly adjusting the mobile work enclosures, the worker can block out undesired daylight as suits the individual. As well, the work enclosures are painted white a highly reflective colour. Further study in required to determine optimum colours for different sides of the work enclosure.

general the lighting condition of the perimeter workspaces was better in April 1984 than it was in December 1983. A major reason is that the worksurfaces have been kept further away from the window to reduce the problem of too much direct daylight and insufficent artificial lighting for work at other times. This was achieved by giving the workers in the open area a guideline to place primary work surfaces three feet in from the windows. This guideline also applies to improving the performance of the heating and air supply systems.

5.5 Acoustics

Noise distractions and voice privacy were also rated as problems for many DGBP staff in both surveys, despite the fact that in November, most staff had private, enclosed offices. These problems perceived by DGBP staff are less than those perceived by DGIS and greater than those perceived by DGTN staff.

In February, when a much higher proportion of DGBP staff, including officers, were working in open office areas a slightly higher proportion of staff reported extreme noise distractions although there was also an increase in the number of staff who reported no noise distractions. However, the complaints about noise distraction are not as pronounced in DGBP as in DGIS, where most people working in open areas have screens compartmentalizing them. Some of the complaints about noise distractions come from people in enclosed offices.

RATING OF NOISE DISTRACTIONS

	DGBP 11/83	DGBP 2/84	DGIS	DGTN
Very distracting	19%	~~18%~~ 21 %	43%	2%
Somewhat distracting	50%	43%	33%	49%
Not at all distracting	31%	~~19%~~ 36 %	23%	49%

The acoustic measurements taken in December 1983 indicated that there was not a lot of noise in DGBP (noted by sound pressure in dB(A)) however there were several on/off noises which could distract the workers. Typical on/off noises are telephone rings and conversations of passersby.

The noise produced by the mechanical system is used as a source of background noise for occupied spaces. If the mechanical system is not providing a specified amount of noise, then the person in that space may be more susceptible to on/off noises. In December 1983, the samples in the north-east corner were recorded as having slightly lower than the specified amount of background noise. At that time, this would have affected four people in closed offices and one support staff in the open area.

After the DGBP renovations, five officers were working in the

th-east corner, in an open plan office. They reported being highly stracted by noises from other parts of the office. Their reports of noise distractions could support the observation that the mechanical system needed to supply more background noise. These staff requested that acoustic office screens be provided, and this was done subsequent to the acoustic testing.

Measurements were taken when the site was occupied to indicate the amount of noise generated by occupants, equipment and other miscellaneous sources. At both times, December 1983 and March 1984, the "occupied" noise levels were acceptable with slight deviations at certain areas. In December, the open area adjacent to the north-east corner was slightly quieter than is recommended. This coincides with the unoccupied measurements. Two measurements were taken at this location in March 1984 and they both fell within the standard.

The persistance of sound was measured to assess how acoustically alive the office environment is. In December 1983, the office appeared to have an acceptable amount of sound absorbant material although the measurements were at the upper limit of the standard. This indicated that the interior finishes and materials could not absorb more sound. In March 1984 the values were significantly reduced indicating that the office has more potential for dissipating sound and reducing its travel. The renovation included removing walls and the measurements indicate that this has contributed to reducing the reflection of sound the open area. As it is expected that the ambient sound level in e office will increase when the electronic equipment is installed, this increased capacity of the environment to reduce the travel of sound should be beneficial.

RATING OF VOICE PRIVACY

	DGBP 11/83	DGBP 2/84	DGIS	DGTN
No voice privacy	30%	18% 33%	47%	13%
Somewhat private	52%	43% 26%	37%	45%
Very private	18%	19% 41%	16%	42%

The pattern of voice privacy ratings between branches is similar to the pattern of noise distraction ratings, with the highest incident of complaint in DGIS and the lowest in DGTN. While only 2% of DGTN respondents complained of noise distraction, 13% complained of a lack of voice privacy. This is likely due to a combination of factors. In part it may be due to the poor acoustic qualities of the partitions between offices, since they extend to the suspended ceiling only and sound travels through the plenum above. In addition, the layout of DGTN is significantly different from that of the other two branches ith fewer noise distraction sources near most offices.

here was considerably greater improvement with voice privacy than there had been with noise distraction before and after renovations in

DGBP. In November, 30% of DGBP staff felt they had no voice privacy around their desk and that proportion of staff decreased to 18% in February. 52% of DGBP staff rated conditions as only somewhat private in November versus 43% in February. Interestingly, the proportion of DGBP staff who reported very good voice privacy showed little change. This overall improvement within DGBP is largely attributable to the FUNDI which gave staff previously working in unscreened open space, some screening which improved their perceptions of their privacy.

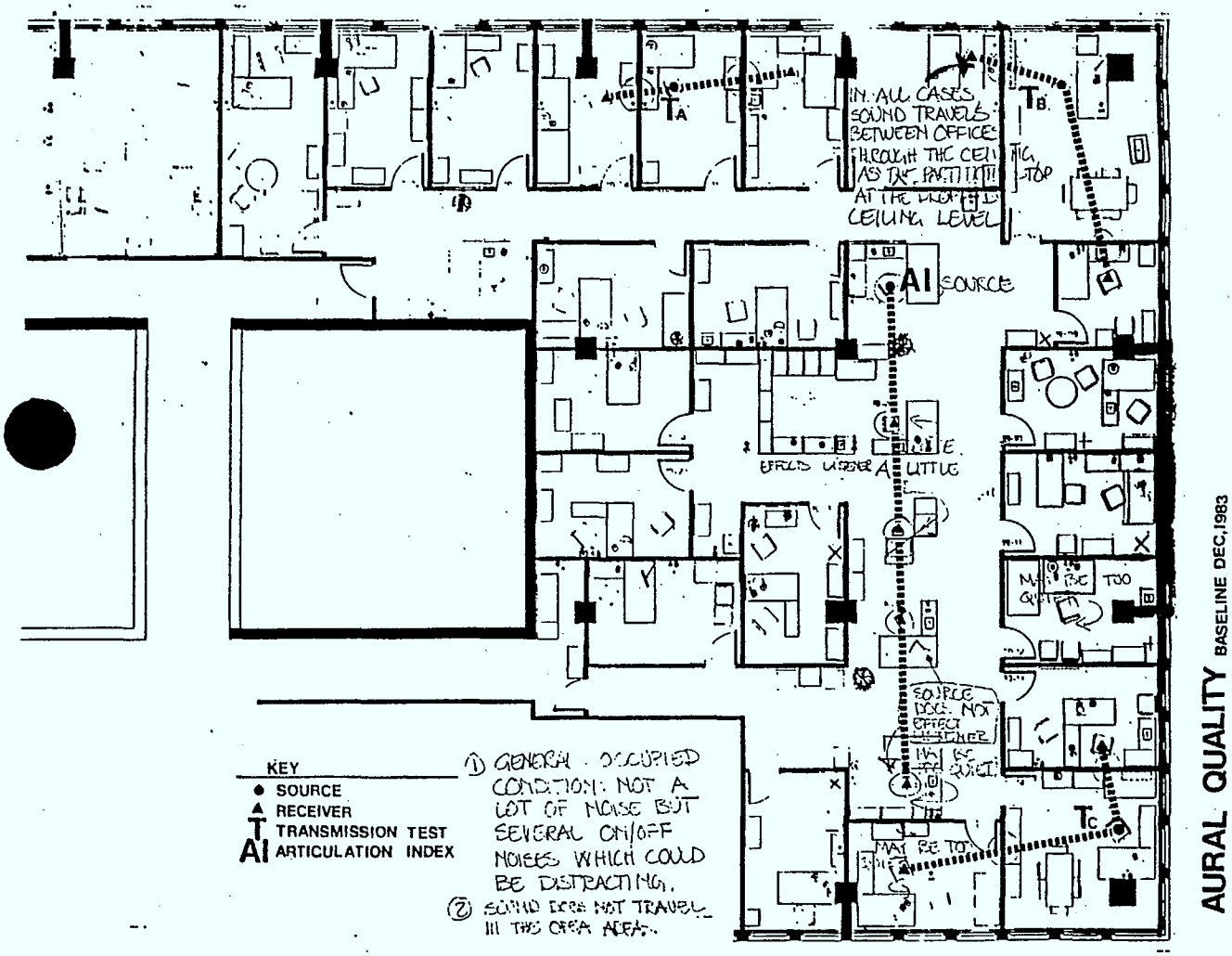
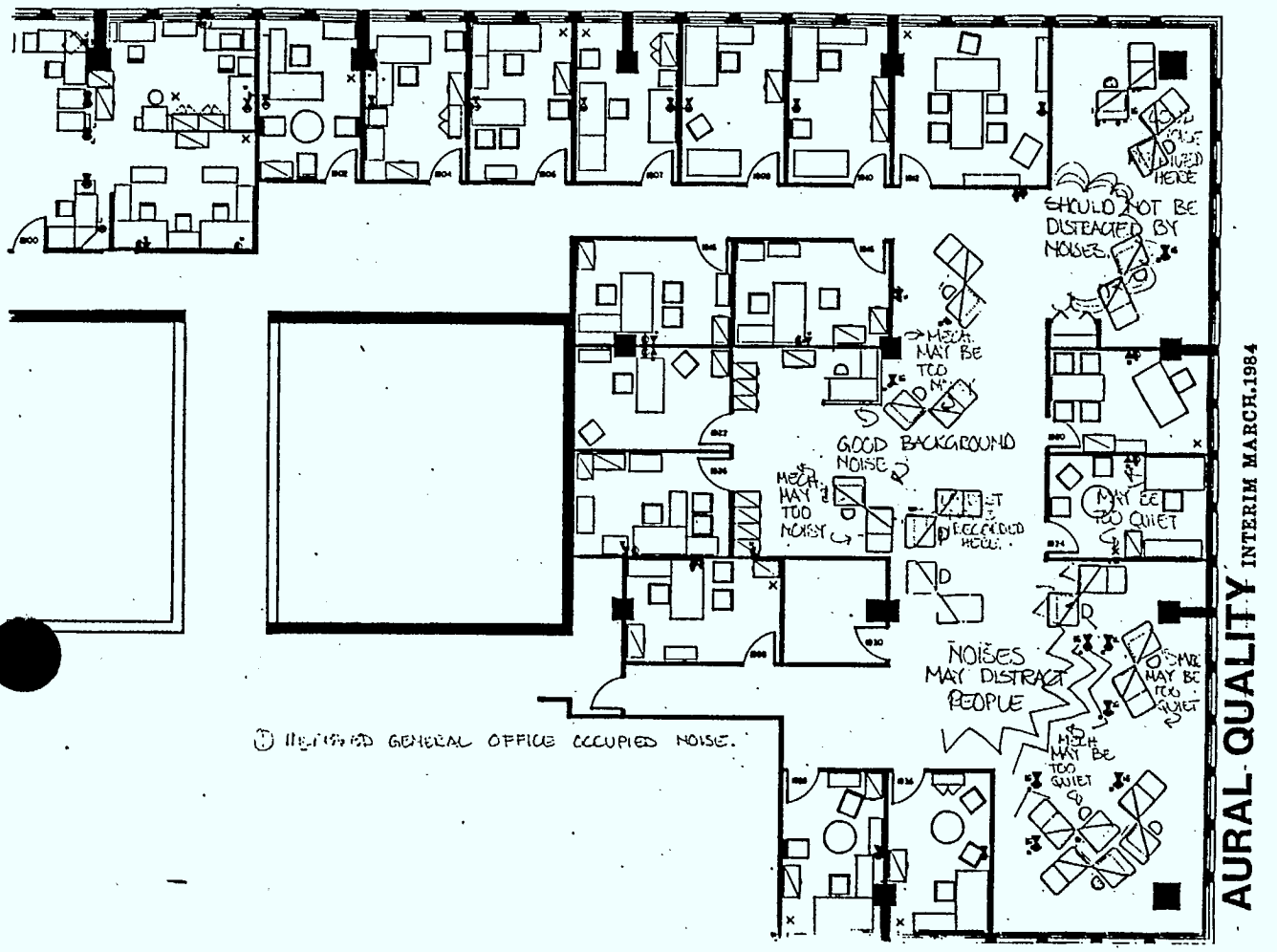


FIGURE 5-8. SUMMARY OF PWC ACOUSTIC FINDINGS, 11/83.

renovation to the DGBP floor plan created three identifiable open areas (A1,A2,A3), as indicated in Figures 5-9. Workers in A1 should not be bothered by noises generated outside of the area. Noises generated by co-workers may affect the listener however there are only three to four people in the area doing similar tasks and the individuals seem to have an understanding. Communication and speech privacy in A2 measured in March 1984 has improved from the inital measurements. A3 is the largest open area with officers. In March 1984, one officer, located the closest to A2, could be effected by sounds from A2. These sounds should not effect the other officers in A3. Since these findings, the one susceptible location was adjusted and office screens were installed. The workers have accepted these adjustments and the effects will also be measured in the final field data collection.

Transmission loss through the interior walls was measured. Based on two sample locations, the walls contributed to reducing the noise from speech some 6dB. This is a sufficient reduction for the human ear to detect (the human ear is only sensitive to a minimum 3dB change). The Director's previous office which had insulation specially placed in the wall to improve the speech privacy was measured as reducing the signal 10dB on one wall but barely 3dB through the other (shared wall of room 1915). The full acoustic benefit from the insulation in this wall was not realized because the wall stopped at the dropped ceiling. Sound could travel unimpeded through the dropped ceiling space. This a common building deficiency.

gure 5-9. SUMMARY OF PWC ACOUSTIC FINDINGS, 3/84



gure 5-9. SUMMARY OF PWC ACOUSTIC FINDINGS, 3/84

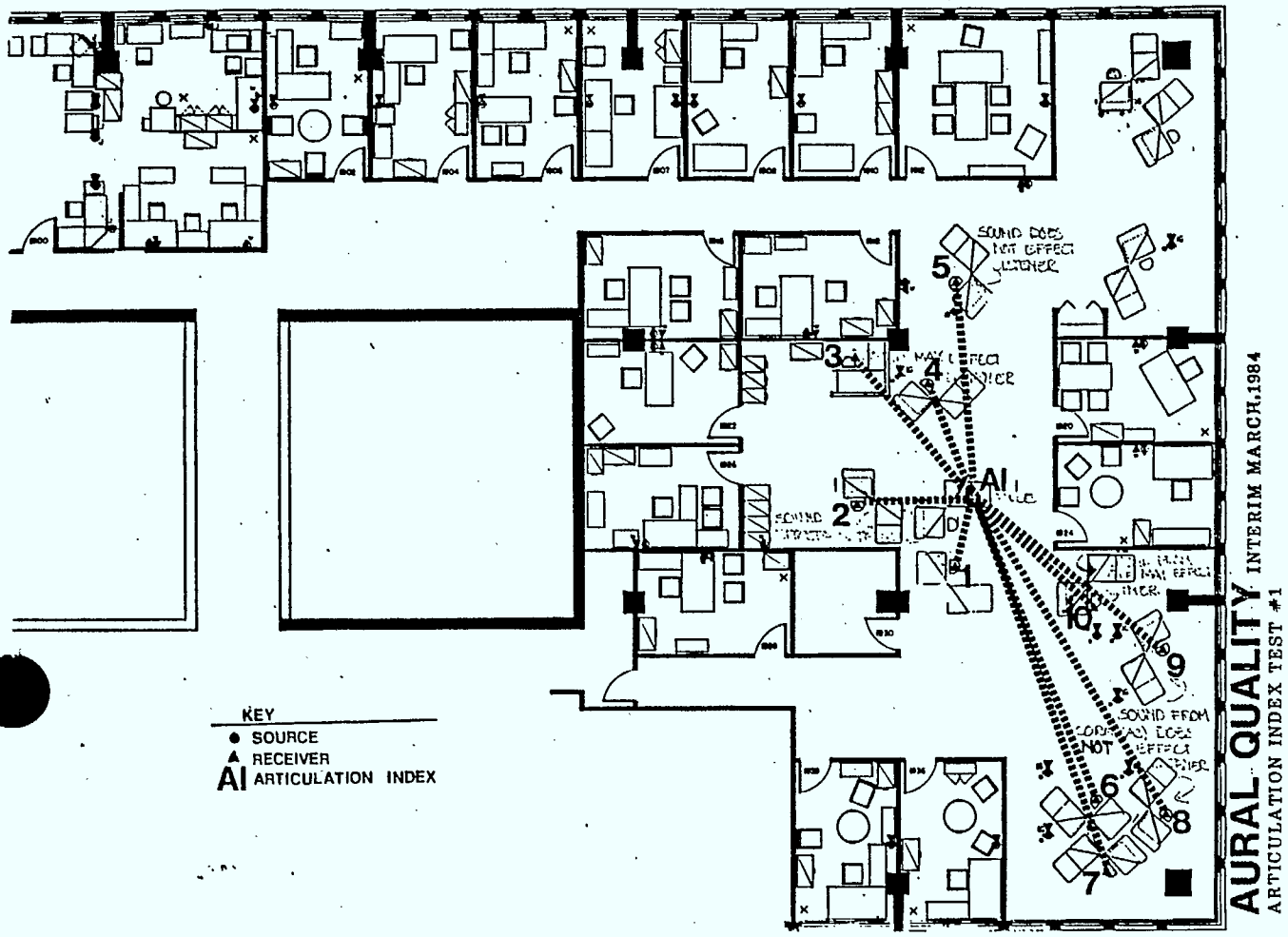
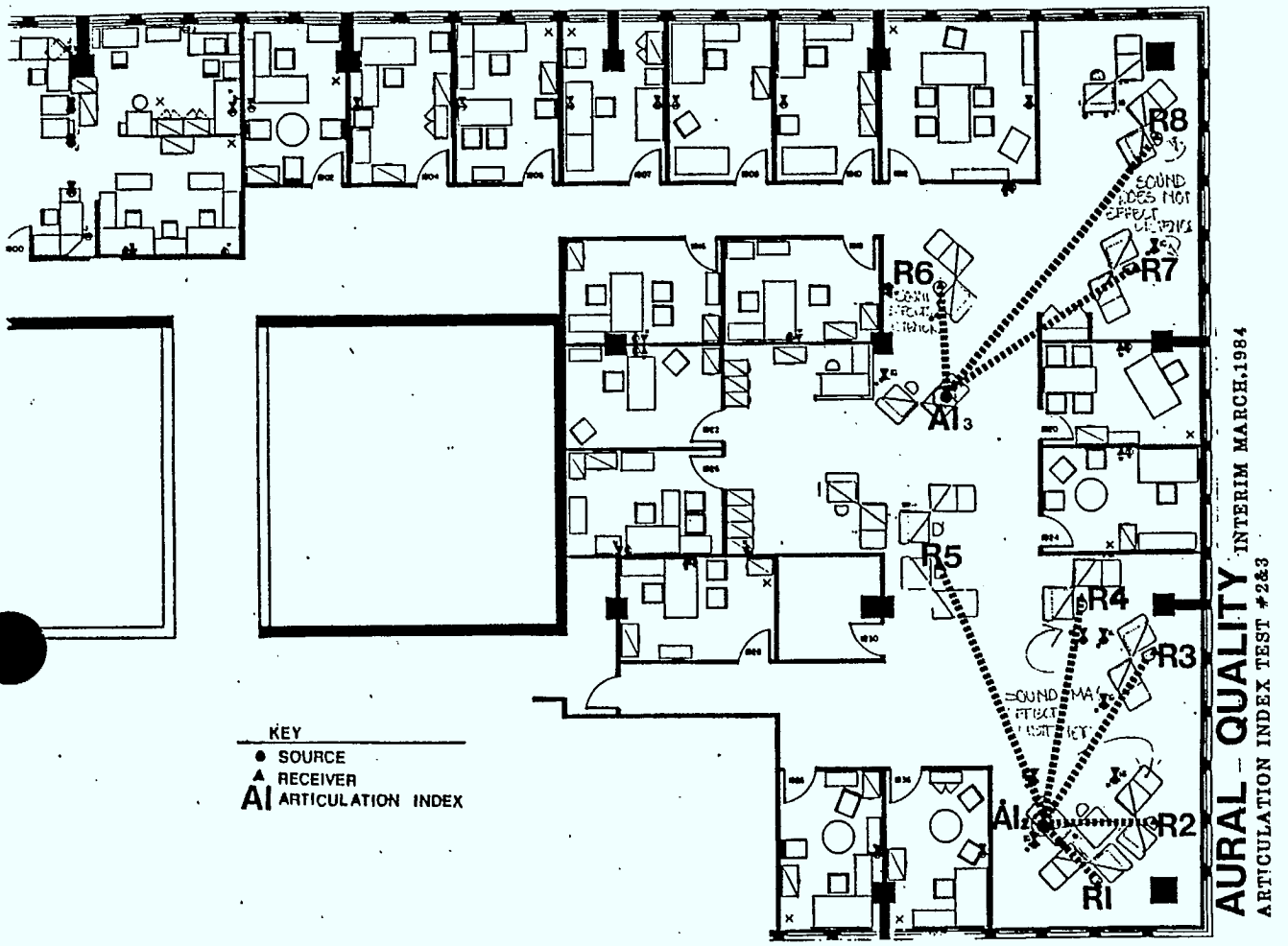


Figure 5-9. SUMMARY OF PWC ACOUSTIC FINDINGS, 3/84



APPENDIX A: SAMPLE QUESTIONNAIRES.

This appendix includes the environmental baseline questionnaire administered to DGIS, DGTN, DM, MINO and DGBP in November 1983, a subsequent environmental baseline questionnaire administered in February 1984 to DGBP staff only after renovations to their office space, and the interview guide administered to FUNDI occupants in DGBP in February 1984.

ENVIRONMENTAL QUESTIONNAIRE
Office Communications Systems Program
Department of Communications Field Trial

_ _-_ _

[P]LEASE CIRCLE THE APPROPRIATE RESPONSE NUMBER FOR EACH QUESTION.

1. In general, how would you rate the **TEMPERATURE** conditions around your particular desk location:

1.....2.....3.....4.....5
Very bad Bad Acceptable Good Very good 1. /_ _

And in specific, how do you rate these particular aspects:

Temperature shifts 1..... 2..... 3..... 4..... 5 Very frequent Frequent Not noticeable Usually constant Always constant	2. /_ _
Temperature control 1..... 2.....3 No control Some control A lot of control	3 /_ _
Heat from sunlight..... 1..... 2.....3 Too much heat Comfortable No heat	4. /_ _
In winter..... 1..... 2.....3 Too cool About right Too warm	5. /_ _
In summer..... 1..... 2.....3 Too cool About right Too warm	6. /_ _
In spring..... 1..... 2.....3 Too cool About right Too warm	7. /_ _
In autumn..... 1..... 2.....3 Too cool About right Too warm	8. /_ _
[C]omments about temperature in your workspace:_____	

2. In general, how would you rate the **VENTILATION** around your particular desk location:

1..... 2..... 3..... 4..... 5
Very bad Bad Acceptable Good Very good 9. /_ _

And in specific, how do you rate these particular aspects:

Air movement..... 1..... 2..... 3..... 4..... 5 Very still Somewhat still Good circulation Somewhat drafty Very drafty	10 /_ _
Air freshness..... 1..... 2..... 3..... 4..... 5 Very stale Somewhat stale Not noticeable Somewhat fresh Very fresh	11. /_ _
Odors..... 1..... 2..... 3 Very unpleasant Somewhat unpleasant Not noticeable	12 /_ _
Ventilation control.... 1..... 2..... 3 No control Some control A lot of control	13 /_ _
Humidity..... 1..... 2..... 3..... 4..... 5 Very dry Somewhat dry Not noticeable Somewhat humid Very humid	14 /_ _
[C]omments about ventilation in your workspace:_____	

3. In general, how would you rate the **LIGHTING** around your particular desk location:

1	2	3	4	5	
Very bad	Bad	Acceptable	Good	Very good	15. /_ _

And in specific, how do you rate these particular aspects:

Flickering of overhead lights.	1 Frequently flickering	2 Some flickering	3 No flickering		16. /_ _
Electric light control.	1 No control	2 Some control	3 A lot of control		17. /_ _
Brightness	1 Much too dim	2 Dim	3 Just right	4 Bright	5 Much too bright	18. /_ _
Daylight	1 None	2 Just right	3 Too much			19 /_ _
Glare from windows.	1 None	2 Occassional	3 Constant			20 /_ _

Comments about lighting in workspace:_____

4. In general, how would you rate the **NOISE DISTRACTIONS** around your particular desk location:

1	2	3	
Very distracting	Somewhat distracting	Not at all distracting	21 /_ _

And in specific, how do you rate these noise distractions:

Telephones ringing	1 Very distracting	2 Somewhat distracting	3 Not at all distracting	22 /_ _
People nearby speaking on the telephone.	1 Very distracting	2 Somewhat distracting	3 Not at all distracting	23 /_ _
Office equipment	1 Very distracting	2 Somewhat distracting	3 Not at all distracting	24 /_ _
People talking nearby	1 Very distracting	2 Somewhat distracting	3 Not at all distracting	25 /_ _
People passing by your desk.	1 Very distracting	2 Somewhat distracting	3 Not at all distracting	26 /_ _

5. In general, how would you rate your **VOICE PRIVACY** around your desk:

1	2	3	
No privacy	Somewhat private	Very private	27. /_ _

And in specific, how do you rate these particular aspects:

	1	2	3	
Privacy when speaking on your telephone.	No privacy	Somewhat private	Very private	28. /_ _
Conversations with others seated at your desk.	No privacy	Somewhat private	Very private	29. /_ _

6. In general, how would you rate your **VISUAL PRIVACY** when working at your desk:

1	2	3	
No privacy	Somewhat private	Very private	30. /_ _

And in specific, how do you rate these particular aspects:

	1	2	3	
Other people working within your view.	Very distracting	Somewhat distracting	Not at all distracting	31. /_ _
Being watched by other people.	Very distracting	Somewhat distracting	Not at all distracting	32. /_ _

7. How would you rate the **AMOUNT OF SPACE** you have for each of the following:

	1	2	3	4	5	
Total workspace...	Very inadequate	Somewhat inadequate	Sufficient	Spacious	Very spacious	33. /_ _
Work storage.....	Very inadequate	Somewhat inadequate	Sufficient	Spacious	Very spacious	34. /_ _
Personal storage..	Very inadequate	Somewhat inadequate	Sufficient	Spacious	Very spacious	35. /_ _
Work surfaces.....	Very inadequate	Somewhat inadequate	Sufficient	Spacious	Very spacious	36. /_ _
Files.....	Very inadequate	Somewhat inadequate	Sufficient	Spacious	Very spacious	37. /_ _

8. How would you rate the **APPROPRIATENESS** of the following aspects of your particular workspace **RELATIVE TO THE REQUIREMENTS OF YOUR TASKS:**

F[redacted]iture arrangement.. in your workspace.	1..... Very inappropriate	2..... Inappropriate	3..... Appropriate	4 Very appropriate	38. /_ _
Chair.....	1..... Very inappropriate	2..... Inappropriate	3..... Appropriate	4 Very appropriate	39. /_ _

9. Have you personally done any of the following to modify heat, air flow, light, or noise in your present work space? Please check all that apply.

____Brought in or requested a fan	40. /_ _
____Taped over or adjusted ceiling air diffuser	41. /_ _
____Brought in or requested a space heater	42. /_ _
____Humidified with an electric kettle	43. /_ _
____Brought in a sweater or special clothes	44. /_ _
____Brought in or requested a desk lamp	45. /_ _
____Disconnected or removed bulbs from overhead light fixtures	46. /_ _
____Brought in or requested an air cleaner	47. /_ _
____Brought in a radio	48. /_ _
____Covered window or adjusted window blinds or curtains	49. /_ _
____Rearranged furniture to increase thermal comfort	50. /_ _
____Rearranged furniture to improve lighting	51. /_ _
____Added or rearranged furniture to prevent others from watching you while you work	52. /_ _
____[redacted]dded or rearranged furniture or materials to give you greater acoustic privacy	53. /_ _
____Added or rearranged furniture or materials to reduce noise distractions	54. /_ _
____Other (please specify): _____	55. /_ _

10. Since you have been working for DoC in the Journal Towers, have you ever moved, or requested to be moved, to another workspace as a result of noise, heat, lighting, air quality, air flow, or other problems?

Yes ☐ No ☐ 56. /_ _

If yes, please explain why: _____ 57. /_ _

11. **Please rate the following attributes of your BRANCH'S space:**

Convenience of workgroup layout.	1..... Very poor	2..... Poor	3..... Adequate	4..... Good	5 Very good	58. /_ _
Location of related work groups.	1..... Very poor	2..... Poor	3..... Adequate	4..... Good	5 Very good	59. /_ _
Location of meeting rooms.	1..... Very poor	2..... Poor	3..... Adequate	4..... Good	5 Very good	60. /_ _
Av[redacted]ability of me[redacted]ng rooms.	1..... Very poor	2..... Poor	3..... Adequate	4..... Good	5 Very good	61. /_ _

IN SUMMARY, TAKING INTO ACCOUNT ALL OF THE ABOVE, PLEASE RATE THE FOLLOWING:

12. Everything considered, how do you rate your individual workspace as a place to work?

1..... 2..... 3..... 4..... 5 62./_ _
Very poor | Poor | Adequate | Good | Very good

13. Thinking of all of the office buildings you know, how would you rank the Journal Tower as a place to work?

1..... 2..... 3..... 4..... 5 63./_ _
Much worse | Worse | About the same | Better | Much better

14. Of all the work group office space in this building, how would you rank your particular branch's space?

1..... 2..... 3..... 4..... 5 64./_ _
Much worse | Worse | About the same | Better | Much better

15. How would you rank your individual workspace compared to other individual workspaces in this building?

1..... 2..... 3..... 4..... 5 65./_ _
Much worse | Worse | About the same | Better | Much better

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

1..... 2..... 3..... 4..... 5 66./_ _
Very negative effect | Negative effect | No effect | Positive effect | Very positive effect

Thank you for your cooperation. Please add any additional comments.

ENVIRONMENTAL QUESTIONNAIRE

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PLEASE CIRCLE THE APPROPRIATE RESPONSE NUMBER FOR EACH QUESTION.

1. In general, how would you rate the **TEMPERATURE** conditions around your particular desk location:

1.....2.....3.....4.....5
Very bad Bad Acceptable Good Very good 1./_ _

And in specific, how do you rate these particular aspects:

Temperature shifts 1..... 2..... 3..... 4..... 5 2./_ _
Very frequent Frequent Not noticeable Usually constant Always constant

Temperature control 1..... 2.....3 3./_ _
No control Some control A lot of control

Heat from sunlight..... 1..... 2.....3 4./_ _
Too much heat Comfortable No heat

In winter..... 1..... 2.....3 5./_ _
Too cool About right Too warm

Comments about temperature in your workspace:_____

8. In general, how would you rate the **VENTILATION** around your particular desk location:

1..... 2..... 3..... 4..... 5
Very bad Bad Acceptable Good Very good 9./_ _

And in specific, how do you rate these particular aspects:

Air movement..... 1..... 2..... 3..... 4..... 5 10./_ _
Very still Somewhat still Good circulation Somewhat drafty Very drafty

Air freshness..... 1..... 2..... 3..... 4..... 5 11./_ _
Very stale Somewhat stale Not noticeable Somewhat fresh Very fresh

Odors..... 1..... 2..... 3 12./_ _
Very unpleasant Somewhat unpleasant Not noticeable

Ventilation control.... 1..... 2..... 3 13./_ _
No control Some control A lot of control

Humidity..... 1..... 2..... 3..... 4..... 5 14./_ _
Very dry Somewhat dry Not noticeable Somewhat humid Very humid

Comments about ventilation in your workspace:_____

3. In general, how would you rate the LIGHTING around your particular desk location:

1	2	3	4	5	
Very bad	Bad	Acceptable	Good	Very good	15./_ _

And in specific, how do you rate these particular aspects:

Flickering of overhead lights.	1 Frequently flickering	2 Some flickering	3 No flickering	16./_ _
Electric light control.	1 No control	2 Some control	3 A lot of control	17./_ _
Brightness	1 Much too dim	2 Dim	3 Just right	4 Bright	5 Much too bright	18./_ _
Daylight	1 None	2 Just right	3 Too much	19./_ _
Glare from windows.	1 None	2 Occassional	3 Constant	20./_ _

Comments about lighting in workspace:_____

4. In general, how would you rate the NOISE DISTRACTIONS around your particular desk location:

1	2	3	
Very distracting	Somewhat distracting	Not at all distracting	21./_ _

And in specific, how do you rate these noise distractions:

Telephones ringing	1 Very distracting	2 Somewhat distracting	3 Not at all distracting	22./_ _
People nearby speaking on the telephone.	1 Very distracting	2 Somewhat distracting	3 Not at all distracting	23/_ _
Office equipment	1 Very distracting	2 Somewhat distracting	3 Not at all distracting	24/_ _
People talking nearby..	1 Very distracting	2 Somewhat distracting	3 Not at all distracting	25/_ _
People passing by your desk.	1 Very distracting	2 Somewhat distracting	3 Not at all distracting	26/_ _

In general, how would you rate your VOICE PRIVACY around your desk: 27/__

1	2	3
No privacy	Somewhat private	Very private

And in specific, how do you rate these particular aspects:

Privacy when speaking on your telephone.	1 No privacy	2 Somewhat private	3 Very private
Conversations with others seated at your desk.	1 No privacy	2 Somewhat private	3 Very private

28/__

29/__

6. In general, how would you rate your VISUAL PRIVACY when working at your desk: 30/__

1	2	3
No privacy	Somewhat private	Very private

And in specific, how do you rate these particular aspects:

[illegible]er people working in your view.	1 Very distracting	2 Somewhat distracting	3 Not at all distracting
Being watched by other people.	1 Very distracting	2 Somewhat distracting	3 Not at all distracting

31/__

32/__

7. How would you rate the AMOUNT OF SPACE you have for each of the following:

Total workspace...	1 Very inadequate	2 Somewhat inadequate	3 Sufficient	4 Spacious	5 Very spacious
Work storage.....	1 Very inadequate	2 Somewhat inadequate	3 Sufficient	4 Spacious	5 Very spacious
Personal storage..	1 Very inadequate	2 Somewhat inadequate	3 Sufficient	4 Spacious	5 Very spacious
Work surfaces.....	1 Very inadequate	2 Somewhat inadequate	3 Sufficient	4 Spacious	5 Very spacious
[illegible].....	1 Very inadequate	2 Somewhat inadequate	3 Sufficient	4 Spacious	5 Very spacious

33/__

34/__

35/__

36/__

37/__

How would you rate the APPROPRIATENESS of the following aspects of your particular workspace RELATIVE TO THE REQUIREMENTS OF YOUR TASKS:

Furniture arrangement in your workspace.	1 Very inappropriate	2 Inappropriate	3 Appropriate	4 Very appropriate	38./_ _
Chair	1 Very inappropriate	2 Inappropriate	3 Appropriate	4 Very appropriate	39./_ _

9. How would you rate the convenience of the new layout of work groups within DGBP?

1..... 2..... 3..... 4..... 5 58./_ _
Very poor Poor Adequate Good Very good

IN SUMMARY, TAKING INTO ACCOUNT ALL OF THE ABOVE, PLEASE RATE THE FOLLOWING:

10. Everything considered, how do you rate your individual workspace as a place to work?

1..... 2..... 3..... 4..... 5 62./_ _
Very poor Poor Adequate Good Very good

11. How would you rate your new workspace compared to the workspace which you occupied last November?

1..... 2..... 3..... 4..... 5 67./_ _
Much worse Worse About the same Better Much better

12. How would you rate the effect of the physical characteristics of your work space on your ability to do your work?

1..... 2..... 3..... 4..... 5 66./_ _
Very negative effect Negative effect No effect Positive effect Very positive effect

Thank you for your cooperation. Please add any additional comments.

APPENDIX B: ABS, PWC TEST PROCEDURES.

1) Aural quality

Tests:
Noise Criterion (NC) values for unoccupied ambient sound.
NC values for occupied ambient sound, with printers on and off.
Transmission loss through partitions.
Articulation indice for open and closed offices.
Reverberation time for open and closed offices.
Environmental questionnaire/interview (specifically questionnaire).

Predictions:
An increase in the occupied NC value is predicted in open areas when all VDTs (and printers) are installed and being used.

It is predicted that people working in the open office will be less sensitive to noise distractions when they are working on a VDT.

2) Thermal quality

Tests:
Dry bulb temperature.
Wet bulb temperature.
Globe temperature.
Operative temperature.
Air speed and direction.
Other relevant information (e.g., window coverings, location of thermostats, season, exterior temperature, occupant clothing level).
Temperature of supply air.
Electonic wire tap on FUNDI radiant heat panels to monitor use of the system.

Predictions:
It is predicted that people will use the radiant heat panels less when the electronic equipment is on than when the equipment is off. This is due to the increased heat being put into the workspace. Addition of VDT is equivalent in Btu to one person (approx 300 Btu/hr). People will use heat panels more due to sedentary nature of VDT work.

It is predicted that females will use the radiant heat panels more than males will.

3) Visual quality

Within the DGBP sample points, nine characterictics of artificial and daylight conditions were measured on site or calculated from the measurements. The measurements were taken on the horizontal surface which appeared to be the occupants' primary place of work. Of the nine measurements, five were selected as sufficient to characterize the quantity and quality of illumination. The terms and description follow:

Tests:

Horizontal illumination with body shadow (Eh). Luminance readings on the surrounding environment measured in Lux or footcandles. This is a measure of the quantity of light energy hitting a surface.

Contrast of the task (C). This is a quality indicator. A contrast between the task and the background is needed for people to read characters.

Contrast reduction at task (R). This is another quality indicator, elaborating upon the above.

Task luminance (LT). Luminance of the task, which in this case was taken as black ink on white paper.

Task background luminance (LB). Luminance of the background, which in this case was taken as the white paper on which the black letters (the task) appear. Both LT and LB contribute to defining the quality of the material to be read.

Luminance readings on the surrounding environment.

Luminaire type, location and operation mode (e.g., disconnected, partially de-lamped, burnt out).

Electronic wire tap on FUNDI lights to monitor use of the system.

The following measurements were taken but have not yet been used in the analysis:

Equivalent sphere illumination (ESI). Another popular measure of light quality is ESI - an attempt to characterize, by a single measure, the reduction in visibility from veiling reflections. Currently the validity of this measure is under investigation and it has been removed from this summary.

Contrast rendition factor (CRF).

Lighting effectiveness factor (LEF).

Predictions: It is predicted that people will adjust the illumination level of the incandescent lamp more times in a day when working with a VDT than when working with standard office tools (e.g., paper, pens, typewriter).

4) Air: circulation

Tests: Floor plan and drawing analysis.
Helium filled balloons.

Predictions: It is predicted that air circulation will be improved from T1 (baseline) to T2 (interim) due to the removal of select interior walls. No further change is anticipated as a result of the electronic equipment.

5) Air: composition

Tests: Passive air sample badges (formaldehyde, organic vapours).
MIRAN, CO_2 counter.
Bionaire negative ion meter.

Predictions: It is predicted that the formaldehyde count (in ppm) in the open area will be less in T3 than in T2. This is due to the outgassing of the particleboard in the FUNDI. All counts are expected to be well within acceptable limits.

It is predicted that the negative ion count will be lower in areas with many VDTs (i.e., DGBP) than elsewhere in the building.

No predictions are made on the CO_2 count. It is being monitored to compare people's perception of air quality against a measured value.

Space accommodation / building services

Tests: Slides, drawings and workstation checklist describing of gross area for the organization and per individual; net area for the organization and per individual; services (e.g., electrical outlets, ceiling fixtures, diffusers); furnishing and furniture; personal artifacts; signs of erosion or inconvience; lighting fixtures, desk and ceiling; supply of warm and cool air; acoustic surfaces; primary, secondary and tertiary circulation paths.

Predictions: It is predicted that people will arrange their workspace more compactly when working with a VDT. This will be observe by the difference in spatial layout from T1 to T2 (change office spatial organization) and T2 to T3 (installation of electronic office equipment).

It is predicted that electronic office equipment will change the way businesses are organized and how jobs are done (i.e., a flattened organizational pyramid with support staff having more responsibility and officers doing what initially appears to be clerical work, such as inputing text). This organizational change will be reflected in the way businesses will use buildings and in the design priorities for facilities (e.g., a change to the patterns of space use, the overall demand for space is less clear, changing "rules" for office selection - will some buildings become unuseable as offices?). (The ORBIT Study: Information Technology and Office Design, London, 1983.)

Research steps include:
a) compare gross area of individual workspace and useable area before and after the addition of electronic office equipment.
b) monitor environmental demands that the equipment places on the building (e.g., noise; heat; air particulates - dust, supplies, paper, floppies, print wheels; vibration; changes to performance of building enclosure; EMI - detectable radiation).
c) determine acceptable locations for the equipment, noting trial and error locations, documenting pros and cons of each (e.g., where user needs it or where the equipment needs to be or where the building conditioning system can cope with the equipment).
d) monitor change in the energy demand per

square metre on the building systems (e.g., electrical, mechanical, illumination).

Patterns of space use in offices with VDT's will differ from present office space use in that individuals will have less area and group areas will increase.

7) Ergonomic

Tests: Floor plans and drawing analysis.
Tape measure.

Predictions: It is predicted that the match of individual to furnishing (e.g., desk, files, chair) and individual to work tools (e.g., typewriter, adding machines, telephone, VDT) will be worse in T3 than in T1 or T2.

Although there are no "magic" dimensions which work for all shapes and sizes of people, it is predicted that the FUNDI is sufficiently flexible to meet the specific preferences of individuals over his/her workspace (e.g., table height, footrest, workspace configuration).

8) Energy consumption

Tests: Line disturbance analyser (three channels).
Line monitors, load side of local conditioning controls in FUNDI.

Predictions: It is predicted that transients in electrical lines will be more damaging to work flow in the final data capture (T3) than they were in the previous (T1 and T2).

It is predicted that the local conditioning systems provided in the FUNDI will reduce energy consumption as the systems are used only when they are needed. Energy use is related to occupants work pattern. Energy can be saved through better use of space and scheduling building services and activities.

PHOTO REFERENCE COMMENTS

PERSON CODE NO. 02. _ _

DOC WORKSTATION CHECKLIST
July 1984

GLOSSARY

Workspace: aggregration of workstations (individual) plus shared facilities (e.g., files, copier, meeting area).

Workstation: area defined by the furniture and equipment associated with the office functions of one person.

Worksurface: (a) primary - horizontal surface directly related to primary tasks and area for directly required material; (b) secondary - space for less frequently required material, storage, reference, files, etc.

OCCUPANT IS PRESENT _yes _no

WORKSPACE DESCRIPTION

ROOM NO _____ AREA NO_____ FUNDI NO_____

FLOOR PLAN _ attached _ unavailable

REFLECTED CEILING PLAN _ attached _ unavailable

PHOTOGRAPHS _ attached (_28mm lens _55mm lens ___mm lens)

_ unavailable

NUMBER OF ELECTRICAL OUTLETS _____ NUMBER OF PLUGS _____

OUTLETS ARE NOTED ON FLOOR PLAN _yes _no

DISTANCE FROM PRINCIPLE LOCATION OF CHAIR TO OUTLET 1)___mm (___in)

2)___mm (___in)

3)___mm (___in)

4)___mm (___in)

WORKSPACE IS: _open plan with few screens _open plan with many screen _open plan without screens _closed office

PLAN total area of workspace: floor_____ m^2 (_____ft^2)

PHOTO REFERENCE

COMMENTS

PERSON CODE NO. 02. _ _

ACCESSIBILITY OF WORKSPACE TO:

	assisted	not assisted	don't know	describe
wheelchair	_	_	_	_____
with crutches	_	_	_	_____
hearing impaired	_	_	_	_____
sight impaired	_	_	_	_____

WORKSTATION FURNISHING

Item	Number	Height	Adj	Depth	Adj	Width	Adj
terminal	_____	___mm ___in	_	___mm ___in	_	___mm ___in	_
hood for screen	_____	___mm ___in	_	___mm ___in	_	___mm ___in	_
printer	_____	___mm ___in	_	___mm ___in	_	___mm ___in	_
typewriter	_____	___mm ___in	_	___mm ___in	_	___mm ___in	_
disk drive	_____	___mm ___in	_	___mm ___in	_	___mm ___in	_
telephone	_____	___mm ___in	_	___mm ___in	_	___mm ___in	_
modem							
other_____	_____	___mm ___in	_	___mm ___in	_	___mm ___in	_
primary work table/desk	_____	___mm ___in	_	___mm ___in	_	___mm ___in	_

work surface is _matt _gloss _textured _smooth describe_____

NO. of drawers ___pens ___files ___storage ___other_____

secondary work table/desk	_____	___mm ___in	_	___mm ___in	_	___mm ___in	_

NO. of drawers ___pens ___files ___storage ___other_____

PHOTO REFERENCE COMMENTS

PERSON CODE NO. 02. _ _

Item	Number	Height	Adj	Depth	Adj	Width	Adj
desk kickback	____	___mm ___in	_	___mm ___in	_	___mm ___in	_
typing table	____	___mm ___in	_	___mm ___in	_	___mm ___in	_
meeting table	____	___mm ___in	_	___mm ___in	_	___mm ___in	_
credenza	____	___mm ___in	_	___mm ___in	_	___mm ___in	_
chair - occupant	____	___mm ___in	_	___mm ___in	_	___mm ___in	_
chair - visitor(s)	____	___mm ___in	_	___mm ___in	_	___mm ___in	_
modifications to chair							
cushion	________						
slip cover	________						
file cabinet	____	___mm ___in	_	___mm ___in	_	___mm ___in	_
file cabinet	____	___mm ___in	_	___mm ___in	_	___mm ___in	_
file cabinet	____	___mm ___in	_	___mm ___in	_	___mm ___in	_
file cabinet	____	___mm ___in	_	___mm ___in	_	___mm ___in	_
bookshelves	____	___mm ___in	_	___mm ___in	_	___mm ___in	_
bookshelves	____	___mm ___in	_	___mm ___in	_	___mm ___in	_
bookshelves	____	___mm ___in	_	___mm ___in	_	___mm ___in	_

Comment on work storage ______________________________

Item	Number	Height	Adj	Depth	Adj	Width	Adj
moveable screen	____	___mm ___in	_	___mm ___in	_	___mm ___in	_

_touch floor ___mm (___in) above floor _touch ceiling

describe: colour ________________ texture ________________

Item	Number	Height	Adj	Depth	Adj	Width	Adj
moveable screen	____	___mm ___in	_	___mm ___in	_	___mm ___in	_

_touch floor ___mm (___in) above floor _touch ceiling

describe: colour ________________ texture ________________

Item	Number	Height	Adj	Depth	Adj	Width	Adj
moveable screen	____	___mm ___in	_	___mm ___in	_	___mm ___in	_

_touch floor ___mm (___in) above floor _touch ceiling

describe: colour ________________ texture ________________

moveable screen _____ ___mm ___in _ ___mm ___in _ ___mm ___in _

_touch floor ___mm (___in) above floor _touch ceiling

describe: colour_____ texture_____

wall: describe: colour_____ texture_____

wall: describe: colour_____ texture_____

wall: describe: colour_____ texture_____

wall: describe: colour_____ texture_____

door: describe: colour_____ texture_____

MISCELLANEOUS

	Number	Location
fan	_____	_____
heater	_____	_____
extra sweater	_____	_____
blanket	_____	_____
humidifier	_____	_____
radio	_____	_____
acoustic treatment to walls	_____	_____
acoustic treatment to floors	_____	_____
background noise (e.g., musak)	_____	_____
air cleaner	_____	_____
give make and model number		_____
deodorizer	_____	_____
negative ionizer	_____	_____
extension cord	_____	_____

PERSON CODE NO. 02. _ _

	Number	Location
PERSONAL ARTIFACTS		
kettle -	_____	_____
beverage maker	_____	_____
posters	_____	_____
plants	_____	_____
photos	_____	_____
certificates	_____	_____
work related material		_____
none		
SIGNS OF EROSION OR INCONVIENCE		
exposed wires		
scratched furniture		
water stains		
dirt stains		
cigarette burns		
tape over diffuser		
tape over cracks		
covered window		
evidence of open window		
added floor covering		
added wall covering		
other_____		

ILLUMINATION

AMBIENT

LOCATION OF OVERHEAD LUMINAIRES _directly above _to the sides

NUMBER OF FIXTURES_____ NUMBER OF BULBS IN THE FIXTURES _____

LENS COVER _eggcrate _stipled plastic _other_____

DO LIGHTS FLICKER? _yes, steady _yes, intermittent _no

IF THERE IS A FILTER IN THE FIXTURE, GIVE COLOUR _blue _pink _____

TUBES ARE: _on _off by bldg manager _off by occupant _burned out

OCCUPANT CONTROLS AMBIENT LIGHT BY:

_ a wall switch located (give reference code _____) controlling workstation. Switch is located ____mm (___in) away and is _easy, _difficult to access

_ a wall switch located (give reference code _____) controlling workstations (list reference codes 02-___, 02-___, 02-___, 02-___, 02-___). Switch is located ____mm (___in) away and is _easy, _difficult to access.

_ switch cannot be accessed.

TASK LIGHT

DESK LAMPS _yes _no

the bulb is _flourscent (__warm, __cool) _incandescent of ____watts _other_____

There are ____number of bulbs.

The lamp _is _is not adjustable.

OTHER LAMPS

Location_____

the bulb is _flourscent (__warm, __cool) _incandescent of

____watts _other_____

There are ____number of bulbs.

The lamp _is _is not adjustable.

DAYLIGHT

EXTERIOR WINDOW _yes adjacent: _facing window _back to window

_sideways to window, desk against a wall _sideways to window, chair back to wall or corner

_not adjacent, but can see window when seated

_no view of window

GLASS TYPE _clear _tinted (if possible, describe filter_____)

DEPTH OF WINDOW OVERHANG ____mm (___in)

WINDOW COVERING _none _translucent curtain _opaque curtain

_horiz. blinds _vert. blinds _roll down shade

_other_____

IF THERE IS A WINDOW COVERING, IS IT? 1)__open __closed __half open

2)__ __ __

3)__ __ __

4)__ __ __

THERMAL COMFORT

WINDOW OPERABLE _yes: _manageable by occupant _require special key or action

_no: _fixed glazing _management rule to keep window closed _too difficult to open

DRAFTS _drafty _stagnant _average _____FPM (give time ___:___)

HUMIDITY _dry _humid _average wet bulb ____°F dry bulb ____°F RH ____% (give time ___:___)

OCCUPANT CONTROLS SUPPLY AIR TEMPERATURE BY:

_ adjusting thermostat located (give reference code 19-____) controlling workstation. Thermostat is located ___mm (___in) away and is _easy, _difficult to access.

_ adjusting thermostat located (give reference code 02-____) effecting workstations (list reference codes 02-___, 02-___, 02-___, 02-___). Thermostat is located ___mm (____in) away and is _easy, _difficult to access.

_ calling building manager to adjust thermostat.

PHOTO REFERENCE

PERSON CODE NO. 02. _ _

COMMENTS

ACOUSTICS

NOISE SOURCE	constant	intermittent	buzz	beeper	white noise	high freq.	low freq.	other
office machine	_	_	_	_	_	_	_	_
- typewriter	_	_	_	_	_	_	_	_
- other_____	_	_	_	_	_	_	_	_
mechanical	_	_	_	_	_	_	_	_
- perimeter hot water	_	_	_	_	_	_	_	_
- interior air handling	_	_	_	_	_	_	_	_
electric lights	_	_	_	_	_	_	_	_
voices	_	_	_	_	_	_	_	_
people circulation	_	_	_	_	_	_	_	_
telephones	_	_	_	_	_	_	_	_
outside building	_	_	_	_	_	_	_	_
other_____	_	_	_	_	_	_	_	_

IS THERE ANY VIBRATION? _yes,intermittent _yes,continuous _no _don't know

AIR QUALITY

SMOKING ___no evidence ___yes evidence (_ ashtray _filled ashtray) __"no smoking" sign

IN GENERAL THE AIR IS: _fresh _with odors (_perfume _cigarette smoke _photocopier machine describe_____)

_stale _other _____ (give time ____:____)

_____number of slides taken for this workstation.

checklist completed by:_____ date: 84/ /

time: ____:____

APPENDIX C:
SUMMARY OF FUNDI LABORATORY TESTS AND FINDINGS

AIR CIRCULATION

Tested in Flow Visualization Water Tunnel, National Research Council, Ottawa.

As a result of the gaps, air circulates in and around the occupant side of the work enclosure. Regradless of the direction of the air supply, air movement in the FUNDI is good.

ACOUSTICS

Tested in an empty, standard government open office, Quality Engineering Testing Establishment (QETE), Hull.

Sound originating from the interior (a simulated user) is reduced somewhat (source: 90 dbA; microphone: 58 dbA average). Adding acoustic tiles to the walls or sealing the gaps have insignificant effect on reducing sound levels (less that 3 dbA). Sound transmission through free air seems to be outweigh any other paths. There is potential to increase the ability of the FUNDI enclosure to absorb sound.

ELECTRICAL SYSTEMS

Tested in the QETE electrical laboratory, Hull.

Radiant Heaters: dimmer switch has to be turned clockwise approximately 45% of its rotation before it will trigger and operate. Once it triggers, it will operate the heater form 5 to 100 percent of its remaining rotational range (i.e., 55% of dial). The switch needs a pilot light to give the user more feedback on the setting of the heaters. It is recommended that dimmers with RFI (radio frequency interference) incorporated suppression be used in future assemblies.

Fans: although electrical modification allow the dimmer switch to control the fan, the motor is not well suited for this set-up. A low-voltage fan would be more appropriate.

Luminaires
1) flourescent: Works as specified and delivers the specified 25 watts. Potential to give greater choice to user (i.e., light spectrum, shade).
2) incandescent: Works as specified and deliveres the specified 56 watts. Dimmer switch works satisfactorily. A different fixture could be easier to adjust and give a greater choice of light level to the user.

Miscellaneous: The power bar in inconvenient to assess if a person has to use the plugs regularly. The FUNDI was not tested for electrical frequencies which might cause interference on VDT's.

ERGONOMICS: Moveablity

Tested in the Mechanical Engineering Section, QETE, Hull.

The FUNDI does not track well, due to the casters. Although the FUNDI can always be moved using a force within the Standards for men and women, the worst condition (all castors facing opposite to the direction of desired movement) requires a force greater the the standard to start the roll, but is easy to keep it moving. Spherical casters would make it easy for the user to make small adjustments to the position of the FUNDI. The weight distribtuion on the casters is unequal and should be corrected by higher quality control on the craftmanship in assembly and by a caster with some self-leveling capability.

SURFACE FINISH: reflectance of principal surfaces

Tested in the illumination laboratory, QETE, Hull.

The reflectance characteristics of the finish was described. The white is reasonably even and consistent with reflectance (Y) value 78%.

THERMAL QUALITY

Tested in the cold chambers at QETE, Hull.

The radiant heat panels heat up quickly and fairly evenly. They effectively increase the ambient temperature up to 2°C within three minutes. More analysis of the lab tests is to be done in November/84.

APPENDIX D: BIBLIOGRAPHY

* indicates a copy is in ABS

* Baron, R., Duffy, W., Information Display Speed and Noise in the Design of Computer Terminals, Univeristy of Massachusetts, Aherst, Massachusetts, page 42-45, published after 1970.

Owing to diversity of computer terminal performance, this study was designed to determine the effects of display speed and display generated noise on operator efficiancy and perceived comfort. Response time of operators performing common computer tasks (typing and Fortran debugging) were compared for different conditions (1) character display speed: ranging from 10-240 CPS (characters per second) and (2) display generated noise (e.g., key clicks, coded warnings): ranging from 72-92 dB(A).

The results suggest that 60 CPS is an optimum display speed (n.b., the majority of current terminals operate at 10-30 CPS) and that display generated noise did not have a significant effect on user response time for the given task.

* Bavelas, A., MacGregor, J., Safayeni, F., Office automation: a conceptual approach, North-Holland Publishing Company, Journal of Information Science 5, 1983, Page 169 - 172.

Takes the position that offices are information processing systems and that the process of organizational control will be most affected by the emerging information technologies. To analyse the organizational control of an office system requires a description of the task-structure and the person-interaction-structure. Considering this, the suggested conceptual model of the office-of-the-future would have the following characteristics:

1) radical change in the way information is reduced;
2) change in the way components of work relate to each other;
3) change in interpersonal communications;
4) altered office "social habitat";
5) altered social structure modifies the task-structure (see items 1 and 2);
6) cyclical change to communication and "social habitat".

All organizations exist, to some extent, in a continually changing environment. Automation causes networks and organizations to reorganize.

This paper is written in a chunky, academic style. Not recommended reading, but they put on paper what others only discuss.

Bickson, T. and Gutek, B. "Advanced Office Systems: An Empirical Look at Utilization and Satisfaction", The Rand Corporation, Santa Monica, Cal., Feb. 1983.

* Canadian Labour Congress, Towards a more Humanized Technology, CLC, Ottawa, Ontario, December 1982.
Health aspects of VDTs in offices. Presents the methodology for data capture, including a questionnaire.

Cohen and Cohen, Planning the Electronic Office, McGraw-Hill, USA, 1983. PWC HF 5547.2 .C63 1983. ISBN 0-07-011583-4

This book provides a good introduction to the various aspects of the electronic office, ranging from management, space planning, architecture, ergonomics, and furnishing. Due to the wide range of topics, and the different perspectives employed, it is somewhat unclear who the intended audience is. Decision-makers would benefit from certain sections and facility managers could gain from others. As well, the book seems suitable for an uundergraduate college course.

The authors describe some of the issues in office planning and how they are modified by the requirements of electronic office equipment. The book contains many studies at a general level and with a slightly different perspective, on aspects of office planning that are familiar to people in the building industry (e.g., lighting, acoustics, selecting system furniture, characterizing the physical needs of a task).

This book reflects considerable effort at consolidating and cross-relating issues of the electronic office. This approach shows the reader the multifaceted implications of adding electronic equipment to the office. Unfortunately, the approach leads to a repetition of topics. Issues are touched upon several times in the book for different reasons (e.g., technical, marketing, economic, work productivity implications). As such, it is recommended to read the book from cover to cover to get the total story.

The authors use words carefully to be precise in their discussions. For example, they use the term "electronic office", implying a place of business filled with automated office equipment which is manipulated by people. The authors avoid the widely used term "office automation" which could imply that people are no longer working in the office.

The text is rich with examples from aspects of people's lives that every reader can relate to (e.g., landmark films, books, buildings; familiar working situations). This helps the reader to absorb the information. On the other hand, the reader who wants to move quickly through the book will be slowed down by the format. Titles for the sections give insufficient queues about the text. More subtitles or text highlights are needed. There are many many illustrations although they are not referred to

directly in the text and the explainations sometimes offer no elaboration to the discussion.

There is much speculation regarding the changes to be seen in offices due to the proliferation of electronic equipment. As such, it is refreshing to read text in which conclusions are reached. However, the examples are taken from the United States, to the omision of the experience in other countries from which we stand to gain much. Most of the conclusions seem to be the opinion of the authors and are not substantiated with references to other research or designs.

The authors argue that the present move to automate the office is a phase in a series of technical developments since 1776 when Adam Smith, in his book "Wealth of Nations", noted the division of labor. Through a brief socio-economic-geographic discussion, they conclude that "it is obvious that changes must be made in the way offices are designed if this reorganization (e.g., flattened organizational pyramids, more work with fewer people at lower cost) is to take place". Many of us would like to see office space standards changed. The process to bring about this change is more involved than the text would lead us to believe.

* Culnan, M.J., Bair, J.H., Human Communication Needs and Organizational Productivity: The Potential Impact of Office Automation, Journal of the American Society for Information Science, May 1983, Page 215 - 221.

Much of what white collar workers do in offices is communication-related. Communication is the critical process in organizations. Office automation has been defined as a new, structured technique for handling both written and oral business communication and person-to-person interaction using technology. As such, it offers the potential to make organizations more productive by improving organizational communication.

For the discussion in this article, communication is the interaction of one or more humans where information is exchanged that ultimely has meaning to the participants. Individuals communicate for: (1) information factual or technical data; (2) control clarify tasks, establish responsibility; (3) motivation to influence others, elicit cooperation and commitment; and (4) emotive to express feelings, establish credibility and social interaction.

The traditional modes of communication are face-to-face, telephone, written and electronic (telex, facsimile). New communicaiton modes include electronic messaging and computerized conferencing. The primary impact of office automation upon communication will be in the substitution of traditional modes for electronic modes. The success of the substitution depends on the purpose of the communication and the communication style of the communicator. In general, communication for the purpose of control or information is appropriate on electronic modes. Communication involving bargaining, negotiation, getting to know someone or resolving disagreements are inappropriate for

electronic modes.

It may take individuals a while to get accustomed to electronic communication. Presently there is no "etiquette" of formal rules or informal norms to guide people on how to use these systems.

A benefit of electronic communication is the reduction or elimination of "shadow functions" (steps which do not contribute to productivity, such as making calls, a busy signal, poor connection, person out of the office, etc.). Managers may benefit from improved control in that information may be more accessible which should result in fewer surprises and less reative decision-making.

For successful implementation: (1) the systems must be used regularly and for a sufficient amount of time. (2) the equipment must be available to each user at all times in the day. (3) there must be a critical mass of users on the system. Ideally this would be all workers, and at least co-workers. (4) there must be a need to communicate. (5) there must be user support from top management and in the form of training, documentation and on-going consultation related to the use of the system.

Dubin, F., "Energy conservation, integrated building design and the consequences of the work environment", ICEUM, 1981.

Galitz, W., Human Factors in Office Automation, Life Office Management Association, Atlanta, Georgia, 1980.
CISTI HF5547.5 G161
Behavioral aspects of office automation. Seems comprehensive and practically orientated. Straight forward in presentation.

* General Services Administration, The Automated Office - An Environment for Productive Work, or an Information Factory?: A report on the State-of-the-Art, November 1983, NBSIR 83-2784-1; Executive Summary, December 1983, NBSIR 83-2784-2; Interim Design Guidelines for Automated Offices, August 1984, NBSIR 84-2908. Center for Building Technology, National Bureau of Standards, Washington, D.C.

* Government of Alberta, The Office Systems Furniture Study Group, Office Systems, Furniture Study and Proposal, June 17, 1983.
A specific study done as a proposal for a government department to acquire office systems furniture to fit their requirements with VDTs. Although some of the conclusions can be questioned, it is a good example of what is entailed in such a study. As well as providing alternatives for furnishings, a list of requirements are summarized for: desk, chair, footrest, document holder, palm rest, printer sound cover and lighting.

Grandjean, E. and Vigliani, E., Ergonomic Aspects of Visual Display Terminals, proceedings of the International Workshop, Milan, Taylor & Francis Ltd, London, 1980.
CISTI TK7882.I6 E67 1980 c.2
Collection of many excellent research papers of VDT use ranging

from visual aspects, psychological to physical. I have photocopied the most applicable for the FUNDY file. Well written, palatable technical information.

* 1. Terrana, T., Merluzzi, F., Giudici, E., Electromagnetic radiations emitted by visual display units, Institute of Occupational Health, University of Milan, Milan, Italy, Page 13 - 14.

* 2. Wheatley, D.J., Drake, B.M., Practical implications of the interest in ergonomic aspects of VDUs, ITT Human Factors Group, Harlow, U.K., Page 251 - 256.

* 3. Buti, B.L., De Nigris, F., Moretti, E., Ergonomic design of a workplace for VDU operators, Societa di Ergonomia Applicata, Milan, Italy and Cortili, G., Institute of Human Physiology, University of Milan, Italy, Page 283 - 292 and Page 260 - 261.

* 4. Cail, F., Christmann, H., Elias, R., Tisserand, M., Investigations in operators working with CRT display terminals: relationships between task content and psychophysiological alterations, Institut National de Recherche et de Securite, Avenue de Bourgogne, France, Page 211 - 217.

* 5. Ghiringhelli, L., Collection of subjective opinions on use of VDUs, Via Schiaparelli 16, Millan, Italy, Page 227 - 231.

6. Stewart, T.F.M., Practical experiences in solving VDU ergonomics problems, Butler Cox & Partners Limited, Morley House, London, Page 233 - 240.

* 7. Doran, D., CRT-keyboard VDUs - Implementing the solutions that already exist, British Airways, Heathrow Airport, London, Page 239 - 249.

* 8. Laville, A., Postural reactions related to activities on VDU, Laboratoire de Physiologie du Travail et Ergonomie, CNAM, Paris, France, Page 167 -183.

* 9. Brown, C.R., Schaum, D.L., User-adjuster VDU parameters, IBM System Communications Division, Kingston, N.Y., U.S.A., Page 195 - 200.

* Grandjean, E., Fitting the Task to the Man, An Ergonomic Approach, Taylor and Francis Ltd., London, 1980.
This is a textbook of which we only have chapter 12 on "Boredom". It contains a psychologist definition of boredom in the office environment and describes laboratory and field studies to distinguish between "cause and effect". The examples are aimed at repetitive tasks (e.g., control panels, machines, projection screens).

arris, D., Ceilings for the Office of the Future, The Construction Specifier, page 58-65, July, 1983.

A good checklist of functions that a ceiling is to provide with a slight bias to VDTs. Stresses that ceiling design is to be integrated with the planning process. Contains several general guideline/motherhood statements (e.g., ceiling must be flexible, must be able to accommodate different users over time) without saying why or how all this can be achieved. A good primer text.

* Helander, M., The Automated Office: A Description and Some Human Factors Design Considerations, Dept of Industrial Engineering and Operations Research, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 24061. June 1983.

A large volume of careful research done in high academic style. Wide coverage introducing scope of office automation, machines and organization. Provides general discussion for how to manage an organizaiton with automated office equipment. Summarizes much of the literature and contraversy of OA and randomly gives a recommendation for design. Informative reading but of inconsitent value.

* Immel, Richard A., The Automated Office: Myth Versus Reality, Popular Computinng, May 1983

Humorously written article touching just about all aspect of the "office of the future". Offers explainations for the success or not of OA and how that relates to different levels of people in a business.

Some highlights:
Offices are gradually being automated. There has not been the wild rush that many observers predicted a few years ago. The basis for the forecasts was the expectation that companies were (and still are) desperate to do something to improve white-collar productivity. It is not clear if white-collar productivity is a "problem" that office automation can remedy or if productivity is just a condition of certain kinds of business.

Measuring managerial and professional productivity is fundamentally impossible. At best that's the wrong approach; at worst it's getting into question that shouldn't be asked. As well, most of the "productivity" everybody talks about comes from the interaction between people, not from the ability to write and process pieces of paper.

People have underestimated the amount of time needed to introduce the changes which are part of OA.

Some people fear that OA could become a replay of the industrial assembly line and create a new battleground for labor and management.

No supplier has put the package all together for the user. The basic obstacle is that the equipment won't all work together! Companies are lagging behind their customers' business needs and servicing.

Instead of using technology to do the same old things faster or more efficiently, it is recommended to reexamine the basic premises behind what a business is doing and how it gets it done.

* Lueder, R., Literature Review on VDT Work Station Design, Mantech, Toronto, 1984.
Easy to understand description (despite the human factors jargon) of the physiology of postures and the importance when working at a VDT. Describes the stresses in the spine and muscles, in particular for the seated position. Surveys suggest that people tend not to sit in one position, and the range of positions varies between individuals.

Comments on VDT workstation criteria. The chair is probably the most important furniture element since it supports virtually all of the body weight (describes features of seat height, seat pan slope, seat depth, back rests and arm rests). There is not ideal keyboard height, angle or keyboard-to-screen distance. An easily adjustable range should be provided (some ranges are given). Similarly, VDT screen height, screen angles, palm supports and document supports require to be matched to the situation, the individual and the task. Lighting consideration are briefly discussed and describe the terminology and why there is a problem.

* Lighting up the CRT Screen - Problems and Solutions, Lighting Design & Application, page 14-17, January 1984.
Three case studies of lighting systems designed for electronic offices. Describes office furnishing, lighting requirements for the tasks and what the chosen lighting system was intended to do. No comment on in situ performance.

* Mick, C.K., Planning for Office Automation, Journal of the American Society for Information Science, May 1983, Page 229 - 233.
Offers three approaches for introducing office automation into an organization. (1) Problem-Solving: Top Down Involves asking "what is to be done?" and seeking information; "how to do it" and identifing specifics; and "now do it" which is the implementation. (2) Participatory Planning: Bottom Up Involves the stakeholders in the decision-making, problem-solving process. Getting a representative sample can be a long and difficult task. Problems are approached from an abstract level of generating goals and are developed until precise project specifications are defined. The notion that change is a continuous process is integrated into the participatory planning approach. Although this approach reflects organizational and personal "life", this is a difficult process to keep focused on the task. (3) Focused Process Approach This is a blend of the first two approaches. Stakeholders are involved and a strong facilitator/leader is used to manage the process (it is not specified if this person should be from within the group or an outsider). A preliminary solution is used as a springboard to elicit peoples' participation. When selecting an office automation system, reliability and

flexibility are preferrable to sophistication. It is better to have a system that can do a variety of functions which will enhance a persons' work. Single function systems (e.g., word processing) tends to force people to specialize, leading to boredom. Once a system is installed, feedback from the users is valuable for fine-tuning and for future installations.

Introducing change involves benefits and risks for the innovator.

Mill, P. "Transdisciplinary building diagnosis, Total building performance", Proceedings from NRC Symposium on Building Performance, 1983.

National Academy of Sciences, Video Displays, Work and Vision, Committee on Vision, National Research Council, National Academy Press, Washington, D.C., 1983.

* National Safety Council, USA, Video Display Terminals, The Human Factor, brochure No. 100M882, 1982.
A public relations brochure giving some gross cut guidelines (e.g., the top of VDT screen should be no higher than eye level to minimize eye movement) to specific guidelines which different "experts" may not agree with (e.g., for comfortable viewing, the screen should be about 18 inches from your eyes). The literature review by Leuder provides more explaination and substaination for the walues which are recommended.

* Nicholson, Robert T., Integrating Voice In The Office World, Byte Publications Inc. December 1983
Integrated voice and data systems can assist the most time-consuming office activity: communication. The two basic applications are voice-as-data and voice-recognition.

To date, use of either application is limited by poor interfaces. That is, high-quality voice requires powerful computing power to rapidly move and store large volumes of data. To make this feasible, the system must be designed to effectively share limited and/or expensive system resources.

Schemes for integrated voice appplications include:
1) Blanks can be left on a "form" displayed on the screen. The user can fill in the blank after a prompt from the terminal. The "form" and computer recording can be forwarded to another section to be input.
2) Voice annotation allows a 3rd party to record verbal comments to a document. A mark appears on the screen where the comment starts and the originator of the document can replay the recorded comment after the file has been returned (by electronic mail).
3) User HELP information can be given verbally by the termnal. A problem is that the user cannot try an operation while the instruction is being "spoken".
4) By limiting the vocabulary to the essentials, it is possible to give verbal system-level commands, in situations where

"hands-free" operation is required.
5) Direct-speech-transcription, where final documents are produced from spoken input and keyboard use is eliminated, is far out on the horizon.

The Productivity Center. "White Collar Productivity: The National Challenge". Houston, Texas, 1983.

* Pulgram, W., Stonis, R., Designing the Automated Office, Whitney Library of Design, N.Y., 1984 (ISBN 0-8230-7136-7). ISBN 0-8230-7136-7

For people involved in introducing electronic office equipment into a building, this book includes a description of what is involved; a planning-process checklist highlighting the differences from conventional office accommodation; expected obstacles; what to try to avoid; and relevant computer-related hardware and operating information. It is a well-organized text with many easily understood graphics. Of particular value are the illustrations of problems encountered in other electronic office installations and the glossary of computer-related terms.

Without providing specific solutions, the text offers guidelines and planning options. Background information on the electronic office is presented along with a manufacturer's overview of current options for computer architecture, user equipment and furniture. This information is presented in a generic form. However, due to the rapidity of innovations in the electronics industry, some of the information may soon be obselete.

The list of environmental considerations for the electronic office is similar to those for conventional offices. The authors acknowledge that conventional office environments have problems (especially acoustics) and that these will still be present in electronic offices. Some problems may be heightened due to the addition of electronic equipment (e.g., machine noise) or the specific environmental requirements of the equipment (e.g., temperature, relative humidity).

The text is theoretically strong although in practice, some of the information required to complete the planning process may be difficult for an organization to predict or control (e.g., describe present task versus how it may be altered by the capabalitites of the electronic equipment; control for the rate of introducing the technology because it tends to be supplier driven; winning support from building accommodations staff who may have to shift their budget allocations for the new equipment; software glitches). Planning for change with unknown boundaries tends to lead to recommendations of "flexibility". To overcome some of the unknowns, questions are included within the recommended checklists and options are left open to program for the "unpredicted". People experienced in building accommodation can modify the planning process presented in this book to suit their situation.

Examples are included of how to select components to create a workstation matched to the activities of a job, as defined by a task profile. Typical tasks for a worker using electronic office equipment are also included (e.g., effect of different video display layouts to encourage or inhibit communication or concentration). Workstation guidelines/solutions are limited to conventional office systems - desks, screens, right-angle configurations, ordered / symmetrical plan. Generally, the introduction of electronic equipment is presented an an opportunity for improving some established business practices. It may also be an opportunity to propose changes to the way in which offices are furnished, primarily to reflect the changes to the business and secondarily to correct for existing environmental deficiencies.

* Rasmussen, J., Human Interaction With Computers, The Human As A System Component, Chapter 3, page 67-96. Publisher? Year?
Description of fundamental mental activities for humans to complete a task with a computer. Provides sample typical routines sequences to improve an operator mental process preformance. Discusses why the human and the computer must "co-operate". The human must be considered an integral part of the data process to maintain a positive attitude towards computer assistance in complex systems. Although outside the scope of this paper, aspects of the human emotional and social work condition must also be considered.

Rubin, A., The Automated Office - An Environment for Productive Work, or an Information Factory?, see listing under "General Services Administration".

Saphier, M., Planning the New Office, McGraw-Hill Books, USA, 1978.
CISTI HF5547 S241 BLDG
Practical cost/benefit to space selection and maintenance. Suggest methods of inventory, costing for additional space, etc. Linear in its approach and disciplinary.

* The Seybold Report on Office Systems, P.O. Box 644, Media, Pennsylvania, 19063. (215) 565-2480.
CISTI Ser HF 5548.2 S51 V.5,n.1 1982
Series of publications giving specific information on performance of different word processing system. Very chatty and an easy reading way to gain a sense of the marketplace.

* Shiff, R.A., Office Automation, The Human Equation, Journal of Micrographics, May 1983, Volume 16, Number 5, Page 28-30.
Written from point of view of business person who is "sold" on office automation. Highlights the human aspects of introducing the technology - proper motivation and orchestration of the human effort. Cautions that management must open address "scare" items about the technology (e.g., radiation, eyestrain, job redundancy). Emphasises the opportunity for job enrichment, increasing the possibilities of dead-end jobs to the status of paraprofessional.

Not highly informative reading.

* Stammerjohn, L.W., Smith, J., Cohen, B., Evaluation Of Work Station Design Factors In VDT Operations, U.S. Department of Health and Human Services, Cincinnati, Ohio 45226, 1979

Tapscott, D., Office Automation, Plenum Press, New York, 1982.
Stance that contemporary integrated office systems are the outcome of the convergence of three technologies: computers, communications and the office. Presents systems to automate an office and how to introduce the technology. Much on software and its structure.

* Teger, S.L., Factors Impacting the Evolution of Office Automation, Proceedings of the IEEE, Vol. 71, No. 4, April 1983, Page 503 - 511.
Examines some of the market factors which will effect the implementation of OA (e.g., Corporate motivation, white-collar worker needs). Stance that office workers spend most of their time in interpersonal communications (voice, meeting and document). OA tools are examined in their ability to support existing communication modes.

* Toft, M., Office technology impacts building design, Canadian Building, page 17-20, November/December 1983.
Well written discussion of some of the options and building furnishings to be considered for an automated office. Emphasises that flesibility is the prime ingredient to meet the (changing) user needs in a new office building. Topice include: HVAC, wiring, building maintenance, lighting and building costs. Does not provide any absolute answers but raises relevant questions.

Uhlig, Farber, Bair, The Office of the Future, Vol. 1, Communication and Computers, North-Holland, New York, 1979.
CISTI (NRC) HF5548.2 U31
Software specific. Excellent coverage of management and style of working change due to technology.