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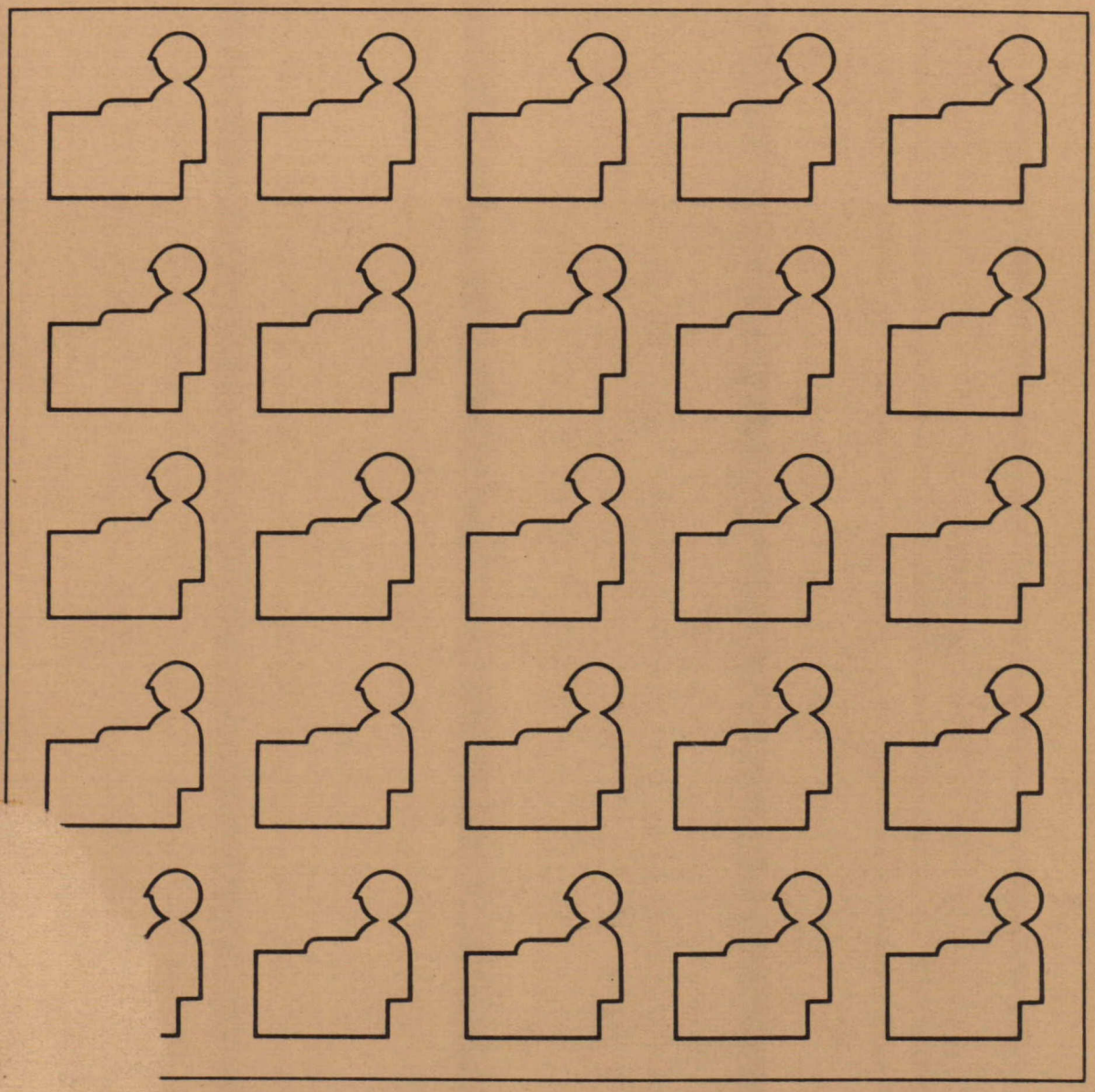
OFFICE COMMUNICATIONS SYSTEMS PROGRAM

PROGRAMME DE LA BUREAUTIQUE

FIELD TRIAL EVALUATION GUIDELINES



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"BRINGING PEOPLE AND THE RIGHT TECHNOLOGY TOGETHER"

FIELD TRIAL EVALUATION GUIDELINES

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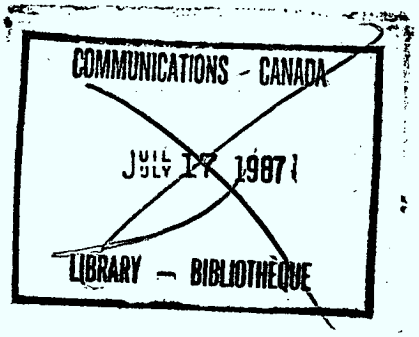

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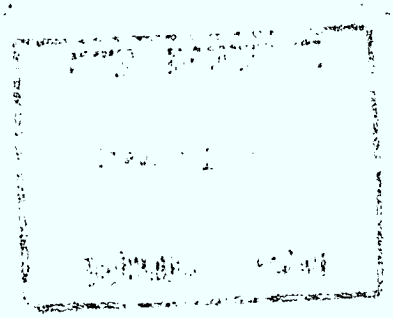

FIELD TRIAL EVALUATION GUIDELINES
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0.0 EXECUTIVE SUMMARY

If properly evaluated, the OCS Field Trials will be rich with lessons, aiding and stimulating Canadian suppliers and users to take advantage of the new opportunities provided by office systems technology. In many ways, the success of the OCS program hinges on how well the field trials are evaluated.

This document presents guidelines for the evaluation. The guidelines will help ensure that the field trials generate the data, information and knowledge required by the main stakeholders:

- The user departments
- The field trial vendors
- All Canadian user organizations
- All Canadian Suppliers
- Other stakeholders such as women, government policy makers, trade unions, and handicapped groups.

One set of guidelines is required because of the multiplicity of stakeholders, each having different objectives, interests and roles in the field trials. It is hoped the guidelines will represent a general consensus among these groups. As well, guidelines are required because of the newness, scope and complexity of integrated office systems. There is very little experience with these new systems, let alone experience evaluating their impact and how to implement them. The experience to date is embodied in these guidelines and should assist the evaluation teams.

The document is not a guide for the design and implementation of systems. The guidelines apply only to the evaluation of these processes and the impact of the system itself. As well, the guidelines do not constitute a methodology for evaluation. This can only be developed concretely, in the context of an actual implementation. Rather, the guidelines will be useful to the evaluation teams in constructing such a methodology.

Guidelines are presented:

- for research methods;
- for describing and evaluating the technology or technical aspects of the system;

- for measuring system use and acceptance by the users;
- for evaluating the impact of the system on productivity;
- for evaluating the social impacts of the system;
- for evaluating the process of determining system requirements and matching all aspects of the system to user needs;
- for evaluating the implementation process; and
- for organizing the evaluation team.

A complete evaluation should cover all of the above topics. Clearly, it will not be feasible to acquire all information desired by all stakeholders. Serious constraints include the funds and resources available to all parties; the response burden on the subjects providing the data; and the proprietary nature of much information. As a result, it will be necessary to set priorities for evaluation objectives.

This document does not attempt to establish such priorities. To do so would be arbitrary and inappropriate. Rather, a first activity of the evaluation teams should be to review the guidelines and negotiate evaluation objectives. This can only be done within the context of each field trial and its specific objectives and constraints.

0.1 Research Methods

Good methods are required to produce valid and reliable data. Methods should be comprehensive, efficient, transferable (beyond the original evaluators), understandable (by all parties in the evaluation) and should guarantee anonymity (or at the least confidentiality) of the respondents. A number of guideline areas are discussed:

1) Conceptual Framework

A clear and stated framework outlining the criteria for system success as the foundation of an evaluation method.

2) Research Design

Each evaluation project should use a quasi-experimental design. This includes a pretest and several posttests of the pilot group and one or more comparison groups, coupled with ongoing system

monitoring. Data should be collected for at least five points in time: a) a pretest no more than 6 weeks before pilot study implementation; b) an observation of the system implementation; c) the first posttest (which may also constitute the requirements analysis for the next phase); d) the observation of the larger field trial system implementation; and e) the posttest for the larger implementation. The problem of attrition from the pilot and comparison groups is discussed, with recommendations.

3) Research Process

A number of aspects are discussed with recommendations for the evaluation team.

- Sampling for office system evaluation research is a tricky business. The criteria to be used are not those typically applied to experimental design.

- There are a variety of standard measurement instruments which can be used and others should be developed. Instruments must be designed in a concrete context, with reference to the system objectives. Maximum use should be made of data collection tools already in place, such as performance monitoring systems. To avoid the danger of invalid data, or worse, undermine potential user cooperation and support for the system itself, extreme caution is advised to not burden the respondents with obtrusive and time consuming instruments.

- Data analysis will present a formidable challenge. Much of the data analysis will be descriptive, rather than statistical in nature. Although the focus will be on each site, it should be possible to conduct some comparisons across the three field trials to provide broader information regarding tools and interventions which work. This can only be done, however, with the recognition that each of the field trials is unique.

- Procedures for data collection, for winning respondent cooperation, and for having a smooth study are discussed.

- Documentation of the evaluation process serves two purposes: a) it enables an evaluation of the evaluation process itself; and b) it protects the program from disruptions due to possible turnover in the evaluation team.

0.2 Technology Description and Technical Evaluation

Guidelines are presented for describing the system and its installation, as well as for data collection regarding how, and how well the technology functioned. This information will be valuable to the field trial suppliers and user departments, as well as to other suppliers and user organizations as it will help them understand the technical issues associated with integrated office systems.

It is clear that some of the technical data regarding the performance of the system should be proprietary to the supplier. Its release will have to be negotiated. Mechanisms for resolving differences are discussed in Section 9 of this document.

Three aspects of the technical evaluation are discussed:

1) The System Specification

Much can be learned about writing specifications for office systems. Explicit specifications protect the customer and the supplier by defining what the system should deliver. They provide a baseline for measuring and altering system performance. The process of writing system specifications will also provide insights regarding what specifications are reasonable, feasible and useful.

The specifications should include information regarding the technical configuration, system capabilities, installation plan, maintenance and back-up as well as system monitoring. In general, the more that can be specified in advance of implementation, the better.

2) The Historical Chronology

Each field trial should generate an historical record of the overall installation. This should include:

- ⊕ physical, human and financial resources required;
- ⊕ a record of system reliability and maintenance; and
- ⊕ a "problems log" where the users can provide feedback to the system operators regarding problems, bugs, changes required, etc.

3) The Technical Evaluation

System performance can be described and related back to the specifications. Performance and ergonomic measures are discussed.

0.3 System Use and User Acceptance

The field trials will provide an opportunity to learn about user acceptance and use of the new office systems. Evaluation data will help all stakeholders understand;

- what system tools were found useful;
- how various tools were used;
- how aspects of work changed (such as communications patterns);
- and how attitudes towards the new technologies evolve with use.

Data can be both a) attitudinal or b) generated automatically by the system itself. Both techniques have advantages and disadvantages. Several issues must be resolved:

- A plan for each evaluation to resolve the privacy issues associated with system monitoring must be developed. It is recommended that there be no reporting or other use of individual user's data -- i.e. that only aggregate data be presented. As well, a contract should be negotiated with the users themselves, specifying exactly what monitoring data are collected and how the data will be used and reported. Experience has shown that without such procedures, user support for the implementation may be seriously undermined.
- System monitoring takes considerable resources, including hardware (as great as one-quarter of the total capacity), software (considerable programming to generate statistics), and human resources (data analysis and intepretation). Responsibilities and funds for this activity will have to be negotiated among the suppliers, users and the OCS program.
- Suppliers may judge some or all such data to be of a proprietary nature. Ownership and release of these data should also be negotiated as part of the overall project.

The document recommends some areas where attitudinal and system monitoring data should be collected.

0.4 System Impact -- Productivity

Data regarding the impact of the system on productivity is of central importance to the user departments, suppliers and OCS personnel. These data will enable modification of the system and the cost-benefit analyses required for system growth. Data will also help field trial and other suppliers with product planning and marketing.

There are a number of problems developing adequate measures of productivity impacts. These are discussed and a number of recommendations are made.

1) Defining Productivity

This will have to be done by the evaluation teams. A framework is recommended in this document. Office systems are viewed as impacting internal efficiency, effectiveness, productivity, and overall organizational performance.

2) Comprehensive Methods

A sound conceptual framework and appropriate methods are required to generate meaningful productivity data.

3) Multiple Measures

A single measurement approach should be avoided. Measures corresponding to definition areas cited above are recommended.

4) Measurement Instruments

A variety of standard instruments can be customized, and a number of new instruments will have to be developed.

5) System Monitoring for Productivity Data

Monitoring individual users to generate productivity data is not recommended and should be avoided for reasons stated in the guidelines.

6) User Role

Users themselves should play a central role in defining office products, critical success factors and

performance measures.

7) Measuring the Reinvestment of Time Savings

Much "productivity" data rests on time savings. The degree to which such savings are used for new work can and should be evaluated.

0.5 System Impact → Social

The field trials provide a unique opportunity to learn about the impact of the new office systems on people. While most social impact data are collected at the level of the individual, several levels of aggregation provide convenient groupings:

- ⊕ Individual Impacts refer to the effects of systems on individual jobs, health, and psychological well-being.
- ⊕ Work Group Impacts refer to effects on workflow, group relations, management style, decision making and superior-subordinate relationships.
- ⊕ Organizational Impacts refer to changes in organizational structure, power, organizational climate and mission.
- ⊕ Societal Impacts cut across organizational boundaries, posing questions confronting the effects of the technology on employment, women, unions, quality of work life, and the changing nature of work.

Measurement of social impacts requires several types of data: attitude/perceptual, task/activity, communication/information, and system use. The guidelines contain a number of recommendations regarding how these data can be collected and how they can be aggregated at each of the above four levels.

An Appendix is included summarizing some of the very useful work of the Human and Social Impact Committee on Office Automation. The committee has elaborated the main social impact issues which should be addressed by the evaluation teams. Other issues and specific questions will arise during and after the evaluation. The evaluation project must provide a flexible, comprehensive and integrated database which will enable post hoc analyses.

Ø.6 Evaluation of the Needs Analysis Process

One important by-product of the field trials can be knowledge regarding how to determine user requirements for office systems. There has been much talk of the importance of "user-driven" as opposed to "technology-driven" approaches to system design. But there has been little actual experience evaluating the results of various user-driven approaches and methods. Consequently, resources permitting, the evaluation teams should include this topic in their portfolio of desired information.

Topics for which the evaluation can provide new information include the development of a needs analysis framework; analysis instruments; analytical techniques and study strategies.

The effectiveness of different techniques for assessing requirements can be weighed by examining user acceptance, attitudes, performance, and through observation techniques.

As well, the field trials provide an excellent opportunity to learn about the topic of overall strategic planning for office systems.

Ø.7 Evaluation of the Implementation Process

Much can be learned through the field trials about how best to implement the new office systems. Knowledge about how to manage the far reaching change brought about by these systems and how to educate and train the users is desparately needed by suppliers and user organizations alike.

Topics for evaluation discussed in the guidelines are:

- a detailed chronology of the implementation process documenting steps, procedures, techniques, resources, etc.
- an evaluation and description of the selection and roles of various implementors;
- a documentation of the amount of time users commit to learning the system;
- a documentation of the kinds and amount of information and general education provided to the users;
- a description and evaluation of the training program; and
- a description and evaluation of the user documentation and training aids.

Techniques for evaluating the implementation are mentioned, including measurement of user acceptance and user attitudes.

0.8 Organization of the Evaluation

This section of the document has a different character than the others. It does not provide quidelines, but rather some opinions from the authors on topics having to do with the organization of the evaluation teams and effort as a whole. Our opinions were solicited by the OCS program as part of the statement of work for the guidelines.

1) The Department Evaluation Teams

- There should be three evaluation teams -- one for each department. The teams should consist of supplier, user and OCS representatives. The expertise requirements for such a team are discussed.
- The OCS representative should be an "external evaluator". If possible, this person should not be hired on a short term contract, for a number of reasons which are discussed.
- The evaluation in each department should be a project, using a formal project management methodology and chaired by the external evaluator.
- The evaluation team should report to the overall Project Manager in each department, ensuring that the evaluation activities are well integrated with the overall system implementation.
- Procedures for resolving differences on the evaluation team are presented, including several levels of appeal involving representatives from the user groups, the vendors and the OCS program, should an impasse be reached.

2) Inter-Site Organization

A joint evaluation committee will facilitate sharing of evaluation methods. It should also be possible for some cross-site data analysis, although extreme caution should be exercised in drawing spurious or inappropriate conclusions. It is recommended that such cross-site analysis be conducted by the external evaluators.

3) External Evaluator -> Level of Effort

The level of effort for the external evaluator and the phasing of effort and activities is presented. The suggested level of effort for each site is 5.25 work years over 3 years elapsed time.

1.0 INTRODUCTION

The OCS Field Trials constitute one of the largest, most ambitious and most significant efforts to implement the new integrated office systems ever undertaken in any country. If successful, the trials will be rich with lessons, stimulating, and will aid both Canadian suppliers and potential users to take advantage of the far-reaching new opportunities.

1.1 The Role of Evaluation

In many ways, the success of the program will be determined by how well the field trials are evaluated. Information acquired through the field trials will be critical to the trials themselves -- enabling ongoing effective design, implementation, planning and refinement. On a broader level, knowledge must be acquired from the field trial experiences to benefit a wide range of stakeholders, as follows.

1) Field Trial Suppliers Only

Evaluation information is required for:

- refinement of the system functionality, interface, configuration, capacity, etc.;
- extension of the user population and system capabilities to subsequent phases;
- refinement of the training program and implementation strategy; and
- cost-justification of system costs.

2) All Canadian Suppliers (Including Field Trial Suppliers)

Information is required to enable:

- market-driven product planning;
- user-driven product design, feature specification, interface design, etc.;
- conditioning the market through normative productivity data;
- demonstration of quality of work life improvements;
- development of marketing strategies; and
- implementation strategy planning.

3) Field Trial Users Only

The user departments require ongoing evaluation to:

- tune the system in order to meet organizational objectives;
- refine the social, environmental, and organizational components of the system;
- perform cost-benefit analyses to assess the feasibility of major capital expenditures in subsequent phases;
- enable overall strategic planning for integrated systems within the department.

4) All Canadian Users/Potential Users

Canadian public and private sector organizations urgently need information to enable them to improve their productivity and effectiveness through the new office technology. The field trials provide a unique opportunity to generate such knowledge. Evaluation information is required to:

- generate confidence for capital expenditures in office technology; and
- help with all aspects of determining user requirements, designing, implementing and planning for integrated office systems.

5) Other Stakeholders

A number of other organizations desire information from the evaluation of the field trials to enable them to formulate policy in this new and complex area. These include, but are not restricted to the following groups:

- Women's groups require information regarding the impact of office systems on women in areas such as employment, quality of work life, job design, career paths, health, etc.

- Government policy makers require information to assist in areas ranging from procurement policy and personnel classification to industrial strategy.

- Trade unions need information to develop a rational assessment of office systems and to formulate policies which are in the interest of their members.

- Organizations for the handicapped need information regarding the implications of the new office systems for disabled persons. It is possible that certain categories of persons could be further handicapped or that the technology could provide new ways of overcoming handicaps.

1.2 A New Challenge

The convergence of traditional computer, telecommunications and office technologies has produced the new integrated office systems. As with the three major OCS field trials, these new systems directly support all categories of office employees. There are relatively few implementations of these new systems and even fewer formal evaluations. As a result, the field trials evaluation will very much be a process of charting new waters. Moreover, from the limited experience to date, the evaluation will 'not be easy sailing'. Integrated office systems dramatically effect the ways people and organizations work by touching most aspects of any work system, and physical plant. The technology is complex. The process of implementation is dynamic and elaborate. There are no generally accepted methods for evaluation. There are few evaluation experiences to draw upon.

As a result, evaluating the implementation of the field trial systems and their impacts will be a challenging matter. The challenge is enhanced by a number of unique attributes of the field trials. The evaluation teams will consist of representatives from the suppliers, user departments and OCS program, rather than simply from the user organization which is usually the case. The evaluation team will begin its work late, as measurement activities which have evaluation implications have already commenced. There are three major evaluation activities occurring simultaneously, requiring various kinds of coordination. The suppliers are implementing new, rather than off-the-shelf technology, causing a delay of at least 6 months between the first measurements and actual implementation. The field trials are highly visible, having already interested a number of stakeholder groups in participating in the evaluation, or at least in receiving the evaluation results. As well, the sheer size and scope of the proposed trials is great, relative to most other public or private sector implementations.

For these and other reasons, the OCS Field Trial evaluation is a considerably larger and more complex undertaking than any office system evaluation conducted to date.

1.3 Field Trial Versus OCS Program Evaluation

Evaluation of the field trials should be differentiated from evaluation of the overall OCS program.

The OCS program is evaluated, based on its objectives, within the framework of the "Principles for the Evaluation of Programs by Federal Departments and Agencies" (Office of the Comptroller General). This evaluation will answer questions like: "Has this program helped stimulate the development of a Canadian Office System Industry?" Such a program evaluation is already underway.

This document presents guidelines for evaluation of the field trials themselves. The goal is to help ensure that the field trials fully exploit the opportunity to produce invaluable data, information and knowledge about the new office systems.

1.4 System Design, Implementation and Evaluation

The process of evaluation is closely tied with the process of system design and implementation for a number of reasons.

- Data collected from the organization, the users and the system itself are critical to ensuring that the system matches user needs and that there is a proper implementation. In this sense, it is unlikely that there will be a successful design and implementation, without a successful evaluation program.

- Many of the respondents in a requirements and pretest evaluation study will become users. As a result, the process of winning respondent cooperation for the study is also the process of winning user acceptance and support for the system itself. It follows from this that there can be no evaluation which is fully independent. For example, it would be dangerous to have independent evaluators conducting data collection activities which were not integrated with the overall data collection plan.

- Much of the data used to analyse the system requirements can also be used for evaluation purposes, just as evaluation data can be used to refine the system, cost-justify the extension of the system, and alter the training or overall implementation strategy, etc.

The role of data in Phases I and II of the field trials is depicted in Figure 1.1. Because of the unusually long delay between the initial requirements studies and the actual implementation, it is clear that an "Evaluation

Pretest" will have to be conducted, just prior to implementation. This pretest is essential for meaningful evaluation data. If the initial requirements analysis were used as the only pretest, it would not be possible to interpret the data and infer causality to any posttest changes. Extraneous factors intervening between the initial measurements and the implementation months later could cause changes measured at the first posttest. Because of the need for this pretest, the fact that the evaluation program is late in getting started is not a serious problem.

The overall issue of the research design is discussed in the next section of this document. Figure 1.1 is presented at this time to underline the close relationship between evaluation activities and the system design and implementation.

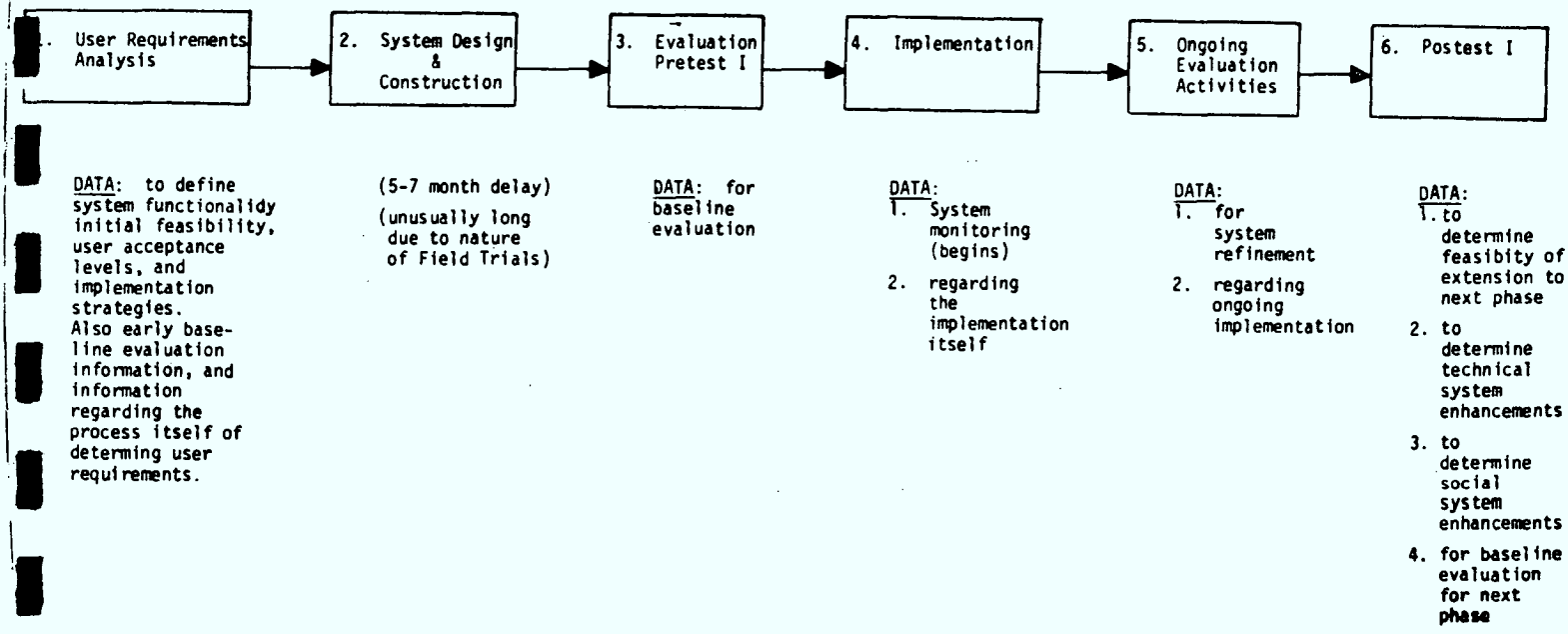

FIGURE 1.1

System Design, Implementation and Evaluation:
Data from Phases I and II

1.5 Limitations of the Evaluation

The field trials evaluation holds the potential to provide a wealth of useful information. It has, however, limitations which should be fully understood by all stakeholders.

These limitations have to do mainly with the "external validity" or "generalizability" of the results beyond the field trial samples to broader populations.

- The "samples" in office system research cannot be chosen randomly. For example, candidates for the system must be chosen on the basis of their need, attitudes, requirements to communicate with each other or share common information, etc. Non-random assignment to experimental and comparison groups makes it more difficult to generalize the findings to broader populations.

- The field trials are being conducted in the public sector -- specifically in Federal Government Departments. Differences between departments; between federal and other levels of government; or between public and private sector will require careful examination when interpreting the data.

- The effects of a system on the individual or work group cannot necessarily be generalized to society as a whole. That is, the impact of a system on jobs and employment in an individual field trial cannot be directly generalized to the macro level of society as a whole. Broader factors such as the state of the economy, government policy, and the role of the unions, etc. affect the relationship between technological innovation and employment.

- The sample of the organizations is small.

1.6 The Evaluation Guidelines

1.6.1 Guideline Objectives

The purpose of these guidelines is to ensure that the field trials will generate the data, information and knowledge needed by the key groups of stakeholders listed above. The guidelines are designed to be used by the evaluation teams. One set of guidelines is required because of the multiplicity of stakeholders. In that sense, the guidelines should represent a general consensus among the various parties, regarding the information to be collected and the process of evaluation.

There are a number of key evaluation guideline topics which correspond to the sections of this document.

- Guidelines on Research Methods;
- Conducting the Technical Evaluation;
- Measuring System Use;
- Evaluating the Productivity Impacts of the system;
- Evaluating the Social Impacts of the system;
- Evaluation of the Process of Determining User Requirements;
- Evaluation of the Implementation Process; and
- Recommendations regarding the Organization of the Evaluation Team.

In addition to addressing the main areas where knowledge is sought, the guidelines are designed to facilitate the use and development of good evaluation methods. Sound field research which produces valid and reliable data is difficult under the best of circumstances. Evaluating the process and impacts of an office system implementation is a new challenge, in many ways different and more complex than traditional evaluation field research. As such, substantial attention to the methods used is required.

The guidelines also review aspects of the research process. Much of the information collected will necessarily be subjective and the process of conducting the research will have a significant impact on the validity and reliability of the data. For example, there is a considerable danger of placing an overwhelming burden on the respondents who are required to complete obtrusive and time consuming questionnaires. Response burden, therefore, has to be carefully kept within acceptable limits to protect the integrity of the data and, worse, avoid undermining the implementation itself.

Information must not only be valid and reliable, it must also be believable. As a result, the guidelines also suggest ways in which the evaluation team can be organized to ensure credibility of the results. These recommendations should facilitate cooperation and conflict resolution among team members.

1.6.2 What the Guidelines are NOT

1) Not a Methodology for Evaluation

This document presents guidelines for the development of an evaluation method. It makes recommendations regarding methods to be used, but it does not itself constitute a method. The evaluation methods to be used

must be developed in the concrete context of a given department, system, and system objectives. For example, the method used to evaluate the impact of the system on productivity will be shaped by the opportunities for improving productivity which have been identified and the system design which flows from these. The same can be said for other components of a method including for example, the conceptual framework, instruments chosen, sampling techniques, study process, analytical procedures and research design.

2) Not Guidelines for the Design and Implementation

This document presents guidelines for evaluating the process by which user needs are assessed and the system is implemented. It does not present guidelines for the needs analysis and implementation themselves.

For example, it is axiomatic that users should be fully involved in shaping the design and implementation. The guidelines do not, however, make such a recommendation. Rather, they are restricted to recommendations regarding how to evaluate and learn lessons from the various approaches to involving the users. In that sense, the guidelines discuss not "how to conduct a field trial" but more "how to measure what was done" and "how to evaluate the effects of what was done."

3) Not an Academic Treatise

The style of this document is pragmatic. While the information contained herein is based on the current body of knowledge on this topic, this document does not use detailed footnotes and references. A number of key readings are referenced in the Appendices for those who require further research sources.

4) Not a Comprehensive Statement of All Data to be Collected

These guidelines do not contain a complete list of all information to be collected or even of all questions for which various stakeholders seek information through the evaluation activities. Because we are in a very early stage of research in this area it is difficult to formulate specific hypotheses regarding the impact of integrated office systems. Furthermore, this can only be done concretely, in the light of actual system objectives. In fact, there will be numerous questions which will arise well after the data collection activities have begun, and even after completion. As a result, one of the goals of the evaluation should be to build a comprehensive, flexible and well-integrated database which can be re-analysed to answer

new questions.

5) Not a Prioritization of Data to be Collected

Clearly it will not be possible to provide all required or desired data to all stakeholders. Some of the key contraints include:

- Suppliers, user departments and the OCS program have resource and funding constraints. It is not yet clear what resources are available for evaluation purposes.

- Much of the data collected will be proprietary to the suppliers or user department.

- Experience has shown that users will agree to participate only in reasonably elaborate and obtrusive measurement activities.

It is not possible or desirable to make arbitrary a priori judgments regarding prioritization of data collection activities. Evaluation must meet the needs of specific evaluation teams and their stakeholders. Similarly, they must be conducted within the specific constraints of the field trials, which at this time are not defined.

As a result a first activity of the evalaution teams should be to review the guidelines, and to establish evaluation objectives and priorities.

2.0 RESEARCH METHODS

This section contains general guidelines for the methods to be used in evaluating the effects of the OCS Field Trials. The purpose is to ensure, to the extent possible, that the procedures used will provide valid, reliable and useful results. Details of content are not discussed as they are covered in the topic sections which follow.

We commence the discussion by stating certain objectives that should be met by the methodology. This is followed by a description of the conceptual framework which is to be used to guide the evaluation efforts. The bulk of this section focuses on research design and research process issues. We close by noting the importance of documenting the evaluation effort.

2.1 Objectives

There are at least five objectives that the evaluation methods should satisfy. These are discussed in alphabetical order.-

1) Anonymity

Each participant - a member of the user group who supplies the evaluation team with data - must be guaranteed that he/she will not be identified as an individual in the reporting of any results, unless he/she grants specific permission to do so in writing. Obviously, data must be gathered and analyzed at an individual level so that, among other things, correlations can be made between specific applications of technology, performance and a priori attitudes. This requires that precautions be taken to ensure that raw data which identifies individuals are available only to members of the evaluation team. Furthermore, individual identifiers should all be coded and the data should be stored in a secure place.

2) Comprehensibility

The methods to be used, including data gathering instruments, instructions and procedures, must be sufficiently straightforward that their objectives and content can be understood by all parties of the evaluation. To obtain cooperation of the participants and to maintain the integrity of the evaluation exercise, there should be no hidden agendas with respect to data collection and analysis. Thus, the purpose and application of any instrument and the procedure and form of the analysis must be understood by the evaluators

representing the three key organizations: the users group, the vendors and the OCS program. Contentious issues can be resolved according to the procedures outlined in Section 9.

3) Comprehensiveness

The methods to be developed are to encompass all aspects of the evaluation effort. The stress must be placed on a priori planning to avoid, to the extent possible, ex post regrets. This is particularly important in a longitudinal study. If adequate baseline data are not obtained, valid and reliable comparisons over time cannot be made. Furthermore, the comprehensive database should be sufficiently well integrated (e.g. common codes for common data elements) that cross-sectional analyses can be conducted with ease.

4) Non-Redundancy

Duplication of data gathering activities, except where appropriate to ensure data reliability, must be avoided. Although it is clear that the user groups, the vendors and the OCS program will want to conduct different forms of data analysis, these should be based on a single, common, integrated and comprehensive data base for each of the field trial sites. The members of the user groups cannot be expected to provide similar but distinct data for use by each of the evaluators. If a single, common database is not developed, user participant cooperation will decline substantially, as will data reliability and the ability to conduct comprehensive analysis. This would subject the evaluation effort to unacceptable risks for all concerned.

5) Transferability

The methods used should not depend uniquely upon the expertise of a given evaluator. Certain evaluation content and procedures may be unique to a given user site to reflect the system being installed and the services being supported. However, the methodology itself should be capable of being executed by any evaluator with expertise and experience in the evaluation of computer based office support systems. Thus, if one member of the evaluation team departs, another with similar expertise could take his/her place without the evaluation effort suffering significantly.

2.2 Context

Evaluation methods have to consider the context in which they are to be used. Two essential aspects of the context are the criteria of success for each field trial and the focus of the evaluation.

2.2.1 Criteria of Success

The criteria of success for the OCS field trials are likely to vary considerably among the user groups, the vendors and the OCS program. These criteria should be established before the evaluation effort begins, and all should be accommodated by the methods to be used. If a stated criterion cannot be evaluated, either because it cannot be measured or because to evaluate it would create havoc with other aspects of the field trial, the evaluation team should state the case in writing to the relevant party. If this issue becomes a source of controversy, it will have to be resolved by the conflict resolution procedures in force.

2.2.2 Foci of Evaluation

The evaluation exercise must consider three different aspects of the OCS field trial program. These are: 1) the methods used to conduct the needs analysis which led to the system's specification, 2) the procedures used to implement the system, and 3) the system itself and its impact on the individuals and organizations using it.

While the latter is recognized as the preserve of technology evaluation, the failure of an office system to achieve its objectives can be caused by failures in any one of the three aspects of the field trial noted above. If the needs analysis is not effective, it would be most difficult to develop an appropriate system. Both the vendors and the user groups would benefit from an evaluation of the needs analysis processes and the processes could be improved for future system design studies. If the implementation procedures are not effective, even an ideal system might be rejected or misused because the potential users did not understand its raison d'etre and/or were indequately trained. Certainly the user groups would want to know if this was the case. Specifics for the content of the evaluations are contained in Sections 3 through 8 of these guidelines.

2.3 Research Design

The field trials supported by the OCS program are expected to proceed as planned. They are beginning with a needs analysis followed by the design and development of a system suited to a client's particular needs. Prototypes are then to be built and installed for a pilot study of 10 to 50 units, the number depending upon the site. This is to be followed by design modifications, where deemed appropriate, based on an evaluation, and a larger field trial of 100 to 200 units, some to be installed in locations some distance from Ottawa. The OCS program will conclude with an evaluation of this field trial. However, if there is sufficient evidence to demonstrate the value of the technology, the system will eventually be extended to several thousand units.

2.3.1 Quasi Field Experiment

The methodology used should be based upon the presumption that one can conduct an actual field experiment. This implies that instruments and procedures be used which can detect change over time and that a comparison group be studied so that experimental effects (those due to the new system) can be factored out from the effects of extraneous events which might bring about change in both the experimental and comparison groups.

We use the term "quasi field experiment" because the conditions for a true experiment cannot be met. Nevertheless, the closer it is to a true field experiment design, the more one can learn from the evaluation effort. The conditions which will not be met include the fact that people will not be assigned randomly to the experimental and comparison groups. In addition, the behavior of the participants will not be independent (to the contrary, it is interdependent and presumably organized), and thus standard statistical comparisons cannot be made.

Perhaps of most importance, the installation of the systems to be evaluated is likely to be on a continuous rather than a discrete basis. Thus it will be very difficult to conduct the traditional before and after comparisons. Nevertheless, it should be possible to develop monitoring procedures that will permit a reasonable approximation of before and after installation comparisons of the more important features of the new office communication systems.

2.3.2 Approach

The sequential use of experimental and comparison groups is described in Figure 2.1. Note that the comparison group for the pilot study installation becomes part of the experimental group for the larger field trial. Likewise, the comparison group for the larger field trial will become participants in the early phases of the full scale installation. This suggestion is made to encourage the participation and cooperation of members of the comparison population. The evaluators can point out that members participating will be the next to receive the new office support system and the level of their cooperation will impact the degree to which the system meets their needs. Note also that this permits the simultaneous collection of some of the needs analysis and baseline data.

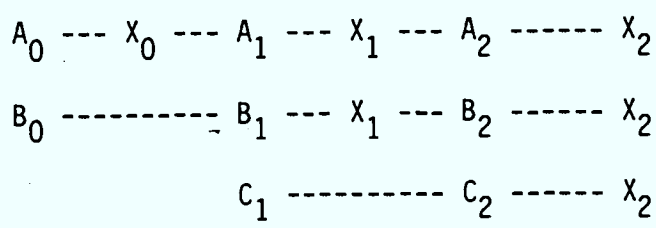

Figure 2.1

A is the experimental group for the pilot study.
B is the comparison group for the pilot study and part of the experimental group for the field trial.
C is the comparison group for the field trial and the next in line for an expanded installation.
X is the installation of the pilot study system.
X is the installation of the larger field trial system.
X is the installation of the full scale system.

2.3.3 Data Collection

Data will have to be collected for at least five points in time.

1) Baseline data gathered shortly prior to the pilot study (no more than six weeks prior to its installation), from both the experimental and comparison groups.

2) Data obtained about and during the implementation of the pilot system.

3) After installation data is collected, four to six months after the pilot system has become operational, from both experimental and comparison groups. Hopefully these data will also suffice as the "before" data of the larger scale field trial. If not, further data collection may be required. In any case, data will have to be collected from the comparison group for the larger field trial study as well.

4) Data gathered on the implementation of the larger field trial system.

5) After installation data obtained four to six months after the field trial system has become operational.

To the extent possible, the needs analysis data for both the pilot study and the larger field trial should be combined with the evaluation efforts conducted at approximately the same period in time. It should be recognized, however, that this may not be possible because of conflicting lead time requirements. Needs analysis data have to be gathered sufficiently far in advance to allow a system to be designed and developed. Baseline data, on the other hand, should be collected sufficiently close to the actual installation of the system to minimize the likelihood that intervening changes, aside from the introduction of the system, will have taken place before the collection of the "after" data.

In practice, system installation and adaptation may be almost continuous, making the stated points in time less clearly discernible. If this situation should arise, "before and after" effects should be measured around those installations and changes which are likely to be most significant for the user group. The evaluation team should agree on these points sufficiently in advance so that baseline data can be collected where required. Also, if it is likely that continuous adaptation will take place, continuous or periodic data collection procedures ought to be used when feasible.

2.3.4 Issues Affecting Research Design

Some of the initial participants are bound to drop out of the study during the period of evaluation, either because they have changed jobs or because they are no longer sufficiently cooperative to provide reliable data. There is little the evaluators can do to avoid completely this problem. However, they can limit it by motivating the participants to cooperate and by encouraging the user organization to select highly motivated and stable individuals as participants. Even with these precautions, the

evaluators should try to detect those individuals who are uncooperative and either increase their motivation or question the reliability of the data they provide. Fortunately, while the problem of participant "mortality" must be recognized, its effect is not likely to be serious since most of the evaluation analysis will be descriptive rather than statistical.

Another problem which could prove to be more serious is the late installation of the technology. This could invalidate the baseline data, as they may no longer be very relevant, and/or it could force the collection of "after" installation data before the users have had time to adjust to the system. Such problems do not lie in the fact that technological difficulties might arise in the development of the system. They exist because of poor communication between the vendor and the evaluation team. It behooves all of the evaluators to be sure that they are apprised of any possible delays of system installation in sufficient time to adjust their data collection efforts accordingly.

A third issue concerns the possibility of poor cooperation between the vendor, the user group and the OCS supported evaluator. If the evaluators themselves cannot work out their differences, then prompt recourse must be made to the conflict resolution procedures in force. The use of conflict resolution procedures notwithstanding, good interpersonal skills ought to be included in the criteria used in the selection of evaluators.

2.4 Research Process

Since the circumstances in which the evaluation is to take place are certain to have a strong influence on the processes which will be used, these probable constraints will be discussed where appropriate.

2.4.1 Sample

The selection of the use for which office support systems are to be designed will have already been made before the evaluation can begin. Nevertheless, the selection of individual participants may not have been done. Furthermore, it is much less likely that persons will have been chosen to participate as members of a comparison group.

The criteria for the selection of participants, where the evaluation team can exercise some influence, are not those one finds in the field experiment literature. Rather they reflect the pragmatics of the situation.

Two other criteria are also relevant. One is the selection of those who are likely to cooperate with the evaluation effort. The other is to select participants from as wide a variety of potential user types as possible. This too is to ensure that the system is subjected to as rigorous and comprehensive use as possible.

The criteria mentioned above also hold for the selection of members of the comparison groups. As we have noted, if at all possible, these should be persons who are next in line to become system users. This will not only act as a motivator for them to participate, but can provide a source of needs analysis data for the next installation.

2.4.2 Instruments

Since all of the evaluators should be knowledgeable in instrument design, there is little point in stating the standard guidelines here. However, there are several aspects of instrument design and use that are particularly important for the evaluation of the OCS field trials and these will be mentioned.

The most important is the ease with which the participants can comply with the instruments and procedures, and the time that they will spend doing so. The evaluation activity has many dimensions and phases to it, and thus it is bound to require a substantial amount of effort on the part of the participants. As a consequence the data collection efforts must be direct, comprehensive and be seen as useful to the individual and/or his/her organization. The latter point implies that participants can be shown, without great difficulty, how the data being collected might be used to the benefit of the evaluation effort. From past experience it is suggested that the data collection effort require no more than four hours of a participant's time during any two-month period.

A second suggestion is to make the maximum use possible of data collection efforts that are already in place. For example, if an organization has a well defined performance measurement scheme in place, use it rather than develop a parallel one which will require additional effort to complete.

If the system automatically collects data on its usage, use them. In fact, it is worthwhile encouraging the vendors to develop software that monitors system use. Not only will it assist the evaluation effort, but there is nothing as effective for diagnosing man-machine interface problems. Both usage data and fault data are useful for this purpose. In summary, make data collection as

easy as possible and avoid duplication of effort.

Further specifics of instrument content can be derived from the requirements set forth in the following six subsections (2.4.3 through 2.4.9), though content will vary from site to site depending upon vendor and user group needs.

2.4.3 Analysis

As with instruments, the specifics of analysis can be inferred from the sections which follow. However, some comments are in order.

The context of the evaluation forces the analysis to be descriptive rather than statistical in nature. The events observed are essentially unique and the sample size is, for all intents and purposes, one. Thus, the analysis must chronical what took place, including subjective as well as objective observations (e.g. attitudes). It should indicate what appeared to work well and what didn't, and suggest, with supporting evidence, how the latter might be improved. Care must be taken to avoid placing blame per se, as the evaluation's main function is to foster the learning process. If the parties that are to benefit from this learning are alienated, little would be gained.

The emphasis should be on the facts of the situation, and judgmental opinions should be minimized. This is not to say that intuitive conclusions should be completely avoided but when stated, the facts upon which they are based should be clearly identified.

Finally, although comparisons across units within a user group and across user groups themselves are very useful from the point of view of the total evaluation effort, they have to be presented in a way that is not punitive for those who fair less well. The evaluation effort should be seen as supportive rather than destructive, as constructive criticism rather than as censure.

2.4.4 Procedures

Getting the cooperation of the participants in the field study is the key to an effective evaluation. This means that the evaluators will have to "sell" the study to the participants, both individually and collectively. Non-evaluators cannot do this. What they perceive as an appropriate evaluation effort is unlikely to be equivalent to that which an evaluator requires.

Maintaining a good relationship with all parties is an important part of an evaluator's job. Not only will it affect one's ability to motivate subjects to cooperate,

but it will influence the ease with which one can control the timing of the data collection. As noted earlier, the timing of the gathering of baseline, implementation and post-installation data contributes greatly to the quality of the analyses which can be made. Baseline data should be collected shortly before the installation of a new system, and before the participants' knowledge of the system is so great that their expectations influence their behaviour. Data on the implementation procedures are meaningful only if they are gathered during the implementation. Follow-up data on system usage and its effects need to be obtained after usage and attitudes have had a chance to stabilize. Usage data collected during training and "playing" phases may be useful from an implementation standpoint, but they provide little information of the overall impact of a system.

One way of ensuring good relationships with the three principal parties to the evaluation is to provide each with periodic feedback. Virtually everyone likes to know that his/her contributions mean something. Feedback can provide such meaning. This can be done either orally or in writing. The important thing is that it be done on a regular basis, and that the occurances not be so far apart that the participants feel that they and their efforts have been forgotten.

2.5 Documentation of the Evaluation

This is essential. The evaluators and the OCS program must be able to evaluate the evaluation process. Evaluation expertise is a marketable service, and the evaluators should expect to be able to learn how to improve their service, just as the vendor and user groups expect to learn how to improve their products and services.

The documentation of the evaluation should take the form of a chronicle of events, stating what was done, when and with what effect. Pronounced successes and failures should be detailed, and the apparent reasons noted. Again, this evaluation is going to be purely descriptive and the interpretation of the events recorded should provide insight into how the processes used might be improved.

The documentation also has an important secondary purpose. It will provide a means whereby should a member of the evaluation team leave, another equally well qualified member could step in and continue the process without a substantial loss to the overall effort.

3.0 TECHNOLOGY DESCRIPTION AND TECHNICAL EVALUATION

This section discusses guidelines for describing and evaluating the technical aspects of the system. The role of specifications in system evaluation, the nature of an historical chronology of the technical implementation process and factors to be considered in a technical evaluation are discussed.

This information is of value to the field trial suppliers and to user departments to ensure that technical modifications are made after the implementation. These data will also be useful to other stakeholders in understanding the technical potential and problems associated with office systems.

The role of specifications in this is twofold. On one hand they provide a baseline to measure system performance against. On the other hand, comparison of performance to specification provides all parties with a better insight into realistic performance expectations.

In addition to the specifications, it is important to keep a detailed historical chronology of the process of implementation. This not only allows one to evaluate the implementation in terms of meeting specifications, it allows the specifications themselves to be evaluated and errors of omissions noted.

3.1 Proprietary Nature of Some Technical Data

Although the field trials are publically funded, it is clear that some information on the systems' functioning will be regarded as proprietary by the vendors. Other technical data may be regarded as proprietary by the field trial users. The release of technical data should be negotiated among the stakeholders. Disagreements can be resolved using the mechanisms described in Subsection 9.4.1. This document presents guidelines for technical data which are fundamental to meeting the evaluation requirements of the main stakeholders.

3.2 Specifications

Any good set of specifications must define:

1) What is to be done and for what effect;

2) By whom;

3) In what time sequence, and;

4) At what cost.

The purpose of these specifications is fourfold:

1) Properly written specifications define the dividing line between acceptable and unacceptable performance.

2) They protect the client by defining precisely what he is getting → when and at what cost.

3) They protect the vendor by defining what he has to deliver → when and at what price. This can be important, especially with new systems where the client may request add-ons.

4) By requiring precise details, the process of writing a set of specifications helps both the vendor and the client to mutually define their expectations. These specifications provide the basis for the contractual relationship between vendor and supplier. The field trials provide the opportunity to sort through many of these issues. This will assist vendors in positioning themselves in the marketplace and will aid potential users in defining their requirements.

The specifications for an OCS system must include the following:

1) Technical Configuration

The number and location of the workstations, location of CPU and appropriate peripheral equipment (e.g. printer(s)).

2) System Capabilities

The specifications must define what the system is supposed to do (the features), storage capabilities, number of simultaneous users it can support, type of ports, and response characteristics. Also included should be details of the processor subsystems, memory capabilities, upgrade capabilities and peripherals.

3) Installation Plan

This plan is an integral part of the specification document. It should define the implementation process in terms of equipment installation and system capabilities over time.

4) Maintenance and Back-Up

The responsibilities of the vendor for system maintenance and back-up in terms of labor, on-site representation and equipment back-up should be defined in sufficient detail so that the majority of normal problems are covered.

5) System Monitoring

In order to evaluate system use an automatic monitoring plan should be devised which will define:

- the data the system is to collect
- who will receive the report of system use
- provisions for changes to the automatic monitoring system.

6) Ergonomic Requirements

Defines the ergonomic parameters of the system and includes such issues as user interface, ease of use, and workstation design.

These issues are discussed more fully in Section 4.

3.3 The Historical Chronology

The historical chronology records the process of implementation in terms of what happened, when it happened and why. The best way to develop such a chronology is to have one person keep a log book in which daily entries are made. Information for the following items should be recorded as necessary.

1) Resource Requirements

Detailed records of physical, human and financial resources required to implement the system for the client organization and the vendor, where possible.

1) Physical Resources

Record such items as hardware (air conditioning, special furniture or partitions, etc.), and space requirements. For instance, the installation of a workstation may increase individual space requirements.

2) Human Resources

One area often overlooked is the demand for extra people. In many client organizations, one or

two people will be trained as in-house experts. There will usually be a demand for training and perhaps there will be a need for one or more operators.

3) Financial Resources

A chronology of the expenditure pattern for the course of the evaluation will be useful in planning financial resources in the future. Particularly with high interest rates, the cash flow pattern can be critical.

2) System Reliability and Maintenance

Detailed records of system down time and failures, in terms of frequency and duration, should be kept to provide a basis for assessing system problems over time. Associated with these data should be information on system maintenance, such as hardware repair/replacement problems and the frequency and extent of software debugging and modifications required.

3) Problems Log

A record of user "gripes" which provides feedback to system operators about problems or technical modifications that are required.

3.4 Factors in the Technical Evaluation

In preparing a technical evaluation of an office system, there are two types of measures that must be applied. These are Performance Measures and Ergonomic Measures.

3.4.1 Performance Measures

Measures of system performance must be largely based on the extent to which the system specifications were satisfied. Consequently, the existance of a detailed set of specifications and an accurate historical chronology are essential. Part of the evaluation should deal with delivery and installation of the system as defined by the technical configuration and system capabilities, and the degree to which the time targets defined in the installation plan are met. Additionally, measures of system reliability in terms of frequency of crashes and maintainability in terms of the effort required to recover from the crashes must be developed to assess the maintenance and back-up capability.

The following aspects of an office system should be among those considered in a technical performance

evaluation.

1) Component location: physical location of system components as compared to the specifications.

2) The user interface: This component of an interactive system handles all aspects of the user system interaction, excluding hardware.

3) Response time: The time it takes for the system to respond to user commands is likely to be a critical factor in user acceptance of the system. This may vary by the nature of the tasks performed on the system.

4) System security: This aspect of performance includes not only protection of system content from unauthorized use, but also protection of individual users from accidental file erasure or data loss due to errors or system crashes.

5) Error diagnostics: The capability of the system to detect errors and suggest what the error was and how to correct it.

6) System Implementation Record: A measure of the degree to which time targets are met and discussion (based on historical chronology) of deviations from the initial plan.

7) Maintenance Records: A qualitative account and analysis of system problems and how they were solved. The aim is to produce a distribution of likely problems to aid future specification efforts.

8) Analysis of automatic data collection with a focus on the use of the data collection system and the success and problems encountered.

3.4.2 Ergonomic Measures

Examples of ergonomic measures that should be considered as part of a technical evaluation are:

- Errors in the use of the system. These can highlight design problems such as software design or keyboard layout.

- Changes to the physical setup of workstations and the physical environment.

- Reports of complaints about physical discomfort, such as eyestrain or backache.

- Because of general concern, the level of CRT

radiation emissions should be monitored several times during the implementation process.

The list is not intended to be exhaustive. During the course of the field trials, evaluators, clients and vendors must be sensitive to possible ergonomic problems. A record of these problems is an invaluable part of the historical chronology of the field trial.

4.0 SYSTEM USE AND USER ACCEPTANCE

An important aspect of the evaluation should be the extent to which each of the field trial systems was actually used and the distribution of this use by variables such as function and time of day. Data collected on system usage will be of particular value to the vendors in refining the system as well as in future product planning. Data will also help Canadian organizations understand how these new technologies can be used.

There are two main ways in which system use data can be collected: (1) manually, by having users log their usage, and (2) automatically, by the system itself. Manual collection does not require a substantial investment in software development nor hardware resources. On the other hand, it requires considerable involvement on the part of the users.

Automatic system accounting/monitoring is perhaps one of the most useful measurement techniques. It provides an opportunity for the researcher to objectively measure user behaviour. Among-other things, it is possible to compare the user's actual behaviour with his or her perceived behaviour as measured by other instruments to validate data collected from more subjective instruments.

Monitoring system use raises a number of issues.

1) The Privacy Issue

The use of these measures raises important ethical and privacy issues. As it is possible to monitor virtually everything a user does on the system it is important that there be a contract with the user regarding exactly what will and will not be monitored. One way of ensuring confidentiality is to contract to report only group rather than individual data. Another requirement is to ensure that there be no correlation between system usage and job evaluation for performance. What is clear then is that the user must be involved in determining what information must be collected. This can be accomplished either in the form of an initial discussion or in terms of a more formal contract proposal submitted to the user.

2) Hardware and Software Requirements

The development of hardware and software to provide monitoring data will place a considerable burden on each vendor. They may wish to collect this kind of information for their own internal use, but the OCS program and the evaluation team may have to make

special arrangements with each vendor for supplying the required data.

3) Proprietary Data

It is clear that each vendor will have a vested interest in preserving, to the greatest extent possible information about their respective products.

On the other hand, the information should be made available both to the program and to the public at large. This is essential if one of the major goals of the program is to be achieved, that is, acting as a catalyst for Canadian industry. However, the vendor should have the right to review reports based on automatic system recorded data before they are released. Conflicts over the release of such data are to be resolved by the procedures set forth in Subsection 9.4.

One example of an unobtrusive method of collecting user data is telephone call detail recording. Call detail recording can be used to collect pretest-posttest data regarding the impact of a system on telephone activities and time use in general.

4.1 Tracking System Use

The system accounting should track, at a minimum, the following types of information:

- login time
- actual system usage (eg., CPU cycles, etc.)
- number of commands used
- number of different commands used
- amount of text generated
- number of messages sent, received, filed, forwarded, and distributed to multiple persons
- total amount of disc space used
- preferred applications
- communications patterns.

One critical area to be examined is the use of messaging. Messaging statistics will be useful in determining the extent to which the pilot members use the system as a means of communication. Frequency of usage should be noted along with time of day, messages sent and received, and average length of message. Tracking the use of various messaging commands may provide an opportunity to determine the extent to which users have learned how to use the commands. Non-usage of a single command may indicate a need to re-examine the training process.

Associated with the monitoring of system data are a number of key questions:

- Are the monitoring data oriented towards usage data or accounting data?
- Is it possible to track communications patterns?
- Is there a means to actually analyze the monitoring data?
- How easily can the monitoring be modified?
- If monitoring is not provided, how difficult would it be to develop this facility?

4.2 Analytical Procedures

There are many powerful analytical tools which can be used to help transform reams of assessment data into information which can enable an effective systems design. Skilled data analysts are required to manipulate the raw data into meaningful statistics.

It is important to carefully document the process used to analyze the data. For example, if the statistics are presented on a weekly basis per user, it will be important to define who was actually in the office for any particular week.

Comparisons of monitoring data are made difficult due to attrition of pilot members and the subsequent addition of new pilot members. It may therefore be advisable to separate the users into a number of groups, for example:

- "ongoing pilot" (all original pilot members)
- "ongoing pilot → continued": all users considered to be a part of the pilot for that particular week in which the statistics were generated
- all users.

It is desirable to be able to track all commands used on the system. It may be the case however that when the user is in a particular functional subset that commands executed by the user within the subset are not recorded. Thus, the evaluation should carefully examine reported statistics on system usage to ensure a clear understanding of what data have actually been recorded.

Heavy users may also bias the statistics. For example, the absence of such a user will have considerable impact on total usage statistics for data analysis.

4.3 User Attitudes Toward the System

System monitoring data will provide quantitative data on system usage. Concurrently, it will be important to determine what the users' attitudes were toward the technology in so far as these attitudes may be correlated with system use. Issues related to attitude measurement are

discussed in Section 6. We note that attitudes toward the office system and its capabilities are of primary interest here. User attitudes may be assessed regarding the following areas:

- functionality
- features
- user interface
- utility
- preferred tools
- desired changes, etc.

5.0 SYSTEM IMPACT → PRODUCTIVITY

As part of the guidelines project, field trial departments, vendors and OCS personnel were all asked by Trigon with the assistance of CECIT what information the field trial evaluation should generate. Invariably the first mentioned was information regarding the impact of the office system on productivity.

Probably the greatest obstacle to the widespread use of the new integrated office systems has been the inability to cost-justify them. There has been substantial soft evidence that these systems profoundly improve the efficiency and effectiveness of office personnel and organizations, but there has been very little valid proof. It has been possible to make a business case for word processing equipment, based on time and personnel savings from increased typing efficiency. It has however, been much more difficult to show how more advanced integrated systems can improve the productivity of all categories of office workers and the overall performance of organizations.

Data regarding the impact of the system on productivity is critical to most stakeholder groups.

The primary objective of the field trials from the departmental perspective is to determine the feasibility and praticability of using integrated office systems to improve organizational productivity. Productivity data for the cost-benefit analysis is critical to determine the feasibility of proceeding to a full operational system. Such data will be considered by all levels of management within the department. As well, productivity data can be used by all federal departments, policy makers, and other public and private sector organizations to better understand the new opportunities created by these systems.

Such data are necessary for the suppliers to make a business case for a full production system. These data are also important for all Canadian suppliers, as they can provide market conditioning and ammunition for marketing personnel. As well, these data will help with product planning -- indicating what types of office tools have the

greatest impact.

5.1 The Problem

Office productivity is an illusive concept. The notion has been ported from the industrial production environment where there are clear measures possible. Traditional industrial productivity is the ratio between output and input, ie:

$$\frac{\text{OUTPUT}}{\text{INPUT}}$$

Measuring office productivity or more broadly, organizational performance in the white collar sector, is a more complex matter. It is even more difficult to quantify the impact of an integrated office system on overall performance. This is true for a number of reasons.

1) Lack of an Accepted Theory

There is no generally accepted theory of white collar productivity or organizational performance.

2) Measurement

The difficulties faced in quantifying office productivity are enormous. Most measures used to date are not true or meaningful productivity measures. Examples are:

- Subjective Measures. Asking respondents to describe the impact of a system on their productivity cannot be considered actual productivity increases.
- Internal Efficiency Measures. "Time savings" for example, cannot be equated with productivity increases. Rather they create the opportunity for such increases.
- Qualitative Measures. Improved employee motivation or better organizational communication relationships can be important. But they do not indicate true productivity gains.
- Misleading Output Measures. Have been used to show alleged productivity improvements. Examples are the number of memos produced or the volume of reports generated. Such measures ignore the purpose of such output. In the office environment such increases may or may not be desirable. To simply measure the output, with no reference to its utility, may be misleading.

3) No Normative Evidence

There is virtually no normative evidence regarding the impact of these systems. Lacking this, it is difficult to project the anticipated benefits of a system.

4) The Problem of Causality

Even with acceptable measures of productivity or organizational performance, it is difficult to show that positive changes were caused by the system. Improvements can be due to a number of other factors, internal or external to the organization.

5) Assigning Dollar Values

In most cases, it is necessary to assign values to the "benefits" side of the cost-benefit equation. These fall in the categories of "cost displacement," "cost avoidance" and "value added". However, translating decreases in office inputs, or increases or improvements in office outputs, into acceptable dollar values is much more complex than with industrial production.

Departmental and other personnel are aware of the importance and difficulties quantifying the impact of the system on productivity. Nevertheless, all have high expectations regarding what is possible. Such expectations will require that the productivity impact is comprehensive, detailed, valid and believable.

5.2 Office Productivity, Efficiency and Effectiveness

The evaluation teams will have to define in advance, key constructs where improvements are sought. The constructs, metrics, variables and data elements will have to be formulated and agreed upon by the evaluation teams, in the context of the concrete field trial.

The evaluation guidelines can suggest some possible definitions. One widely accepted view is depicted in Figure 5.1. From this perspective office systems can impact the following:

- Efficiency. Systems can (a) reduce inputs into the office such as costs of labor, materials, services, etc., or (b) result in greater output (with the same or less input) such as more contracts negotiated, accounts processed, or correspondence produced.

- Internal Efficiency. Systems can reduce the inputs which are internal to the office. Examples are less time spent scheduling, filing, waiting for work, looking for information, filling out forms, etc.

- Effectiveness. Systems can improve the quality of the products of office work. Examples are better legislation, better management reports, more useful response to public inquiries, etc.

- Productivity. Systems can improve the overall ratio between input and output in the office, improving the quantity and quality of products of office work, using the same or less input resources. In this definition, productivity is used in a very broad and general way, although the metrics chosen to quantify it can be specific. Productivity is seen as being similar to overall organizational performance.

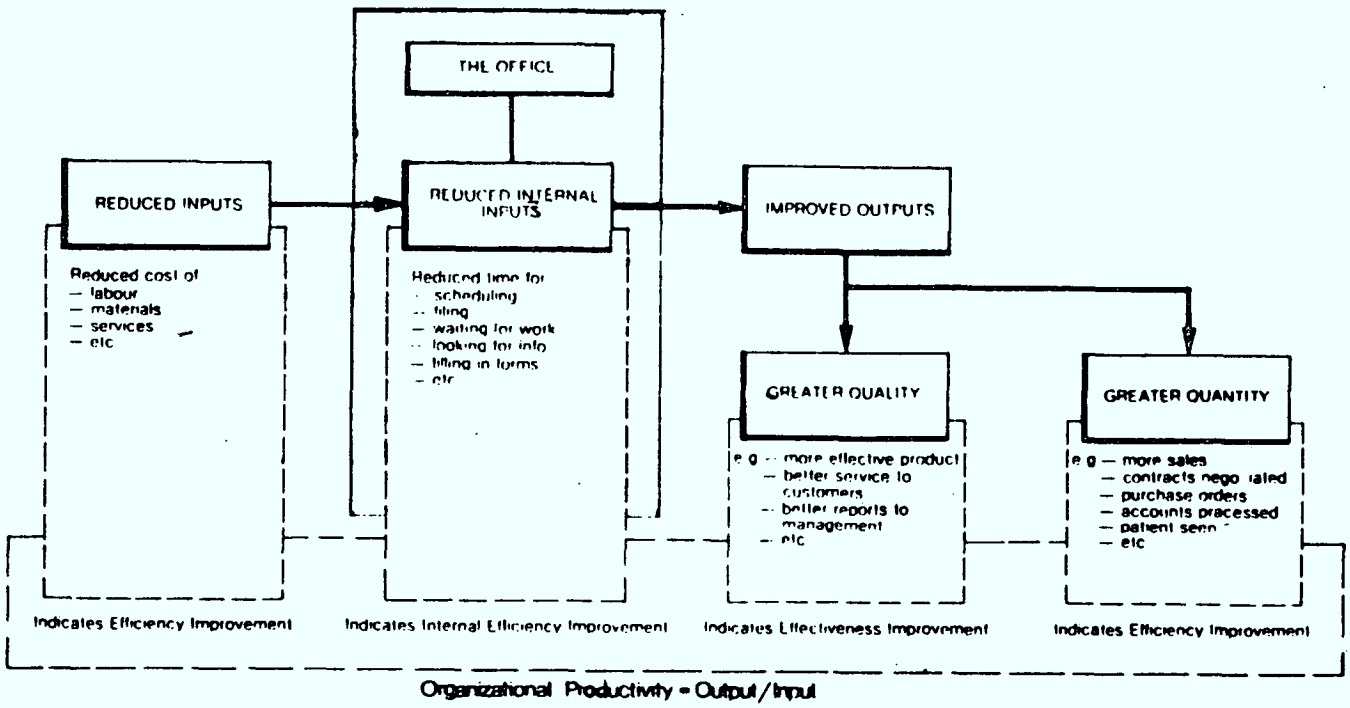

FIGURE 5.1
Office Productivity, Efficiency and Effectiveness
from
Tapscott, H.D. "Office Automation: a User-Driven Method"
(Plenum Publishing Corp. New York, 1982.)

5.3 Measurement of Productivity Impacts

From the experience to date measuring office system impacts on productivity, several guidelines emerge.

5.3.1 Comprehensive Methods Needed

The starting point for valid and reliable productivity measures is a sound conceptual framework and a comprehensive method for productivity evaluation. Nearly all evaluation work done to date is of limited value because the researchers lacked a coherent framework, clear objectives and (at least initially) stated hypotheses.

As well as a sound conceptual foundation, it is important to introduce as many experimental controls in the research design as are feasible and workable. This can help the evaulation to have "internal validity" (the extent to which results can be interpreted as being due to the system).

Section 2 of this report (Research Methods) outlines these and other main considerations of method which can help provide meaningful productivity data.

5.3.2 Multiple Measures

Given the absence of widely accepted productivity measures and the difficulties in controlling contaminating variables, it makes sense to use a variety of different metrics to quantify efficiency, effectiveness, productivity and overall organizational performance improvements. There are a number of categories from which measures can be drawn:

- Input Measures. The material, cost, resource, human, etc., inputs into office work can be measured at different junctures (e.g. pretest, posttest).

- Internal Input Measures. The impact of the system on resources internal to the office can be quantified. The key variable here is use of time. That is, the time spent on various activities before and after a system implementation can be quantified. Time savings can be (a) measured at the level of the individual and aggregated to a larger group; or (b) can be measured at higher levels, such as the amount of time, or elapsed time to do a certain procedure or produce a certain product. Such internal input improvements do not alone indicate a productivity improvement, as the actual inputs (e.g., labor costs) remain constant. They do, however, create an opportunity which is important to measure.

- Output Measures. The products of office work can be measured, quantitatively and qualitatively. The number of purchase orders processed may, for example be a useful output measure. On the other hand, it is often appropriate to examine the quality of outputs. For example, measures can be developed to examine the utility, appropriateness, accuracy, format, packaging, etc., of an office product such as a standard report.

- Overall Performance Measures. It is often possible to measure the impact of a system on overall performance of a given work group or organization. This involves a process of identifying objectives and factoring out the impact of a system on meeting those objectives. Performance monitoring systems are in place in some departments and may be used effectively in evaluating the impact of the field trial.

5.3.3 Measurement Instruments

Instruments for data collection will have to be developed as part of the evaluation itself. Most categories of instrumentation can be used. These include questionnaires, diaries, logs, key product tracking, information flow modelling, critical incident techniques, secondary source data, communications network analysis, interviews, and observation.

5.3.4 A Role for System Monitoring

Some office system research has used system generated data to evaluate individual and group productivity. A typical example is the measurement of keystrokes to evaluate the productivity of key punch operators or word processing operators. Clearly, system accounting data can be very useful in a variety of ways, which are discussed elsewhere in this report.

The use of monitoring techniques for highly structured, compulsory activities such as key punching has provided useful productivity data. However, such techniques do not work well when evaluating the impact of integrated office systems. These systems centre on unstructured or semi-structured work. Their use is also largely voluntary. Effective use of the tool requires the cooperation, support and commitment of the user. Productivity monitoring therefore runs the risk of undermining the implementation -- that is, of weakening the process of winning user acceptance of the system.

For these reasons, it is recommended that no system monitoring data be used for productivity measurement, in particular for individual performance evaluation. This should be made clear to users, as part of the process of agreeing upon exactly what system-generated data will be used.

5.3.5 User Role in Defining Productivity Measures

It is recommended that the users themselves, and the the management within the user departments take an important role in defining office products, critical success factors and performance measures. The central goal of any implementation is to make an improvement. The users and user management are best equipped to define what constitutes an "improvement" in the context of their organization. There are few, if any universal productivity measures which are applicable to all organizations, at all times. Office productivity is a construct that must be defined concretely, within a given context.

In some cases, users have taken responsibility for quantifying the value of defined improvements as well. This is very positive as it facilitates the cost-benefit analysis, especially when evaluating the less tangible, but vitally important opportunities, created by the new systems.

5.3.6 Measuring the Reinvestment of Time Savings

Office systems can have a striking impact on time-use. It has been noted for example, that electronic mail alone can save some managers two hours a day. A good system design will include a reinvestment strategy for saved time. This is a plan regarding how all categories of office personnel can undertake new activities not possible before. A typical example is that word processing can save a secretary time in correcting and retyping documents, especially when it is integrated with a multi-function system. If a cost-displacement strategy (eliminating jobs) is rejected, a reinvestment strategy of some kind (even if informal) should be implemented. Perhaps the secretary can undertake to assist the manager with financial planning using system tools. Improved administrative support of this kind is a typical objective.

Measuring how saved-time is used is a particularly important and thorny problem. A measurement approach to this must again be concrete, evaluating to what extent specific reinvestment objectives were achieved.

6.0 SYSTEM IMPACT → SOCIAL

6.1 Introduction

Integrated office systems produce changes in what people do (job content), how they feel about what they do (job satisfaction), how they feel about others (interpersonal relations), and the environment in which they work (physical location and arrangement, organizational structure and climate). There have been a number of phrases in recent years which summarize the issues about which these evaluations are meant to gather data. These include Quality of Work Life (QWL), Organizational Development (OD), Socio→Technical Systems Analysis (STS), and Job Enrichment. In no way do we mean to imply that these phrases (or the conceptual frameworks underlying them) are synonomous. Each is appropriate for describing a portion of the analysis required for a proper study of the social impact of an office system.

The purpose of this section is to provide evaluation guidelines based on a discussion of these impacts and related measurement issues. To provide a framework for discussion of these impacts, the remainder of this section defines four levels of analysis, general data requirements and appropriate levels of aggregation. Subsequent sections discuss measurement of social impact at each level of analysis in terms of these factors.

6.1.1 Levels of Analysis

To discuss social impacts of office systems, one must be careful to identify the level of analysis used. For the purpose of this report, four levels (individual, work group, organizational, and societal) are identified.

Individual Impacts: At the individual level, one is concerned with the impact of office system technology on an individual's relationship to others, his/her job and to the organization.

All of these impacts affect a person's perception, attitude, and behaviour. In addition, changes brought about by the introduction of new technology can lead to increased or decreased feelings of stress and fears concerning individual safety. For example, increased stress could result from inadequate training, isolation from co→workers, or "de→skilling" of the job. Psychological stress is as real a source of concern for health as is the more tangible source, physical stress.

Work Group Impacts: On the level of the work group such topics as how the group perceives itself, work flow,

management style, relations with other work groups and relations with the organization as a whole must be considered. At issue here would be such topics as centralization/decentralization of decision-making, changes in group autonomy, changes in the relationship between supervisor and group, and the emergence or disappearance of group activities and/or responsibilities.

Organizational Impacts: When dealing with office system impacts at the organizational level, one must be concerned with structural effects, work flow, overall functioning (effectiveness and efficiency) and attitudinal issues such as overall job satisfaction and organizational climate. It is when data are aggregated at this level that one can see the effects of changes at the lower levels. One concern is that positive local impacts may cause dysfunctional organizational impacts and vice versa (the local versus global optimization problem).

Societal Impacts: These impacts affect segments of society which cut across organizational boundaries. Included are effects on identifiable sub-groups such as women, unions and the handicapped as well as more generalized effects such as changes in the overall quality of working life and patterns of employment.

6.1.2 Data Requirements

In this subsection, we are concerned with the types of data that should be collected to properly assess social impacts of an office system. In general, four types of data are required:

- Attitude/Perceptual Data
- Task/Activity Data
- Communication/Information Network Data
- System Use Data

Attitude/Perceptual Measures provide data on what people think they do and how they feel about doing it. Task/Activity Data provide information on what they do and how they do it. Communication/Information Network Data allows one to connect individual tasks and jobs to examine interpersonal and intergroup communications and information transfers. System Use Data (which can be collected automatically by the system, or by the use of logs or observation), provide a baseline measure against which the other data can be compared.

Knowing individual attitudes allows the investigator to assess likely resistance to new technology and to

evaluate the impact of experience with the technology on these attitudes. Knowledge of an individual's job in terms of tasks and activities performed provides input to system specifications prior to implementation and enables assessment of changes in job content and workstyle after implementation. Similarily, the Communication/Information Network Data provides the capability of modelling changes in individual and group communication patterns, as well as providing an opportunity to assess substitution effects between alternate modes (e.g. Electronic Mail versus Telephone). The System Use Data (Section 4) provide a concrete measure of the utilization of various systems and will partially elaborate Network Data.

So far, the four categories have been discussed in general terms. Below, each is discussed in terms of the specific data that pertains to that category.

1) Attitude/Perceptual Data

This category includes data on:

- Interpersonal Relations
- Organizational Climate (including privacy, health, supervision, etc.)
- Job Satisfaction
- Attitudes to Office Support Systems and perceptions of frequency and volume of use and problems arising with these systems.

These data should be collected via standard/accepted questions for each dimension. Good Instrument Design is vital to the data collection effort. Users will often refuse to complete a poorly designed questionnaire. Use of standard questions allows comparison of field trial results to established standards which provide a meaningful basis for comparison. While the first three dimensions can be incorporated into a single instrument, it is likely that a separate instrument to collect data on office support systems will be required. In general, each instrument should take no more than 20-30 minutes to complete. Longer instruments will greatly increase the lack of cooperation, and thus data reliability.

2) Task/Activity Data

These data will likely be collected at two levels of detail: the tasks comprising an individual job, and the content of the more important of these tasks. To assist in making useful comparisons and assessing

impacts, several tasks which are unlikely to be affected by an office system should be chosen, as well as those which are most likely to be affected.

At the level of the job, the evaluators should endeavour to determine the tasks which an individual must do to fulfill his/her job requirements. These can be ordered in terms of their relative importance and proportion of available time each requires.

At the level of individual tasks, one should collect data on the nature of information processing that each task requires, the nature of output (destination, type, volume, frequency) and aids used in completing the task. While there are many ways to collect these data, it is likely that individual interviews, using specially designed forms, will prove to be most effective.

These interviews, which will likely last about one hour, will also provide an opportunity to answer any questions and to collect anecdotal data which will be useful in post-hoc explanations. For example, one could explore issues of health, safety and privacy based on reactions to attitude data collected earlier.

3) Communication/Information Network Data

These data are collected to provide the basis for constructing a network which defines who communicates with whom, via what mode. Associated with these data should be information on the duration of the interaction, the purpose of the interaction and information on communication failures. Data on communication failures will highlight bottlenecks in the communication systems while establishing the purpose of the interaction in terms of its relation to a particular task, allowing one to tie the interaction to the task data discussed earlier. Communication data have been collected via a variety of means, but the most reliable method to date is an interaction diary. Using this method, an individual records his/her interactions on a diary sheet. Most diaries are designed so that an interaction can be recorded in about 5 seconds. Experience has shown that reliable data can be collected for a period of up to two weeks.

4) System Use

The behavioural data referred to here are those data that can be automatically collected by the office system. Since these have been discussed in Section 4, they will not be discussed here. To the extent that data on system use and communication can be collected automatically, the burden on the users and the evaluation team is reduced. Automatic data collection does not alleviate the need for other data collection instruments since information on the context of the interaction will still be required. They do substantially reduce the effort required in other areas and consequently reduce costs and respondents' stress.

6.1.3 Levels of Aggregation

The data discussed so far are collected from individuals. The analysis of impact at the other three levels is accomplished by appropriately aggregating the data. For instance, one might look at an individual's attitude toward office system technology. By aggregating the attitudes for all members of the work group, one could arrive at an overall attitude for this group. If one were to do this for a number of work groups, intergroup comparisons could be made.

Aggregation of these same attitudes over the whole organization would give a picture of the organization's attitude toward office systems. Comparisons between organizations would allow one to draw inferences about likely societal attitudes toward office systems. Furthermore, measuring these attitudes before, during and subsequent to an office system implementation would allow the investigators to draw inferences regarding the impact that the implementation of the office system had on attitudes toward office systems at each of the 4 levels of analysis. A similar approach would be used to assess other impacts at each level.

In order to accomplish this, there must be a detailed a priori research plan with extensive coordination between the research teams (see Section 9). Furthermore, the instruments must be carefully designed to avoid duplication of effort, loss of data, incomplete data and overload on the host organizations. Finally, the timing of the data collection phases must be carefully planned (this issue is discussed in Section 2.3.3).

Having defined the scope of a social impact evaluation at the beginning of this section, we proceed to discuss the evaluation of the impact at each of the four levels, as detailed in the separate subsections for each.

Data may be aggregated to develop impacts at each level, as follows:

6.2 Individual Impacts

The general nature of individual impacts was discussed in Section 6.1.1. In this section, these impacts are examined in some detail as individual data form the basis for analysis at other levels of aggregation. We begin by discussing the nature of individual impacts, the types of data required, and close with specific comments on measurement of individual impacts.

6.2.1 Definition of Individual Impact

The changes in the individual's attitudes, perceptions and behaviours which are attributable to office systems are by definition the individual social impacts of the office system implementation. In order to assess change, one must measure the preceeding factors at several points in time (pre-implementation plus several post-implementation measurements). Comparison of the results of these measurements allows one to infer the likely impacts of the office system. This approach applies whether one is concerned with impacts at the level of the individual, the work group, the organization or society as a whole.

6.2.2 Types of Data and Instrumentation

The data required to assess individual impacts are based on the four general categories mentioned previously (6.1.2). Essentially, data are required on:

1) Individual attitudes toward his/her job; co-workers, organizational climate; technology and change in general; and toward the specific departmental office system technology.

2) Perceptions of office support systems including: what technology is currently available, how frequently it is used, and any problems with the current services.

3) Individual tasks and activities; including tasks which comprise an individual's job, and the inputs, outputs and processing associated with each task.

4) The existing communication network recording who talks to whom, via what mode, for what purpose.

5) System Use Data as described in Section 4.

6.2.3 Measuring Individual Impacts

Though these comments appear under individual impacts, they pertain to measurement of impacts at other levels as well. They are as follows:

1) The various types of data discussed above must be sufficiently comparable so that cross-checks can be made. For example, one could compare attitudes and communication patterns to see if the office system had a significant effect on the cross-correlation between these variables.

2) The data must be coded in a standard way.

3) The databases must be set up with sufficient flexibility so that any type of data can be accessed by demographic characteristics such as age, sex, hierarchical level, union membership, etc. (This will be important when one wishes to aggregate over various dimensions.)

4) When data are collected over time, care must be taken to ensure that the instruments are administered in a consistent fashion.

6.3 Work Group Impacts

At this level we are concerned with the social impact of the office system on group attitudes, flow of communication and information within the work group and changes to the way in which intragroup information is processed. Also included are impacts on the management style within the group and relations with other work groups and the organization as a whole.

The impacts are assessed as follows:

1) Group Attitudes:

By aggregation, the responses of work group measures on such dimensions as interpersonal relations within the group and management style, a group score for each relevent dimension can be obtained. Impacts are derived by comparing these scores over time. For example, comparison of the group attitude pre- and post-implementation would give an estimate of the effect of the office system on interpersonal relations. In addition, comparison with the control group will yield valuable information.

2) Communication/Information Networks:

Changes in communication patterns and management styles can be investigated by studying differences in group communication patterns over time. For example, comparing the relative proportions of horizontal and vertical communications over available modes for pre- and post-implementation data allows one to determine impacts on management style, (e.g. autonomy) span of control and level of coordination within the group.

The remaining impacts (job content, work processing, etc.) can be assessed in a similar manner.

Comparisons of impacts between work groups in various functional areas and at different hierarchical levels allows one to assess impacts across these levels.

6.4 Organizational Impacts

By aggregating data over the whole organization, one can assess impacts on:

1) Organizational Structure

This can be done by utilizing diary data and developing a complete network using hypergraph analysis or some similar technique.

2) Attitudes

Aggregation of attitude data over the whole organization provides a picture of change in the overall quality of work life and organizational climate.

3) Task Behaviour

Development of a task network from the task analysis data allows one to assess change in both the flow of information and its processing. Analysis at this level is particularly important since it allows one to check for impacts on information transfers across work group boundaries.

Other data, based on observation, careful documentation of the implementation process and interviews, will provide insight on the impact of special subgroups within the organization, such as unionized employees, clerical staff and management.

6.5 Societal Impacts

There will be a number of groups in Canada who will be anxious to learn the outcome of these evaluations as they pertain to their particular vested interests. Even though these trials are limited in size and scope, it is likely that we can gain insights which will be of use during the eventual, more massive introduction of the technologies under evaluation. By acknowledging the concerns of these groups and collecting, where possible, data which can be analyzed to begin to answer their concerns, the usefulness and acceptability of these evaluations can be significantly enhanced. Some of the concerns for women, unions, middle management, and policy makers are discussed below. Other issues are listed in Appendix 1. We do not discuss all issues here; those who have a particular interest are directed to our Reading List, in particular, readings 5, 8, 10, and 12.

Many women fear that they will be impacted more negatively than men (on a proportional basis) by microprocessor technology. The concerns are that (1) more jobs in which women are employed will be lost, (2) the new jobs emerging will be filled by proportionately more men, and (3) that the jobs left for women will be more stressful, less challenging, less safe and less secure than they were before. It will be important to gather information concerning the presence or absence of these impacts.

Unions in Canada are concerned about many of the same issues as women. The emphasis is slightly different: they express concern regarding (1) the health aspects of the technology, (2) retraining for those whose jobs are automated out of existance, (3) the size of the gap between "information" workers and "knowledge" workers and the possibility of creating job ghettos, and (4) the possibility of unfair treatment of people who work part-time or from home.

While lacking specific spokespeople which the womens' movement and unions have, middle management can be seen as a definite societal segment with concerns regarding new technology. For this group the issues are (1) possible changes in roles and responsibilities (including span of control, centralization of decision-making, etc.), (2) style of work (including hours of work, work at home, and supervision of personnel via computers instead of face-to-face), and (3) changes in organization structure which may inhibit their access to higher level jobs.

Policy makers will have a great interest in this project as they require information which will assist them in evaluating the impact on education and training needs for

all those impacted by the new technology. Beginning levels of computer literacy and its relation to perceived stress will be but one specific topic which could be addressed during the evaluations.

The need to address these issues goes beyond the likely capabilities of the data that can be collected from only three field trials. Though the trials cannot pretend to answer all these issues; or indeed provide complete answers to any of them, valuable insights can be obtained. In order to garner these insights the evaluators must:

1) Ensure that sufficient demographic data is collected at each level of analysis so that the data can be aggregated across a number of relevant variables.

2) Have sufficient coordination between evaluation teams so that interorganizational comparisons can be drawn.

The societal impacts can be suggested, though not definitively, by aggregating data on a particular issue across each organization and conducting interorganization comparisons. For example, one might study how the content of unionized jobs (or at least some unionized jobs) changed during each implementation. One could then draw comparisons across the organizations.

To the extent that there were common effects, tentative impacts could be posited. These initial conjectures would not be definitive, but would point the way for further work.

7.0 EVALUATION OF THE NEEDS ANALYSIS PROCESS

The purpose of this section is to provide guidelines for evaluating the needs analysis procedures. A system may be technically sophisticated and highly reliable, but if it is not based on an accurate reflection of user needs, it is unlikely to be a success. Hence, one of the key by-products of the field trials should be information, methods and strategies for assessing user needs and determining the technical, social, and environmental components of a system. This would be of considerable use to both field trial and other Canadian user and supplier organizations.

7.1 Methods

In order to evaluate the needs analysis process, it is necessary to consider the elements which might constitute the overall measurement methodology. Some or all of the following elements have been commonly noted as instrumental to a sound methodology:

1) a conceptual framework,

2) an understanding of the objectives of the measurement undertaking,

3) a research design,

4) the measurement instruments,

5) a sampling method,

6) a method of analyzing the data, and

7) an overall study strategy.

Each of these areas may be examined to see how the approach used maximized the likelihood that user needs were effectively determined. The instruments and analytical procedures used to obtain the information can also be examined.

7.2 Effects

Complimentary to an examination of the methods used in the needs analysis, another means of assessing the success of these methods is to examine their results. While this would seem straightforward, the problem is that the success or failure of a system may be based on any number of factors, the needs analysis being only one of them. Hence, use of performance measures should be considered in light of the documentation of procedures.

1) System Use

To the extent that a system is being used according to expectation, one has evidence supporting the conjecture that the needs analysis has been successful. Hence, actual versus planned use (the latter being based on the needs analysis) should be measured to determine just how effective the means for determining the system's design have been.

2) Attitudes

Another area to examine when considering the impact of the needs analysis is that of user attitudes. Positive user attitudes can, in part, be attributed to a successful transformation of user needs into the actual design of the system. Methods of assessing user attitudes have been documented in Section 4 of this report.

3) Unstructured Observation and Interviews

Discussions can be held with designers, implementors, and users to get their views on what specifically did and did not work.

7.3 Context of Assessment

A systems design should encompass these three critical components: the technology itself, the jobs performed in using that technology, and the overall environment in which both the job and the technology is located. The key is to collect appropriate information in terms of user needs which can be translated into the design encompassing these three elements. The evaluation should determine if and how the information was collected to meet the fulfillment of these needs.

7.4 Strategic Planning and the Design Process

User departments have already identified the need to begin long range strategic planning for integrated office systems. Although each department will be committing significant resources (monetary and otherwise) to their respective systems, they will have to also examine how these technologies will interface with other systems, either departmentally or inter-departmentally. As well, they will have to examine the implicaitons of the new technology for human resource management, the physical plant and organizational structure, to name a few. The planning and implementation of integrated office systems must go hand-in-hand.

As the topic of office automation is a new one for most people, there is likely to be a lack of homogeneity regarding perspectives, objectives, strategies and tactics. Thus, the planning process is as important as the product of planning → the office systems plan.

The field trials provide a unique opportunity to learn more about the relationship of office system pilots to long range planning. The evaluation plan should include methods to acquire such information.

Given the existence of a well defined planning process, to what extent did it help create the climate for change? To what extent did the plan enable the implementors to approach the users with clarity and consistency? The evaluator should determine if the latter plan exists and if it does, what did it contain. The elements of an example plan, and its relation to the implementation of a pilot is best illustrated by the following diagram.

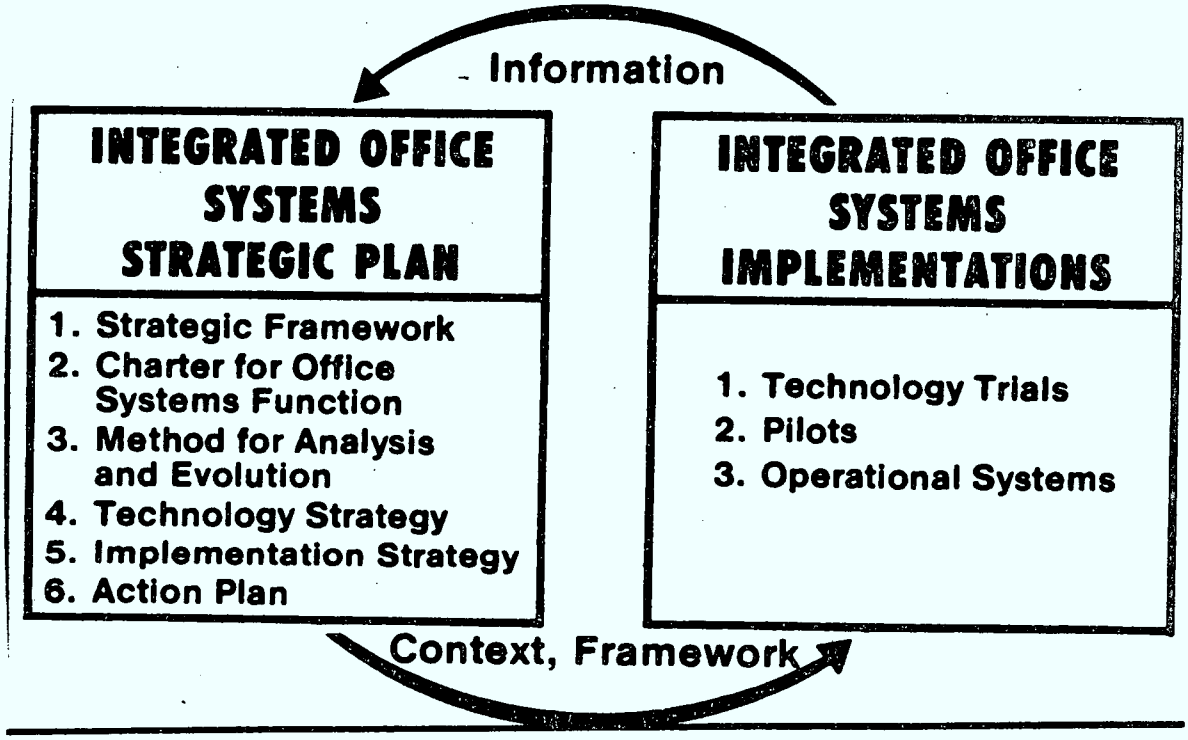

Figure 7.1
Strategic Planning and Implementation

8.0 EVALUATION OF THE IMPLEMENTATION PROCESS

The intent of this section is to provide the reader with a set of guidelines regarding the evaluation of the system implementation.

Implementation encompasses the introduction of a new system to the organization. As such, it begins the day the users and designers first meet and continues until the system is turned over to the users. For a change to be introduced successfully, the people who are to be subjected to the change should understand the reasons for it. A successful implementation will depend very much on the degree to which users perceive the system as having value.

There is much that can be learned through the field trials regarding how to implement new office systems and this knowledge can be of critical value to field trial suppliers and users and to other organizations. As a result, one of the goals of the evaluation should be to monitor the implementation process. The objective is to draw lessons regarding the types of implementation strategies, technologies and materials that appear to be most useful.

8.1 Organizational Issues

Implementation involves managing the change within the client's organization. There are two aspects to managing this change:

1) introducing the system so that the clients can see how it may be in their interests;

2) providing an opportunity for the clients to adopt the change into their working patterns through education and training.

The first task in evaluating the implementation is to ensure that a detailed chronology of what was done is prepared. The evaluator should attempt to record how the user organization was prepared for the implementation with respect to time commitments, their understanding of the problems the system would address and the detailing of responsibilities with respect to implementation.

A second task is to describe and evaluate the selection and roles of the various implementors - leaders, trainrers, educators and change agents. These people may come from a variety of groups, including but not limited to, the users and the vendors. In both these cases, the implementors will play a role separate from the users. They are the directors of the implementation. The

objective here is to gain knowledge about what types of people, roles and responsibilities appeared most successful.

Another area for examination is the amount of time the users commit for introducing the system, system training and learning the system.

8.2 Education and Training

It is important to differentiate between training and education. The former can be considered as teaching people skills that they will apply directly in some activity. The latter, on the other hand, refers to teaching people knowledge of concepts and other issues. The end product of education is therefore understanding and appreciation.

8.2.1 Education

The introduction of an integrated office system must be done with great care and planning. It is potentially disruptive, frustrating, time-consuming and costly. Resistance to the new technology may be strong. The major considerations in planning for this change will be behavioural rather than technological. The evaluator should examine the extent to which the users were supplied with information regarding topics such as:

- how the new system would work,
- what the new system would provide them from a functional viewpoint,
- what their contribution requirements would be in order to make the system work,
- how they could use the system effectively.

The amount of information provided to the users regarding the system, as well as the timing of the release of that information, should be measured. Ensuring that users are appropriately informed of implementation activities can help facilitate a smooth system implementation, as well as ensure a high level of user motivation.

8.2.2 Training

The training program is one of the most significant challenges of the evaluation process. It will be critical to learn as much as possible about the various methods of training -- what methods and materials did and did not work.

The ultimate objective of the training program is, of course, to ensure that the user be able to use the system effectively.

Some of the areas involved in the training include:

- an initial appreciation of the system,
- learning how to use the system,
- the traning methods (video, CAI, etc.),
- manuals and other training materials,
- size and composition of the training groups,
- feedback to the trainers, and
- refinement.

1) Evaluating the Training Sessions

The organization of the training may significantly affect the users' level of knowledge regarding the operation of the system. The timing, phasing and follow-up of the training should be examined.

The introduction and assimilation of procedures related to integrated office systems requires an extended learning curve, a fact quite different from previous office systems innovations, such as the photo-copier, calculator or even word processing. In some cases, this process may take two or even three months.

The evaluator should examine the length of the training sessions to determine their effect upon user acceptance and level of understanding of the system operation. How were training sessions scheduled? How were changes in scheduling accommodated? Did all users actually receive all the necessary training? Was there sufficient back-up training?

2) Documentation

Clear, concise and sufficient documentation is critical to a succesful implementation. How was the documentation presented to the user and what methods were used to ensure its technical accuracy?

8.3 User Acceptance

An important aspect in the design of office systems is to know whether and to what extent new office systems will be accepted by the potential users. Reichwald (1980) has defined acceptance as "the willingness of an applier to employ the usage potential of the new technology for the intended tasks." For the user this ultimately means the ability to perform the tasks at hand. It is possible to measure user acceptance. This may be done subjectively through interviews and attitudinal questionnaires, or objectively through the use of system monitoring data.

Monitoring system results can provide an indication of the success of the system implementation. (This issue was covered in Section 4 on System Use).

Attitudes may be affected by many different things, including, but not limited to:

- feelings of inadequacy in learning new skills,
- fear of failing to grasp new procedures and skills,
- inability to predict how the system might respond,
- inability to adjust or change habits which have been relied upon for both guidance and protection,
- belief that the computer system will take "control",
- changes in existing social patterns which result in social isolation, and
- lack of identification with the new system in that, if the system is not initially sought by the worker, and the consequences of the change are not seen as directly beneficial, resistance may occur.

Users' attitudes toward the system may be obtained through questionnaires, the study of changes in communications patterns, and direct observation of system behaviour.

9.0 ORGANIZATION OF THE EVALUATION

9.1 Introduction

Organization of the evaluation effort itself is a complex and essential task. Many players are involved, each with different interests. This section supplies a set of organizational recommendations designed to assure competent, comprehensive and coordinated evaluation efforts.

9.2 Evaluator Roles

There are three distinct evaluation clients: the vendors, the user groups, and the OCS program. One could add Canadian industry and society, but we are presuming that these interests can be subsumed under those of the OCS program.

Each client is expected to provide its own evaluation team representatives, either members of the client's staff or outside evaluators under contract and responsible to the client. While each evaluator will be primarily responsible to the organization paying him/her, all will be required to participate as an active member of the overall evaluation team. If disagreement persists within the team, the conflict resolution procedures described below can be put into effect.

The evaluation effort will be expedited and disagreement minimized if each of the three major parties to the evaluation supplies evaluators with the following characteristics:

1) knowledge of integrated office systems design, implementation and evaluation;

2) competence in terms of education and experience in field research in public sector organizations;

3) experience in evaluation project management;

4) experience in the modeling and evaluation of socio-technical systems, expecially those intended to support white collar activities;

While it is unlikely that any one individual will possess all of the above characteristics, each of the three evaluation teams should strive to have its team members collectively satisfy all of the stated requirements.

9.3 External Evaluator

The external evaluators, those directly under contract to the OCS program, are expected to have a unique role in the evaluation effort. Those assigned to each of the three sites must possess all of the requirements stated in the previous subsection. This is for several reasons. First, the vendor and/or the user group may choose to use the field trials as an opportunity to gain needs analysis and evaluation expertise in-house, and thus may be unable to supply experienced evaluators at the beginning of the exercise. Second, the evaluators for the vendors and users are bound to have parochial perspectives since they are working for specific clients. Thus, with the exception of the OCS supported evaluator (an organization of evaluation experts), there will be no one who has an interest in providing an overall perspective. Third, all of the user groups have stated specifically that they are looking to the OCS program to provide evaluation expertise. Thus, not to do so would cripple both the OCS and user group evaluation efforts.

Not only must the external evaluators be experts, but it is preferable for each of them to be contracted for the duration of the evaluation effort for several reasons.

1) Not to do so would put the entire evaluation exercise in jeopardy. As has been noted in these guidelines and mentioned by many others, the evaluation effort will be continuous and evolutionary. If the external evaluator is not a party to the entire evaluation, he/she will not be able to undertake an adaptive evaluation strategy, which is required for a continuous evaluation. Thus, long run objectives will be sacrificed for short run ones, and documentation of the overall evaluation cannot be assured.

2) The vendors and the user groups are expected to provide persons who will stay with the evaluation team throughout the lifetime of the evaluation effort. It is clearly in their interests to do so, both from the quality of their own evaluations and from the learning that can be obtained. If the external evaluator is seen as being temporary, it will be very difficult for that person or group of persons to exercise any influence over the overall evaluation. Hence, both coordination and cohesion will be lacking, and the most likely source of expertise will not be adequately tapped.

3) If the external evaluator is under a short term contract, that person's emphasis is likely to be on demonstrating that the contract should be renewed.

Therefore, long run objectives will be sacrificed so that short run objectives can be met. In fact, the external evaluator might concentrate solely on short run objectives, because they are the only ones which will appear to provide the long run payoff. The consequence would be an inflexible and non-adaptive approach, one totally unsuited to an overall continuous evaluation effort.

The only argument for a short term contract for external evaluators is that they could be removed if they did not perform in accordance with the contract, and/or because they and the user group were in sufficient conflict that the evaluators could no longer serve a useful function with that group. Mechanisms already exist for removing a supplier under contract who is providing substandard work. To provide another means is superfluous. In the second instance, when the evaluator and the user group are in conflict, any evaluator who has concern about his/her reputation would withdraw since it would be impossible to perform a competent job. The emphasis should be on finding competent external evaluators, not on using inappropriate methods of control.

If it is not possible at this juncture to assign adequate funds for the entire evaluation project we recommend establishment of a short-term contract to be extended at a later date once the funds become available.

9.4 Intra-Site Organization

The evaluation team at each site is to be made up of representatives from the vendor, the user group, an external evaluator and the Department of Communications, if a person from that organization is available. While it is hoped that most decisions on data collection instruments and procedures can be made by consensus, the team will need a chairperson. It is recommended that this individual be the external evaluator. This is for several reasons. First, he/she will be as expert, if not more so, as any other member of the group. Second, the external evaluator has no particular vested interest as his/her primary responsibility is to ensure that the overall evaluation effort is as effective as possible. His/her clients are less specific than the vendor and user group representatives. The external evaluator is working for the OCS program and the public at large. Third, she/he and she/he alone will be independent of the organizations involved in the conflict resolution procedures.

The external evaluator and the entire evaluation team should be responsible to the user organization Project Manager for the entire field trial.

9.4.1 Conflict Resolution Procedure

Any member of the evaluation team who is not satisfied with the decisions made by the team can register an appeal through the conflict resolution procedure. The first level of appeal is the Project Manager, the member of the user group responsible for the conduct of the field trial. If agreement cannot be made at this level, appeal can be made to the Evaluation Committee, which is composed of senior (probably executive level) representatives from the vendor, the user group and the DOC program (see Figure 9.1). It is assumed that this will be the court of last resort. It is also assumed that if the appeal concerns issues of research methodology, the Evaluation Committee will seek outside and independent expert advice in this regard.

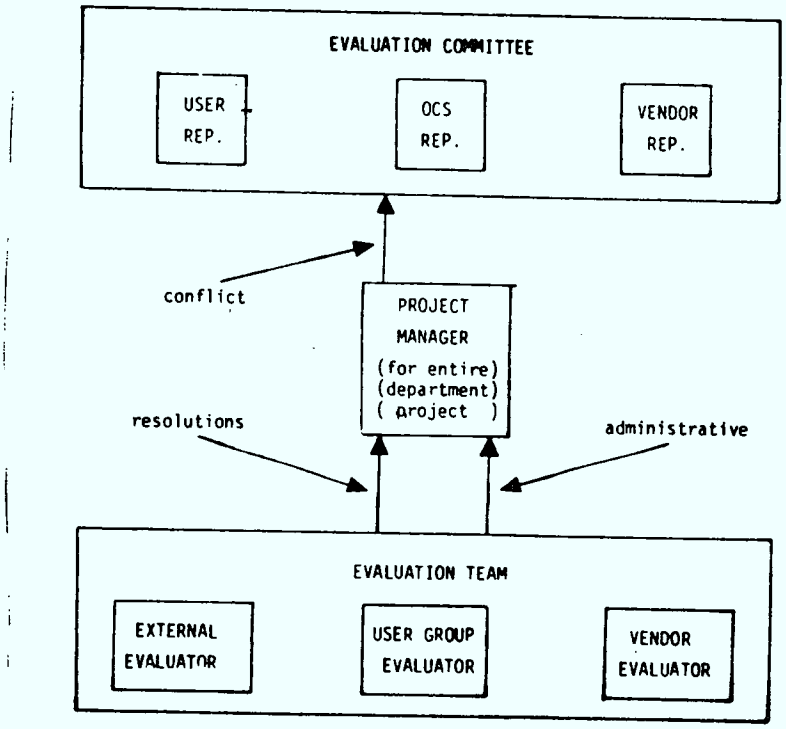

FIGURE 9.1
Intra-site Evaluation Hierarchy

9.4.2 On-site Operation

The evaluation team, including its chairperson, should report to the Project Manager for the day-to-day operation of the evaluation exercise (Figure 9.1). This is vital, since it is the user group that must supply the data, and their cooperation is extremely important if the data obtained are to be reliable. Furthermore, the Project Manager should have the right of review of evaluation reports before they are released. This is to provide him with a means to question content which appears to be damaging to the government department involved. If there is a dispute about report content between the Project Manager and an evaluator working for another client, this should be resolved by the Evaluation Committee.

9.5 Inter-Site Organization

Although the focus of the evaluations is that which can be learned at each site independently of the other sites, an evaluation across all three sites needs to be undertaken as well. This effort is not to be a report card, comparing the effectiveness of the efforts of the three vendors. Rather, it is to provide a summary of the knowledge that has been gained in all of the field trials so that both vendors and users alike can benefit from the successes and avoid the problems that arose during the field trials.

An overall evaluation report requires cooperation across the three evaluation teams. This is the responsibility of the external evaluators and should be so stated in their contracts. The external evaluators should assure that there are sufficient data collection instruments and procedures in common so that meaningful cross-site analyses can be made. To assure such cooperation, a committee spanning all three OCS field trials, with representatives from each external evaluator, vendor and user group, could provide the appropriate coordination mechanism. If consensus on those methods to be used in common across all sites cannot be reached, appeal should be made to the Evaluation Committee and a superior conflict resolution authority, if appropriate, to ensure that this is the case.

The inter-site reports, to be prepared by each of the three external evaluators, must recognize that each of the field trials is unique and that in many dimensions they are not comparable. Nevertheless, this does not negate the value of reporting on all three sites in a way that the Federal Government, Canadian vendors and the public at large can benefit from a combined picture of what has taken place. Each external evaluator should be

responsible for such a report.

9.6 External Evaluator: Level and Phasing of Effort

Although the specifics of the data collection instruments, procedures and forms of analysis can only be decided after the external evaluators have been chosen and the evaluation teams formed, the expected level of effort and the timing of the various phases of the evaluation research can be detailed on a per site basis. This assumes that vendors perform on schedule. Any delay in the development of the office communication systems will have to be taken into account at the time the evaluators receive notice of the delay.

Level of Effort Work Years	Dates of Effort	Activity at Each Site
1/2	Oct. '82/ Jan. '83	Development of overall evaluation plan and initial data collection instruments and procedures.
1/2	Feb. '83/ Mar. '83	Collection of baseline data → pre-pilot study (sample size 30 → 50).
1/4	Apr. '83/ Aug. '83	Collection of data on implementation of pilot study.
3/4	Sep. '83/ Mar. '84	Collection of ex post pilot study data, analysis and report.
3/4	Jan. '84/ Mar. '84	Collection of baseline data → pre-field trial (sample size 200 → 400).
1/2	Apr. '84/ Sep. '84	Collection of data on implementation of field trial.
1	Sep. '84/ Mar. '85	Collection of ex post field trial data.
1	Jan. '85/ Sep. '85	Data analysis and preparation of final reports.

Note that the combination of level of effort and the dates concerned imply that the external evaluator must be able to supply at least three competent persons to the project at particular points in time.

The total level of effort suggested for each of the OCS field trials is 5 1/4 work years. While costs may vary considerably depending upon the external evaluator involved, and cannot be determined precisely until

responses are received to the request for proposals, a reasonably estimate is $100,000 per loaded (including all overhead charges) work-year.

Clearly, useful evaluation information could be obtained for less. However, experience has shown that there is a "critical mass" of resources required to generate valid and reliable data from integrated office system research. The above estimates are based on all such evaluation programs conducted in Canada to date.

10.0 APPENDIX 1: SOCIAL IMPACTS ISSUE CHECKLIST FOR EVALUATORS

The purpose of this Appendix is simply to raise some broad issues related to office systems and social impacts that may lie beyond the scope of our guidelines. The following list may serve as a quick guide to evaluators who wish to check issues covered by their data colleciton instruments. Those who want a more detailed discussion of some of these issues can turn to the Report of the Human and Social Impact Committee to the User's Group, Office Communications Systems Program. Also a report on the Impact of Office Automation on the Privacy and Confidentiality Needs of Individuals, prepared by D. Wells is useful. A summary of the issues is provided in a paper by Dr. Dorothy Philips. These papers can be found in the attached list of readings.

10.1 Societal Issues

1) Effects of Economic Productivity

How will office automation effect national productivity? Will - there be increased output with the same staff or will there be a constant output with decreased staff. If productivity increases result who will share in the increased wealth.

2) Type of Employment

How will office automation change the nature of jobs? What kinds of skills and jobs will be required; which jobs will become obsolete?

3) Differential Employment Effects

How will increasing automation affect employment among various groups in society? Specifically, one can think of effects on clerical employees, most of whom are women. There are other groups such as the undereducated, older workers, handicapped persons etc. who may be effected in singular ways by office automation.

10.2 Organizational Level Issues

1) Effects on Organizational Structure

Span of control, flat/tall, centralized/decentralized, etc. All of these possible effects must be identified and their implications understood.

2) Effects of office systems on the manager's role and style of managing. In particular, the effects on middle management must be understood.

3) One must be sensitive to the effects on job content and job design. An important issue in the civil service the resulting job classifications.

4) New systems imply a need for training and retraining at the various levels affected. Not only will individuals have to be properly trained; training programs must be developed that will be effective in meeting individual and organizational requirements.

5) The effect of alternate work sites on both the organizational structure and management style must be considered. Patterns of work may change resulting in new demands for coordination of effort and recognition of individual contributions. These new patterns could significantly affect organizational design and the quality of working life.

10.3 Individual and Small Group Issues

While there are almost as many individual issues as there are individuals who will be affected by the new systems, some general issues can be identified.

1) Health and Safety

A variety of issues surround the use of office automation equipment. Since potential users of office systems are worried about possible physical and psychological effects it is necessary to deal with them. The evaluators must certainly be sensitive to these issues.

2) Stress

The use of the new technology may engender high levels of stress particularly among older or less educated workers. The levels of stress must be monitored and effective means for stress reduction developed through evaluation feedback.

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