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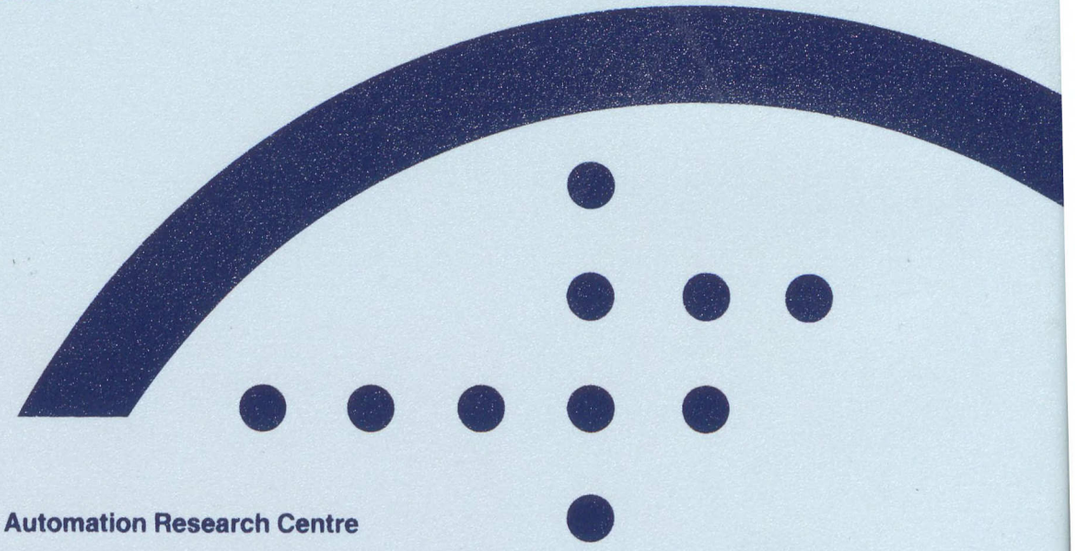

Canadian Workplace Automation Research Centre

Evaluating Office Automation:

A Guidebook

Canada

EVALUATING YOUR OFFICE AUTOMATION:

A GUIDE FOR MANAGERS
IN MEDIUM-SIZED AND LARGE ORGANIZATIONS

ORGANIZATIONAL RESEARCH DIRECTORATE
CANADIAN WORKPLACE AUTOMATION RESEARCH CENTRE

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EVALUATING YOUR OFFICE AUTOMATION: A GUIDE

A INTRODUCTION

A.1 What this guide is for

Suppose that some employees in your department have been using an office automation system for a couple of years. Recently, your management has said that they want to consider expanding office automation to other areas of the department, and perhaps throughout the whole organization. First, however, they want to know what the effects of the system in your department have been, and consequently what they can expect if office automation is expanded. What information can you give them?

This is a guide to gathering and reporting that evaluative information. It will tell you how to identify, measure, and report the costs and benefits of office automation. The guide was inspired by an unsettling finding from a study the Canadian Workplace Automation Research Centre (CWARC) conducted on how office technology was being used in 55 departments in nine large Canadian organizations: not one of those 55 departments had ever carefully assessed the effects of the technology, despite great interest in and need for that information.

We at the CWARC feel that, despite the widespread belief that office technology can provide the critical competitive edge in office productivity, the wise investment of scarce organizational resources in this technology depends on knowing exactly what the returns are on those investments. The various effects of office system implementations on how and how well offices work can and should be evaluated. This is especially true for pilot projects, where some judicious evaluation can contribute to informed decision-making about system expansion.

While there are many possible approaches to such evaluations, the principles, methods, and recommendations in the following pages are drawn from "best practice" in the broader field of evaluation research. (Section F contains a comprehensive bibliography.) The guide is organized in the order of the steps needed to plan, conduct, and report the results of the evaluation. The resources needed for each step are also described.

The evaluation techniques described in this guide are intended to provide foresight, not hindsight. When you use these techniques, we want you to end up with some well-grounded, precise ideas of what you can expect from office automation in the future, rather than what went right or wrong in the past. The fundamental purpose of evaluation is to provide critical information for negotiation and decision-making. **The fundamental purpose of this guide is to provide critical information for office automation management.**

In our experience, it is the managers responsible for the results obtained from office system implementations who are most interested in evaluation. We have therefore assumed that the principal users of this guide will be those managers and their staff. The person responsible for the evaluation should be:

1) familiar, at least in general terms, with the organizational history and culture surrounding the implementation project; and

2) able to mobilize other organizational resources - including people and funds - to assist in the evaluation.

It will be up to the manager of the department concerned to decide whether to delegate responsibility for the evaluation. The guide, however, has been written for the person or people who will actually conduct the evaluation.

A.2 Is it worthwhile to evaluate?

Evaluations cost time and money, and if not properly conducted, can provide disappointingly little useful information. Under what conditions should you consider undertaking an evaluation?

In general, an evaluation should be done only when its benefits exceed its costs. In practice, this means that it is worthwhile when it provides information that is used to make decisions about system expansion, upgrading, or elimination, and when the results of those decisions are worth more than what the evaluation cost .

A.2.1 What are the potential benefits?

Are the answers to the three questions below important to your organization?

1. What have been the effects of automation so far?

2. What effects can we expect in the future?

3. What is the risk if expected benefits are not achieved?

If they are, evaluation should be considered. It will yield higher quality, more certain answers than any other method of addressing these questions.

A.2.2 What will it cost?

The most common rule of thumb in costing an evaluation is that it should cost between two and five percent of the total one-year costs of whatever it is you're evaluating. When calculating this for office system evaluations, you must include not only the hardware and software costs, but also the costs of training, user support, system maintenance, and change (how to do this will be described in section C.3.5). For your preliminary estimate, a good rule of thumb is that the "soft" costs of automation are roughly equal to or one-third larger than the "hard" costs; therefore **you can estimate that your evaluation should cost:**

2-5 percent of (total cost of materiel x 2).

- *For example, evaluation of a fairly typical 20-workstation, local area networked system [1] should be budgeted at between $5,000 and $9,000.*

If the potential benefit from evaluation is larger (that is, if the benefits from the decision to expand, upgrade, or phase out will be very important to the organization), proportionately more may be spent, perhaps as much as 10 percent of total system costs. To estimate the staff time required, you can use the 2-5 percent rule of thumb as follows:

- Decide who will be responsible for conducting the evaluation (normally, the office automation manager or his or her assistant, or an internal consultant, plus someone more junior to act as an assistant).

- Calculate the daily salaries of these people and then calculate their average.

- Then, take the total evaluation costs obtained from the calculation above, subtract 20 percent for overhead costs, and divide by the salaries to get the number of days required from each person. (This assumes that each will be required for the same number of days. With a little algebraic manipulation you can vary the split between junior and senior time as you wish, depending on the capabilities of the people.)

- *For the example given above (of an evaluation of a twenty-workstation system, where the total evaluation cost is calculated to be $9,000):*

  - *if the senior person's daily salary is $200, and the junior person's is $120, and both spend the same number of days on the evaluation, 22.5 days will be required from each (or four and one-half working weeks each).*

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[1] *As we will use this example throughout, more details are given on page 11.*

- *if the senior person's daily salary is $300 and the junior person's is $100, and the senior person contributes roughly one-third of the total days on the project, 15 days (three working weeks) will be required from the senior person, and 27 days (roughly five and one-half working weeks) will be required from the junior person.*

Note that this cost estimate includes the time to be spent by those who will conduct the evaluation, but not the time of those who will be surveyed or interviewed during the evaluation.

A Typical Case for Evaluation

Early in 1983, Company X decided to see for itself what the office automation revolution was all about. Twenty personal computers were purchased, along with wordprocessing and spreadsheet software packages. The personal computers were given to three managers, five secretaries, and twelve professionals in Department Y, a line department reporting to the Vice-President, Marketing and Sales.

It was expected that the professionals and managers would begin to type and revise their own reports, and that the secretaries would then format them properly. The professionals were also encouraged to experiment with specialized software packages. All of the new users received a half day of training on the basics of personal computers. The secretaries also received more extensive training with the wordprocessing package.

In mid-1984, a local area network and some communications software were purchased. This meant that the users in this group could exchange files electronically, and could communicate using electronic mail. By this time, almost half of the professionals had purchased their own personal computers and claimed that they were more productive when working from home, so the Company decided to officially endorse "telecommuting" and to absorb the communication costs.

Early in 1987, a management committee was formed to investigate the advisability of installing a company-wide electronic mail system, perhaps with other office automation functions. The committee's first question was: "What ever happened with that system in Department Y?"

A.2.3 How long will it take?

Experience tells us that the best and most worthwhile evaluations are those that are planned **before** the implementation. Whenever possible, evaluation should be included in the implementation plan, and viewed as an integral part of the system planning and implementation process. When this is the case, the number of days budgeted for the evaluation will be spread throughout this whole period.

We recognize, however, that in most cases, managers will be conducting "after-the fact" evaluations, when the system has already been in place for some time. In these cases, **the elapsed time before actionable results are available from a maximally informative evaluation will be at least three months.** More time will be required if the implementation is particularly large or complex. Answers to particular questions can be available in as little as one month.

A.2.4 Will the results be used?

Although the objective of evaluation is to provide critical information for decision-making, very often evaluation results are never used. In fact, past research shows that there is almost no relationship between the amount or quality of evaluation work, and how much the results influence decisions.

You can increase the likelihood that your results will be used:

a) if you pay as much attention to **finding the right questions** as finding the answers; and

b) if you pay as much attention to **how you find the questions** as to what the questions actually are.

More concretely, the most successful evaluations proceed in three phases of roughly equal duration: **negotiation, design, and execution.** The actual collection and reporting of evaluation information should take up only third of the total time.

The major steps and considerations in each of the phases are described in the following pages.

B Phase 1: NEGOTIATION

B.1 Obtaining senior management support

Because this kind of evaluation is often new to organizations and is also more costly than the typical practice, **support from at least one senior manager will be important from the start.** If you do not already have this support, identify one or more senior managers (or a management committee) who could derive some benefit from the results of the evaluation, and who could be in a good position to help you. Using whatever means you usually find effective, convince him, her, or them to publicly support the evaluation. If you cannot obtain such support, it will be much more difficult to conduct the evaluation and to ensure that the results will be used.

B.2 Involving stakeholders

Any evaluation has several stakeholders -- people or groups who have some stake in how it turns out. (Often, some of these are not aware that they are stakeholders.) It is usually recommended that all stakeholders be represented in the planning of the evaluation, usually through a Task Force or Steering Committee.

The purposes of this "user participation" are:

1) to increase the range of concerns addressed,
2) to increase awareness of and access to evaluation information, and
3) to improve the fairness of the evaluation process.

On the other hand, these ideals are often difficult to reach, for several reasons:

1) stakeholders typically have competing interests,
2) they may be unable or unwilling to participate,
3) involving them does not necessarily increase the likelihood that they will use the results, and
4) any committee process is cumbersome.

In most cases, **we recommend that a stakeholder group** (Task Force, Steering Committe, Evaluation User Group) **be formed, and that it have responsibility for approving important steps in the evaluation**. At the least, this will increase the visibility of the evaluation and commitment to the process if not the results, even if reconciliation of all interests is not possible. Cases where you may not want to set up such a group are those where the audience for evaluation results is really just one person, or where you can address stakeholders' concerns more informally.

Typically, stakeholders in office automation evaluations include:

- senior management of the organization (those who have already given their support, and others who have a stake in future automation)
- management of the data processing, computer, and/or management information systems department
- human resources/personnel department

- physical plant management department
- users in secretarial/clerical jobs
- users in professional jobs
- users in managerial jobs
- any labor union whose membership includes users
- employees in job categories which may be affected by future automation
- suppliers of existing mainframe and/or office systems
- suppliers of any equipment you want to interconnect

All of these groups can be asked to provide a representative to sit on the Steering Committee. If any refuse or do not respond, try to find out why. It is possible that you may have to work around some prior conflicts in order to form the Committee.

Finally, remember that **you are involving stakeholders in the evaluation of an existing situation**, not the continued operation of a system, nor the actual planning of a new one. There may be a more appropriate role for some stakeholders in these other phases.

B.3 Securing agreement on objectives

Before the evaluation begins, **stakeholders must understand and agree with the objectives of the evaluation** and, therefore, the questions it will and will does not address. Once the stakeholders have been identified and the Steering Committee formed, the first important step in the evaluation is to hold a Steering

Committee meeting to discuss the objectives of the evaluation. The outcomes of this meeting should be public commitment of the Committee to the evaluation objectives, definition of the Committee's role and responsibilities, and approval for beginning of the design phase.

B.4 Securing agreement on how the results will be used

Utilization of results is helped if stakeholders have a good idea beforehand of how they will use them.  You can **improve the likelihood of utilization by spending an hour or so with each Steering Committee member, developing a (formal or informal) contract about what information you could provide and how he or she would use it.** These meetings should take place after the first Steering Committee meeting.

B

Checklist for negotiation

Have you:	YES	NO
Support from at least one senior manager for the evaluation?	____	____
Formed a Steering Committee?	____	____
Agreement from the Steering Committee on the evaluation objectives?	____	____
Agreement from each Committee member on how the results will be used?	____	____

If you have answered "NO" to any of these questions, please refer to Section B.

C Phase 2: DESIGN

The design phase of evaluation is the most critical. In this phase, you will essentially make a documentary of the implementation (like a television documentary), describing it from planning to present. Then, you will analyze and discuss the information you uncovered in your documentary to arrive at the questions which will really be the "guts" of your evaluation. Finally, you will devise ways to answer the questions. We will take each of these three steps in turn.

C.1 The documentary

Your objective in this step is to describe as fully as possible all the reasons why the system you are evaluating is the way it is, and how it got to be that way. A thorough look at all these questions now will make it easier later to separate their effects from characteristics of the technology itself and from other things going on in the organization (see section C.4).

As in a television documentary, you will want to **examine your subject from several different angles:**

a) **The formal organizational angle:**
Look up all the "official" information on the implementation, including memos, meeting minutes, requisitions, etc., and any regulations that may have been pertinent.

b) **The informal organizational angle :**
Starting with the people who were "officially" involved (that is, who figure prominently in the information you have already collected) and others you already know, conduct informal, unstructured interviews (see Appendix 2 for a description of interview types). Basically, these interviews will be fairly open-ended conversations with the key players in the implementation about their views on how and why it happened. Ask them to suggest other people to talk to. Stop this process when it all begins to sound the same; that is, when people are no longer giving you new information.

Apart from their "official" viewpoints, these people will also have personal opinions and feelings about the automation process. If you have not done so already, try also to get an impression of their more informal reactions. This will help you see the evaluation problem from multiple viewpoints, and will probably provide you with some good examples and quotes that you can use to add color to your presentations or reports.

c) **The formal stakeholder angle:**
Make sure at this time to interview representatives of all the stakeholder groups. This will be their main opportunity to put on record their views of the organization's approach to automation in general, and the project being evaluated in particular. It is important at this stage to draw out all the issues that matter to them. Again, ask these people to suggest others to talk to, and stop interviewing when it starts to sound redundant. Try to collect the personal viewpoints of these people, too.

The documentary interviews should begin with questions about the interviewee's job and, if relevant, role in the implementation of the system. Subsequent questions should focus on the interviewee's opinions about the planning of the implementation, the implementation itself, the costs and benefits of the automation, and, most importantly, **the questions that an evaluation should address.** The information gathered in these interviews should also include answers to the following questions:

1) How was the decision to implement arrived at? What were the initial objectives for the system? Was there a pre-implementation feasibility study or needs analysis? Did users participate in the decisions, or were their attitudes assessed some other way? What was management's attitude at the beginning?
2) How were users informed about and prepared for using the system? What kind of training did they receive, when, and for what cost?
3) Were any changes in procedures, processes, tasks or division of tasks made when the system was introduced? Why? How were they decided on? Which of these were intentional, and which unplanned?
4) How is the system being used now? For what tasks? By whom? How much?

At this point, it is often useful to **write a narrative history of the implementation, describing the main events in chronological order, and from the various angles.**

Although it may seem that you now have all the information necessary to draw conclusions, the evaluation is by no means complete. The next steps will be to turn the subjective impressions collected so far into objective fact: that is, plain hard data that anyone else could reproduce.

C.2 What do you want to know? Generating questions

The next step in designing the evaluation is to decide what you really want to know. Take as much time as you can for this phase, and get as much advice as you

can - nothing is as devastating as discovering after the fact that you neglected to ask some critical question.

To start with, **list all the questions that the people interviewed thought should be addressed in the evaluation.** Then, **arrange these questions into similar categories.** (General categories of office automation effects are described more fully in section C.3.3.). **These questions represent the universe of important issues for the evaluation.** Examples from the case described on page 11 might be:

- ***1. Since the system was put in, have users been absent from work more often?***
- ***2. Since electronic mail was implemented, have the telephone bills dropped?***
- ***3. Are the professionals who work from a terminal at home more productive?***

From among these, you must decide which are the most and least important to you, keeping in mind how the results will be used. Cross out any which you are not interested in investigating further. **A manageable evaluation should try to answer no more than 10 major questions.**

In many cases, what evaluators want to know is to what extent the objectives of the project being evaluated have been met. In office systems evaluation, however, it is typical to find that an "objectives-achievement" approach is not feasible, because objectives for the system:

a) are often not specified in advance, or are so general that they can't help you decide what to measure (for example; "to improve departmental func - tioning"); and

b) often fail to cover all the side-effects of automation.

For these reasons, we suggest that you don't concentrate your efforts solely on measuring the achievement of objectives. (Nonetheless, asking all the stakeholders what they thought the objectives of the system were, as suggested in Section C.1, is extremely useful. First, it may reveal some potential effects that you had not yet thought of evaluating, but more important, it can be an "early warning sign" for conflicts between stakeholders or for general confusion about what the system was supposed to do in the first place.)

When you have a list of no more than 10 evaluation questions, submit them to the individual Steering Committee members. If the feedback you receive suggests that some stakeholders have a problem with some of the questions, hold a Steering Committee meeting to discuss, revise, prioritize, and approve the questions.

C.3 Designing testable questions

The third step in the design phase is to devise ways to answer each of the evaluation questions. We will cover this phase quite thoroughly, since it is the most technical part of evaluation design.

C.3.1 The effects of something on something else

First, you must state what you want to know in measurable or "operational" terms. A useful trick for doing this is to **phrase each evaluation question so that it asks about the effects of something on something else.** Try to to come up with two or three operational questions for each of your original evaluation questions.

As you develop questions, give careful attention to what measurements they would involve. This issue will be adressed more thoroughly in section C.3.7., but for now, keep in mind that **for these operational questions to be useful, it must be possible to measure both the "something" and the "something else."** Often there are several ways to measure both. Almost as often, it will become apparent that information you would need to answer some of the operational questions will be impossible or extremely difficult to obtain. **Retain only measurable operational questions on your list.** In any kind of evaluation, decisions about what to measure must be tied very closely to decisions about how to measure.

To help you think about how you can actually collect the measurements, Appendix 2 provides a brief description of measurement techniques commonly used by evaluators.

Below are *some examples* of several operational questions for each of the three evaluation questions mentioned in section C.2:

1. ***Since the system was put in, have users been absent from work more often?***

   Is there a negative correlation between average daily log-on time and number of sick days used? Do people who report that they use the system most also report having more headaches? Do secretaries who do mainly wordprocessing have more frequent or longer absences than secretaries who do mainly other things?

2. ***Since electronic mail was implemented, have the telephone bills dropped?***

   What is the relationship between the numbers of local and long-distance phone calls made by each department, and the number of electronic messages sent and received by each department? Were there fewer long-distance telephone calls originating in the plant six months after the implementation as compared to six months before? Do managers who use electronic mail report spending less time playing "telephone tag" than managers who do not use electronic mail?

3. ***Are the professionals who work from a terminal at home more productive?***

   Do professionals who have terminals at home log onto the system more frequently between 7:00 and 11:00 p.m. than professionals who do not have terminals at home? Do professionals who use home terminals say that they are able to accomplish more now than they were before? Do professionals with home terminals receive higher ratings on their performance appraisals than professionals who do not have home terminals?

Keep in mind as you develop operational questions that:

- 1) There will be aspects of the original evaluation questions that you are not really interested in;
- 2) There will be some changes that have occurred during the same time that the system was in use that were caused by things other than the system (see section C.3.5.2);
- 3) Some operational questions will be politically unacceptable or in violation of a practice or policy.

Cross out any operational questions which meet these criteria.

C.3.2 The effects of what?

Once you have phrased the things you want to know in terms of the effects of something on something else, you will probably begin to notice that you are not asking many questions about the office automation system itself. More likely, you want to know about the effects of things that were associated with the installation of the system. The most common questions of this type are about the effects of:

1) use of the system, as opposed to mere access to it;
2) how, when, where, and why it was implemented;
3) re-organized work processes; or,
4) training.

What we are pointing out, then, is that **the greatest effects of office automation have less to do with the machinery itself, and more to do with how the machinery comes to be used.** While this may seem obvious,

we must emphasize that it means you can find very different impacts from exactly the same system.

It also means that **the overall worth of your system to your organization depends to a very large extent on the training, implementation and redesign of work that accompany installation.** Because you can control these things, it is critical to identify their roles.

Your documentary information will be valuable in sorting out exactly what is the cause of what; go back and look it over carefully as you formulate operational questions. Analysing this information will also allow you to make observations and recommendations about how these organizational processes should be handled in future implementations.

C.3.3 The effects on what?

Office automation implementations can have many effects, not all of which will be relevant to your evaluation questions. As you are developing operational questions, you may find that it is difficult to know whether you have covered all the effects that are important in your case. The following list of types of effects, all of which have been identified in previous research, may help:

- **Productivity and performance:** how well individuals and work groups perform their jobs;
- **User satisfaction:** how users react to using the system;
- **Level and quality of system use**: how much the system is used, and how well;
- **Worker well-being:** how satisfied employees are with their work and working conditions;
- **Organizational communications**: patterns and effectiveness of formal and informal communications within the organization;
- **Organizational culture and image**: how the organization is perceived by its employees, clients, and competitors;
- **Job and operations design:** the way tasks and activities are organized within and between employees' jobs.

Appendix 1 contains more detailed summaries of each of these types of effects. Appendix 3 provides some suggestions about how to measure them.

To prioritize among the effects you have identified as important, look for those which:

a) are most central to the mission of the organization,
b) were part of the original objectives for the system, and
c) your management will be most interested in.

For example, a newspaper (whose main mission is to produce text) will probably want to put more effort into measuring the effects of automation on text production than will a polyethylene manufacturer (whose text production is far less central).

Finally, even if your operational questions cover all the effects that were intended, try also to include any **unintended effects** that might have occurred. These will be important when predicting the effects of future systems.

C.3.4 The effects on whom?

In any office systems evaluation, care must be taken to choose the right level of analysis. The level of analysis is the level or type of organizational unit that you want to draw conclusions about. It could be individuals, job categories, workgroups, departments, manager-secretary pairs, or some other organizational unit. **First, decide what level you want to look at, and second, make sure to collect information at that level.**

For example, suppose you want to draw conclusions about the effects of access to corporate databases on the junior sales analyst's percentage

improvement over time in monthly sales report production speed. If you only collect data on their department as a whole and not on individual analyst's, you will not be able to draw conclusions at the individual level of analysis.

In the evaluation of office automation, the most common levels of analysis are individuals and work groups. Because office systems are usually implemented in intact work groups (everyone in the work group gets the system at the same time), wherever possible, **we recommend looking at effects on intact work groups.**

C.3.5 For what cost?

An often neglected part of cost-effectiveness or cost-benefit evaluations is the careful calculation of all costs associated with the system and its implementation. As we have already mentioned, the cost of automation is much greater than just the costs of hardware and software.

A comprehensive assessment of hardware / software costs, for all types of office systems, should include:

- the computers and terminals;
- hardware maintenance and servicing;
- software;
- supplies such as diskettes, ribbons, and manuals;
- special office furniture, such as chairs, workstations, printer tables, and hoods;
- costs for any additional space required for work or storage, and;

- communications equipment such as modems, local area network cards, cables, and servers, or telephone switches.

The remaining costs, which we call "organizational," should include costs for:

- initial training and refresher courses;
- having people in training (that is, their salaries for the training period);
- a factor of about 20 percent loss of productivity per user over the first two months;
- one technical support person for each 50 users and one user support person for each 50 users (or, one technical/user support person for each 25 users);
- management of the files and databases, estimated to be between 50 and 100 hours per year per user.

All costs should be amortized over several years, since most but not all of the expenditure will be in the first year. If possible, the expected turnover rate in the user group should be taken into account. The amortization period should be the number of years before you expect to do a major upgrade.

For microcomputer-based systems, the results of these cost calculations will generally show that the hardware/software costs are only one-third to one-half of the total. Where there is one user per workstation, the costs are approximately equally split between user costs and equipment costs. Therefore, if there are two users per workstation, the total costs will be roughly three-quarters of those when there is one user per workstation.

As a rough guideline, a recent study has estimated the costs of a microcomputer-based system with a local area network and one user per workstation, amortized over three years, to be $10,000 per worker per year.

Costs per worker for mainframe-based office systems may be, surprisingly, more difficult to calculate than those for micro-based systems. Although the department which runs and services the computer may be able to say how much of the computer budget a given department or work group uses each year, few of the organizational costs are likely to be included. To calculate all the costs, you may have to collect information from several departments. *For example, we have found that the department responsible for computer-system training varies within the same organization according to the kind of computer system and software the employee is being trained to use, the employee's classification, and the type of training given. Additionally, the responsible department is not always the department which actually pays the bill.* You may also find that you cannot easily break down existing cost records to the numbers you need. However, a little perseverance should provide figures in the right order of magnitude.

C.3.6 Comparisons: The logical basis of evaluation

Comparisons are critical to the logic of evaluation. In office automation evaluations, two kinds of comparisons must be considered: comparing the status quo with alternatives, and operating automation effects from others. These are described below.

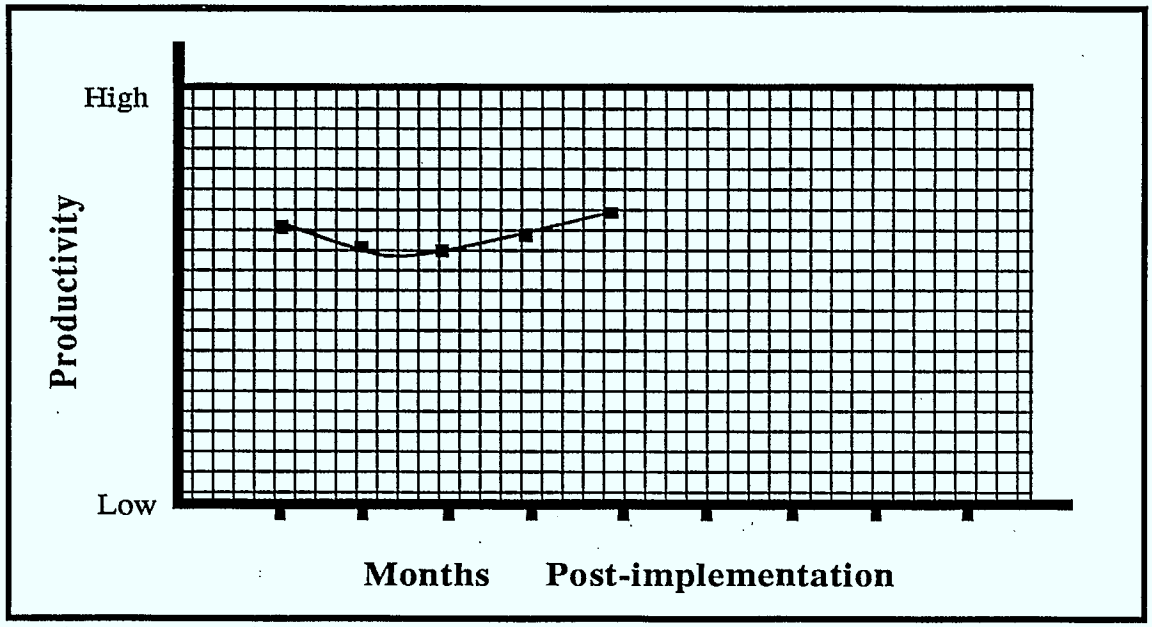
C.3.6.1 Comparing the status quo with alternatives

Operational evaluation questions should involve some kind of **implicit or explicit comparison**:

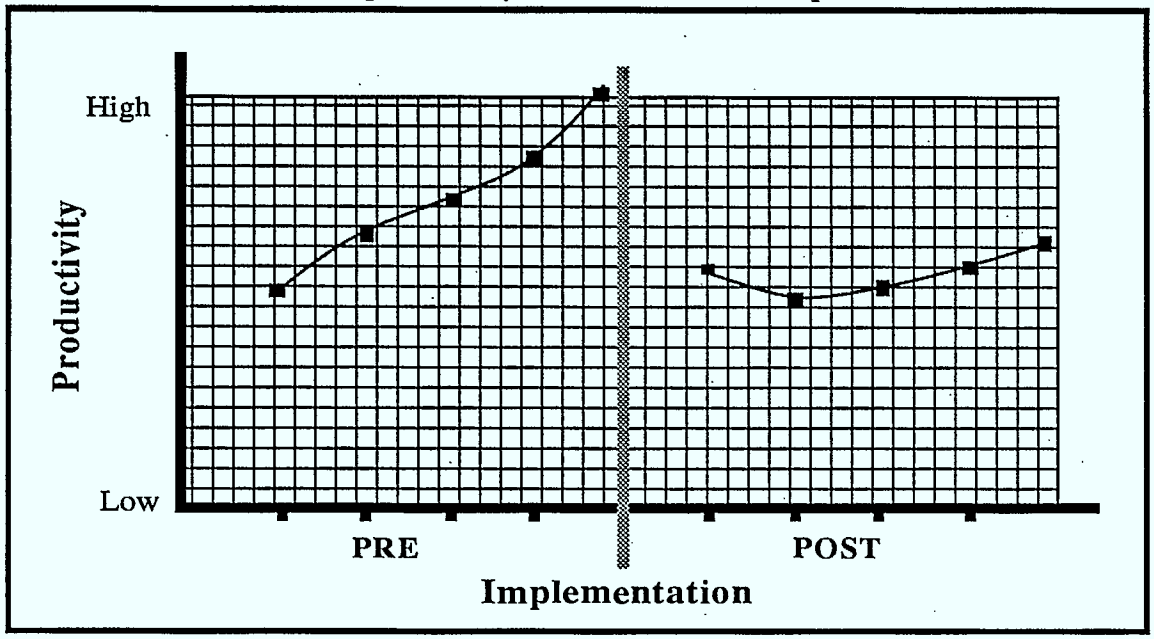
> *Do people who use the system for more minutes each day use more of their sick days each month than people who use the system for fewer minutes each day?*
>
> *Do those departments which send and receive more and longer electronic messages make fewer and/or shorter telephone calls than those departments who send and receive fewer and shorter electronic messages?*
>
> *Do professionals who have terminals at home log onto the system more frequently between 7:00 and 11:00 p.m. than professionals who do not have terminals at home?*

Without some kind of comparison between the status quo and one or more alternatives, you will not be able to draw conclusions about the cost-effectiveness of your office automation. It is easiest to illustrate this with an *example*:

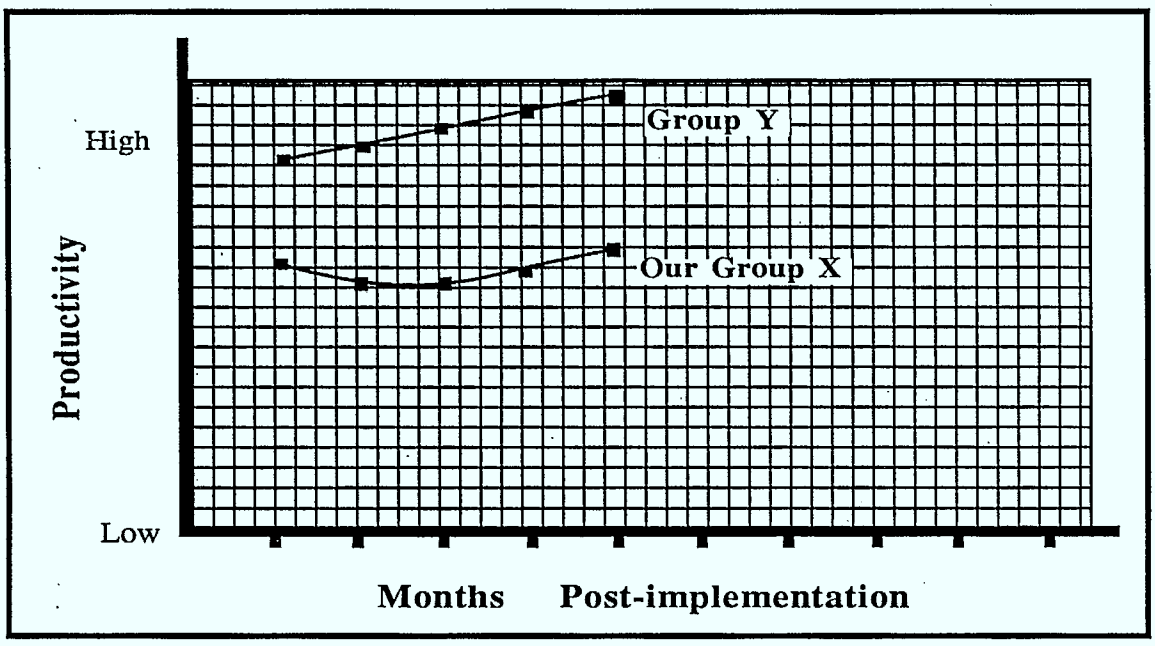
Suppose your evaluation showed that post-implementation productivity was increasing:



With these data, productivity seems to have improved with the implementation. But, suppose a comparison had been made between productivity before and after the implementation:



The results look very different. Or, suppose productivity had been compared to a similar office in a different plant:



Without the comparison, the results tell a different, and possibly biased, story.

You will have to choose the types of comparisons that make best sense for your particular evaluation questions. In general, the most sensible comparisons represent the most likely alternatives for future implementations. *For example, if future choices will be between automation and no automation, then comparison of an automated work group with a non-automated work group are most appropriate. Alternatively, if future choices will be between mandatory versus discretionary training for use of a system to which all employees will have access, the most sensible comparison will be between a group which has mandatory training and a group which does not.*

There are three ways to design comparisons between alternatives:

1] **Comparisons among the people or groups who use the system being evaluated before, during, and after the system is implemented.**

In most organizations, this type of comparison is appropriate and **easiest to arrange**; a comparison is simply made between the **same people before and after the implementation.** If you choose this type, keep in mind that timing of the "before" and "after" is important. The first six months after implementation are usually chaotic, and many stable office automation effects do not begin to show up until one year after implementation. And of course, before-after comparisons require **measurement of the same things before and after** implementation, so this kind of evaluation design must either be planned in advance of the implementation, or limited to questions for which accurate "before" information can still be collected after implementation.

2] **Comparisons between the people or groups who use the system being evaluated and some other people or groups who have a different system, or no system, or who have had the same system for a shorter period of time.**

The logic of this type of comparison requires that **the people or groups who have and do not have the system be as similar as possible** in terms of any characteristics which might also be related to the effects you're looking for. In general, this means that they should be as similar as possible in the kind of work they do. Finding such a group is likely to be difficult because (one would hope) each work group or department performs unique functions, and systems are usually given to all or most people within a work group or department. This option is also **the most expensive of the three**, since it involves collecting data from a group other than the one you are mainly interested in. However, **such comparisons are powerful,** and should be used if available.

3] **Comparisons among people or groups who were supposed to have received the same system at the same time, but for whatever reasons, actually had different experiences.**

The third kind of comparison can be used when neither a pre-measurement nor a comparison group are available. The reasoning behind this design is that even though everyone in the work group or department was supposedly given the training or access to the system or whatever else you are interested in the effects of, probably some "got" it more than others, that is, there is some **natural variation in the implementation.**

This variation might show up as differences in the number of training sessions that users actually attended; differences in the number of or types of applications that were actually "up" and fully functional on the computers of various groups of employees; or differences between those who used the system a lot versus those who let it gather dust on their desks.

Your choice of comparison should also take into account how important it is to you and your stakeholders to have precise estimates about specific effects. *If it is absolutely critical to have precise information about, for example, expected levels of use in order to decide how much equipment to buy or how much time to allow for training, you may decide you need a comparison group. On the other hand, if your interest is mainly in the effects of system configuration on processes within the work group, a comparison group may not be worth the cost and effort.*

Several possible types of comparisons can be specified for each evaluation question. Confidence in the results will be increased if the same thing is found when the question is examined several ways. As in the question-generation phase, some comparisons will not be helpful, and some will be impossible; eliminate these. What you are left with is the basic elements of your evaluation design.

C.3.6.2 Separating automation effects from other organizational changes

Because most events in organizations have multiple causes, comparisons are also often needed to sort out the effects of a technological change from other organizational changes. *For example, a market downturn coincident with the arrival of a new chief executive officer (CEO) and the relocation of headquarters can all have independent and joint effects on performance, morale, labor relations, etc.* A problem when assessing the effects of the introduction of new technology is **figuring out which effects are attributable to:**

a) The technology

b) Events which will always accompany technological change, or

c) Other events that happened at around the same time but would not always happen when your office technology is updated.

This separating process is important because it can help you **be much more definitive about what changes can be expected in future implementations.**

Some examples of effects that should and should not be separated are given on the following page.

Separate out? YES

- *Situation:* *Because of wiring problems with the equipment, employees in the pilot project were moved into an open office area.*

  Effect: *On performance, from the new, noisy, unpredictable, working environment.*

  Why? *Open offices can impair productivity, but a move to open offices will not always accompany office automation.*

- *Situation:* *Because the pilot project had such a high profile with the Board, the president and two senior vice-presidents were trained to use the system along with the first user group.*

  Effect: *On motivation and perceived responsibility for system success among the first user group, due to presence of senior management.*

  Why? *Presence of president has positive effects that will not exist for any other user group.*

- *Situation:* *At the same time the equipment came in, union representatives started distributing leaflets on the stressful effects of automation in the workplace.*

  Effect: *Anxiety, resistance and peer pressure due to persuasive messages from union.*

  Why? *Knowing how employees react to these messages can help you design ways to deal with their reactions separately from the implementation.*

Separate out? NO

- *Situation:* *The decision to implement coincided with the arrival of a new CEO.*

  Effect: *Changes in morale, procedures, and culture caused by CEO's actions.*

Why not?: Because these are long-term changes that have occurred throughout the entire organization; there is no alternative way of doing things now.

Situation: When the needs analysis was conducted, it became apparent that there was a better way to organize part of the work processes; this change was implemented at the same time as the system.

Effect: Greater efficiency or productivity as a result of changes in processes or a Hawthorne effect.

Why not?: Change in work processes is a natural part of implementation; both can and should co-occur.

The critical prerequisite for separating effects is a detailed description of exactly what went on in the work group, department, company, and outside world while the system was being planned, implemented and used. Only if you are aware of all the other possible effects can you decide if it will be necessary to untangle them. Review the documentary information (Section C.1), looking specifically for any events that a) could have affected any of the effects the evaluation questions will address (for example, productivity, job satisfaction); and b) could have affected the user group but not other parts of the organization. These are the effects you should consider separating from the effects of the system.

The logic of separating effects is similar to that of comparing between alternatives. There are two main strategies. **The first is to use as a comparison another group or work unit as similar as possible to the one under study**, but which either: a) does not get the office automation; or b) gets the automation but is not subject to the effect you want to separate out. (Choice "a)" is

usually easier than choice "b).") These comparisons are identical to the second and third comparison types described above, and have the same advantages (precision) and disadvantages (cost).

The **second strategy is to ask people in the group you're looking at very specific questions about all the possible effects, and to ask them to estimate the relative influence of each possible effect.** Their estimates can then be pooled for an indication of overall effect. The drawback to this strategy is that respondents may be unable to separate the effects in their own minds - especially for performance effects, or effects on the group as a whole. However, this strategy adds only trivial costs to the evaluation, is usually easier to sell within the organization, and is easier to manage.

Again, your choice of comparison strategy should depend on how important it is that automation effects be separated from the other effects.

C.3.7 Measurement: The operations of evaluation

Once you have decided what questions to ask, you must decide how to ask them. That is, you must decide how to measure the effects.

C.3.7.1 Deciding how to measure

As we mentioned in section C.3.1., it is important that each of the components in every operational question be measurable. Now that you know what you want to measure, you must decide exactly how you are going to measure it.

We have already mentioned several ways to make evaluation measurements. **Appendix 2 contains a complete list of methods**, along with their advantages and disadvantages. The methods covered in Appendix 2 are:

- participant observation;
- independent observation;
- unstructured interviews;
- semi-structured interviews;
- structured interviews;
- open-ended questionnaires;
- closed-ended questionnaires;
- diaries;
- archival analysis.

Some types of measurement will make more sense for your questions than will others. *For example, in an investigation of the effects of office automation on employee health, it would make sense to measure health by counting sick days used or by asking employees about their health on a questionnaire. It would not make sense, though, to measure health by simply observing employees at their workstations, without talking to them.* **The measurement methods you choose for each question should depend on their relative costs versus how**

much depth and breadth they give you, the quality of the data it is possible to get, and their suitability to address your specific questions.

We would like to point out here that although it looks simple, constructing valid interviews and questionnaires is actually very difficult. (Valid in this sense means that the questionnaire or interview measures what it is supposed to measure, and gives results that can be replicated). This is why **we recommend, wherever possible, the use of standardized instruments that have been developed and tested by professionals**. If you cannot find suitable materials elsewhere and decide to make up your own, try to get some professional consultation. Appendix 2 also gives some pointers on questionnaire and interview design.

You should now review all the operational questions, checking to see if there are any components that you do not yet know how to measure. Refer to the Appendices for some suggestions, but if after this you are still unsure about how to measure a component, go back to section C.2 and specify more carefully what you really want to know.

C.3.7.2 Triangulating

At this point you may find that although you can think of several different ways to measure each type of effect, none of them captures all the aspects of what it is you want to measure. This is a common problem in evaluation: evaluators have to

use measures which are less than ideal, because the ideal is impossible, too expensive, or impractical.

For example:

You may want to know the average percentage of their time that employees use the system. To measure this, you use the log-on times that are recorded automatically by the computer. This is a highly imperfect measure, because many people log on in the morning and off at night, while actually using the system only for very brief periods. But, modifying the system to capture actual usage time and/or having observers directly monitor user behavior are out of the question, because of both the expense and the union's objections to employee monitoring.

What can you do about having to use less than ideal measurements?

The answer is to **get as many angles as possible on the same effects**; in other words, to triangulate. The imperfections in the various measures should tend to cancel each other out, leaving you with a more complete overall picture. And, **the more important a particular effect is to the overall purpose of the evaluation, the more effort should be expended to measure it**.

For example, if your analysis of whether it will be cost effective to add 20 more workstations and a local area network depends on your knowing how much people are using their microcomputers now, you would want to have several measures of use, including not only log-on time but perhaps time diaries and interviews as well.

Once again, review all the operational questions, this time making a list of all the information you will have to collect. Check this list over carefully, making sure that it will be possible to collect all this information and that the costs of measurement take into account the importance of what is being measured.

C.4 Finalizing the questions

By now you should have a very clear idea of what questions your evaluation will answer. You should have:

- **between three and 10 evaluation questions;**
- **at least two operational versions of each evaluation question, each of which should specify the effects of what, on what, for whom, as compared to what.**
- **at least two ways to measure the effects in each of the operational questions.**

The second-to-last step in question design is to take a close look at the list of operational questions, and think carefully about whether you will be able to answer all of them with the time and money you have. Now is the time to rethink whether the effort of evaluation will be worthwhile - and to cut your losses if it seems that the cost of evaluation will be greater than the benefit.

As the last step in the question design, you may wish to **convene a meeting of the Steering Committee to obtain their approval of the operational questions**. This will ensure that the Committee members hold realistic expectations. However, try to avoid getting into the details of exactly how you are going to measure every effect. These meetings can quickly become bogged down in discussion of relatively minor points. The one exception to this, where you should go into as much detail as possible about the measurements to be taken, is for productivity and performance effects. **If productivity is a major issue in the**

evaluation, it is critical that stakeholders agree that how you are going to measure it is how it should be measured (see Appendix 1).

C

Checklist for design

Have you:	YES	NO
Made a documentary of the implementation?	____	____
A list of between three and 10 evaluation questions?	____	____
A least two operational versions of each evaluation question?	____	____
At least two ways to measure each effect?	____	____
Approval of the evaluation questions from the Steering Committee?	____	____

If you have answered "NO" to any of these questions, please refer to Section C.

D Phase 3: EXECUTION

D.1 Data collection and compilation

Now that you have defined your evaluation questions, all that remains is to gather the information you need, analyse it, and report your findings.

D.1.1 Obtaining consent and commitment

The people you want to gather information from should be given ample notice of this. **We recommend that a memo be sent to all those who could be affected by the evaluation roughly three weeks before the data collection is scheduled to begin.** This memo should describe the purpose of the evaluation, what will be asked of the participants, when, how long it will take, and should ask for their commitment. It should be signed by the most senior person you can get to sign it. Be sure to explain how the results will be used, and how participants may be affected. Ensure participants that any information they provide will be held confidential to the person who collects it.

This memo should be followed by a second, approximately one week before the data collection is scheduled to begin. In the second memo, remind participants about the evaluation, and let them know when they can expect to be contacted. Give a telephone number or location where you can be

reached, as some people may have questions, and some will be unable to meet your schedule.

D.1.2 Collecting data

Data collection is the part of evaluation where it is most critical that things go according to schedule. Participants will be less likely to take their participation seriously if they sense that the project is disorganized or unmethodical. It **may be helpful to make a master schedule of all contacts with all participants**, recording any changes as they happen.

We recommend that you try to find someone other than a major stakeholder (including yourself) to hand out the questionnaires, conduct the interviews, or collect the computer-monitored data. Your respondents may feel much freer to provide their real opinions if they feel anonymous to you.

All data collection should disrupt office functioning as little as possible. Interviews should be no longer than one-half hour, and conducted in respondents' offices if they are private, and in a meeting room if not. Questionnaires should be distributed to each respondent's desk, with his or her name on the envelope but not the questionnaire. Allow people one week to return completed questionnaires. Provide them with return envelopes, and arrange for a drop-off point near a convenient location, such as an elevator. (If you have a comparison group, indicate somehow on each questionnaire to which group it belongs so you can separate the groups afterward.)

Finally, for our discussion of data collection, we must mention a couple of things about credibility in evaluation, based on our experience. It is often difficult for evaluators to remain neutral, especially if they have been involved directly in the design and implementation of the system itself. To ensure that the results are credible to outsiders, you must try to **make sure that you are perceived as being objective about the results of the evaluation**.

The credibility of participants should also be preserved. Although ineffective usage and high anxiety may seem irrational and unfounded to you, making your views known at the wrong time can quickly result in sabotage of either the system or the evaluation.

D.1.3. Compiling data

The first step in analysing data is to organize it in a meaningful way. Start by going back to your evaluation questions, and decide what pieces of analysis can give you the answer. Then, decide what additional findings might qualify the answer. Compile the data so that you will be able to get this information from it, keeping in mind at all times how you will want to present the results.

If you are not familiar with the compilation of questionnaire or interview data, you can probably find someone who is, in your marketing research, personnel, or forecasting departments, or in an external consulting firm. It should only cost you a few hundred dollars to have the data compiled externally.

Although many highly sophisticated statistical techniques are available to you should you decide you need them, keep in mind that statistics are really only a kind

of metaphor for describing a situation. It is better to use a simple, understandable metaphor to get your point across, than a complicated one that your audience doesn't understand. In general, **we recommend that your statistical analysis stick to simple frequencies of various kinds of responses, and some cross-tabulations where needed.** If a lot of people (that is, more than 30) were all given the same, numeric-response questionnaire, some correlational analyses may be considered. Finally, **if you have a comparison group, most of your analysis should concentrate on comparing the two groups**

D.2 Turning data into information

D.2.1 Deciding what the results mean

If your compilation has been based directly on your evaluation questions, the answers to those questions should be fairly evident. **If some findings are ambiguous or unexpected, however, try to think of all the possible interpretations, and then rank them in order of plausibility.** Their meaning is best decided collectively, with the Steering Committee.

Now, however, you must try to answer the three questions that were behind your decision to do the evaluation:

1. What have been the effects of automation so far?

2. What effects can we expect in the future?

3. What is the risk if expected benefits are not achieved?

Question 1: Past effects

Based on the data you have collected, you can probably **summarize the overall effects** of the system you evaluated. This is the easiest question of the three questions to answer, provided your work to this point has been careful and thorough.

Question 2: Future effects

To answer this question, you will have to go beyond the effects you observed for the past automation, and think carefully about what things would be the same and what things would be different in future implementations. **It is helpful to specify several alternative scenarios** (based on the comparisons used in the evaluation, and include as a minimum a "no further automation" alternative). Also valuable here will be the efforts you made to separate out effects that would not be likely to always co-occur with an implementation. If you know, *for example*,

that future implementations will not include moving people to open offices, you can eliminate those effects from your estimates of future effects.

One of the most important future effects to estimate will be costs per user. Although there is no foolproof way to gauge how much the costs of the last implementation might be different in the future (other than for changes in the cost of materiel), the organizational costs are likely to be fairly stable over time. The costs of some alternative arrangements for training and user support can be calculated, as can expected salary level change. Remember, however, that because no more than half of the total costs will be for equipment, even drastic decreases in equipment prices will not necessarily have a drastic impact on expected future costs.

The other types of effects are somewhat more difficult to forecast. You can be confident that the more similar future implementations are to the one you evaluated, the more likely it is that the same effects will show up. **Hopefully, however, you have learned how to improve the next implementation in order to avoid some of the effects you don't want the next time. This is the most valuable way to turn these data into information.**

Question 3: Future risk

Finally, you must consider **what might happen if expected benefits are not achieved.** You can now calculate fairly readily how much money you might lose if the next implementation were to be a total or partial failure, taking into account the investment, the time lost and the opportunity costs (what productivity increases you might have had if you had achieved the expected benefits). Compare the potential losses to the potential benefits, for the most likely alternative scenarios The scenarios should then be compared against each other.

This question, however, is at the heart of the decisions you have tried to facilitate with the evaluation. **It is best decided by the stakeholders** If you have provided information that can enlighten these decisions, the goal of the evaluation has been achieved.

D.2.2 Reporting and follow-up

Although you now know how useful the evaluation could be, the job isn't done until the results are used.

Once you begin to have sense of what the data are telling you, **start discussing the results with your stakeholders.** Get a feel for how they might explain the results, and for additional questions they might have. Follow up on their suggestions.

When your analysis is quite complete, and you feel that you know what the results are, **present the results to a formal meeting of the Steering Committee.** This will be your most important forum for presenting the results. Be as precise as possible about the answers to the three main questions, backing up your analysis with information about specific effects.

Include recommendations, or at least suggestions for recommendations. Use graphics, demonstrations, or whatever else you need to ensure that the results are understood. Pay careful attention not only to direct suggestions about what else to look at or how to view the results, but also to the the undercurrents of reaction among the stakeholders.

At this point, the Steering Committee may ask for futher analyses, for a second presentation, or for a formal report. Provide these as needed. **Your real follow-up**, however, **should consist of a brief meeting with each of the committee members, discussing how he or she will use the results.** If you feel that the results have been adequately disseminated and are being acted upon, you may not want to bother with a formal, detailed report.

Any recommendations, as usual, should be actionable and targeted. Research has shown that evaluation recommendations are most likely to be acted on when they specify precise behaviors or actions, and fall directly within the authority span of the stakeholders.

D

Checklist for execution

Have you:	YES	NO
Informed all people concerned and asked for their cooperation?	____	____
Had the data collected?	____	____
Compiled the data?	____	____
Decided what the results mean?	____	____
Discussed the results with the Steering Committee?	____	____
Made recommendations to the Steering Committee?	____	____

If you have answered "NO" to any of these questions, please refer to Section D.

E CONCLUSION

We hope that this guide has provided you with enough information to help you decide when evaluation of office automation would be worthwhile for you, and to help you evaluate whenever it is justified. We recognize, however, that we cannot have answered all possible questions about all possible situations. Please feel free to contact the Canadian Workplace Automation Research Centre if you would like clarification, advice, or assistance.

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Appendix 1: Some Common Impacts of Office Automation

1. Productivity and performance

This is at the top of the list because it is the item that managers most often want to measure. We know from our and others' experiences that it is also the most problematic to measure.

Although many vendors, consultants and researchers claim to have measured productivity gains from office automation, we believe that no approach is yet satisfactory for all cases. However, approximations are possible, and usually worth the effort.

Some things to **keep in mind** when looking for effects on productivity are:

- The way your organization currently measures productivity may not be able to capture office automation effects, especially for managerial and professional work.

- While it is tempting to equate efficiency and productivity, efficiency gains rarely contribute substantially to central organizational mission. For example, you may find efficiency gains of 300 percent in document production, but in most organizations, document production accounts for only a very small part of overall performance.

- Asking people if they think productivity has improved due to office automation is not the same as actually measuring whether productivity has improved. This is true even if the people you are asking are very senior managers. A decade of research now shows that natural, unavoidable cognitive factors prevent even experts from being objective about outcomes in their own domains of expertise.

- Inappropriate or clumsily handled measurement practices can corrupt the things you are trying to measure. It is not inconceivable that people who think that their personal performance is being evaluated solely by their log-on time will try to increase their log-on time without actually being any more productive.

In our opinion, the only way to get adequate productivity measurements for evaluation is to design them especially for that purpose, well before the implementation. If this has not been done when you arrive on the evaluation scene, do not expect that the data you would like to have will be available.

Our recommended approach to developing and collecting productivity measures is described in Appendix 3.

2. User satisfaction

Office system evaluations often include measures of how much the people who use the system like it, how much they think it helps them, what they would like to change about it, and how they felt about the way it was implemented. As in other areas, however, satisfaction measures can be singularly uninformative if they are not tailored to identify specific, correctable problems.

- Research on user satisfaction with office systems usually shows that on the average, users are moderately satisfied with their office automation and that the more experience users have, the more satisfied they are.

3. Level and quality of use

Although it may seem odd to include use as a type of effect, remember that you're not just evaluating the equipment, but also everything else associated with its introduction. The amount and quality of training people receive, their physical distance from the computer, the way work processes are rearranged to accomodate the system, etc., can all effect levels of use.

Measuring use, though, is not as simple as one might expect, for two main reasons:

- First, people may not actually be using their equipment for all the time that the equipment is actually logged on or turned on. This means that computer records of amount of log-on time will not tell you how much the system is really being used. To get around this, you either have to ask people directly how much they use the system, or have special software that records the number of transactions people make with the system.

- The second problem is more difficult to get around. When people are interacting with the system, there is generally no way to tell how effective their use is.

  For example, you could find that two individuals both use the system for about one hour each week, which is a much lower than average usage rate. But, one of them could be a complete novice, who tries for an hour a week to figure out how to read his electronic mail. The other may be a highly sophisticated user, spending his hour uploading, downloading, and manipulating information very quickly. One user is much more effective, but there is no real way to tell this from how much time each spends. A related difficulty is that often those employees who derive the greatest benefit from the system are those who actually use it the least, for example, managers.

This means that **cost/benefit calculations for office automation cannot safely be made with usage as the sole index of benefit. You have to know something about how the automation is used**

4. Worker well-being

This general area covers many aspects of individuals' reactions to their work situations, including job satisfaction, perceived quality of working life, stress, health, absenteeism, and turnover, all of which may be affected by office automation. These are generally measured by asking people's opinions on surveys or in interviews. Many standardized measures of these concepts are available, some with norms for the general working population and/or specific types of workers. **We recommend that you use existing measures for this type of effect rather than developing your own** - see Appendix 3 for suggestions. To find out which of these if any are already in use in your organization, or for recommendations, contact the personnel research part of your organization.

- Although there is not yet enough good research on this topic, it seems that worker well-being, especially satisfaction with intrinsically motivating parts of the job, declines shortly after implementation for workers who have less autonomy in their work (see the section on job design, on page 67) and little choice about using the technology. Satisfaction then gradually increases to pre-implementation levels or higher.

- Effects on employee health are usually limited to increased incidence of neck and shoulder pain, eyestrain, and headache among workers who remain seated in front of screens and keyboards for more than three hours at a time. Note, however, that these health effects can be alleviated by proper ergonomic and environmental design.

5. Organizational communications

This is an important area of effects, because much office automation technology is also telecommunications technology. You may wish to know the extent to which the office system has

- replaced other forms of communication,
- improved or decreased efficiency of interaction,
- improved or limited access to either centrally stored or distributed information,
- increased or decreased perceived convenience of communications,
- reduced or increased time spent communicating.

You may also be interested in changes in communication quality, but as for productivity, this is a difficult thing to measure.

Research on the effects of the introduction of new electronic communications media into organizations seems to show that, on the average:

- uptake of new systems occurs most rapidly and sometimes only where there are pre-existing communication needs, that is, when people already have to communicate with each other;

- media substitution effects (the replacement of, for example, telephone calls by electronic mail) are usually small and highly dependent on the nature of the message and the communicators.

6. Organizational culture and image

An aspect of automation which seems to be important is the image it creates of the organization in the eyes of employees, clients, and competitors. Outsiders' impressions of the organization's innovativeness and entrepreneurship may be reflected through customer surveys and market studies, or whatever means is usually used to obtain customer feedback. Within the organization, technological change may be a result of or result in changing organizational values, priorities, or self-images.

7. Job and operations design

This class of impacts is important from two perspectives: operations management and labor relations.

From the operations management perspective, office automation can cause or accompany changes in the way work processes are organized and tasks are divided. It will be important to document exactly what those changes are, and how they have contributed to productivity. From the labor relations perspective, if office automation results in significant changes to job design, changes in job classification, evaluation, and pay may have to be considered. And, of course, technological change is a major issue in the bargaining platforms of many labor unions.

Job design refers to the mix in each job of factors which result in motivation, satisfaction, and performance. The factors which seem to be most important to have a lot of in each job are:

- skill variety (use of varied skills),
- task identity (the extent to which the job requires completion of a "whole"),
- task importance (to the organization and other people),
- autonomy,
- feedback from the job itself (on performance, competence), and
- feedback from others.

Office automation can both enrich and impoverish job design, depending on how it is implemented.

For example, secretaries who become word-processor operators in a "pool" often experience less skill variety (because all they do now is type), less task identity (because the work is allocated in bits and pieces), less task importance (because the ways they can affect the organization are now more limited), and less feedback from others (because they don't interact personally with the authors of the documents). Thus, their motivation, satisfaction, and performance may decline.

We recommend the use of one of the several available standardized questionnaires which measure these factors -- see Appendix 3 for details.

Job design generally deals with the structure of individual jobs. Another, equally important, consideration is **how automation affects how the jobs fit together,** or operations design. Your organization probably already has methods for designing operations and diagnosing operational problems. If they have not been already, these methods can be easily applied to the diagnosis of operational changes caused by automation.

- In general, automation only results in major operational change when it was planned to do so -- in which case there should be some record of what changes were intended and why.

Appendix 2: Measurement methods for evaluators

1. Common methods

Participant observation

Definition:	Direct observation by a member of the work group
Advantages:	Detailed, colorful description with a sense of history
Disadvantages:	Observer may bias participants' behavior, observer may be unknowingly biased
Cost:	Relatively low for data collection; relatively low for analysis

Independent observation

Definition:	Direct or indirect observation by an independent observer
Advantages:	Detailed, colorful description
Disadvantages:	Observer may bias participants' behavior, observer may fail to understand the significance of some events
Cost:	Relatively high for data collection, relatively high for analysis

Unstructured interviews

Definition:	Interviewer has unstructured conversations with people about their opinions and experiences
Advantages:	Relatively good depth
Disadvantages:	Difficult to generalize across interviews
Cost:	Relatively low for data collection, relatively high for analysis

Semi-structured interviews

Definition:	Interviewer has a list of questions to cover, but is otherwise unconstrained
Advantages:	Relative good depth, some generalizability across interviews
Disadvantages:	Somewhat limited breadth
Cost:	Relatively low for data collection; relatively high for analysis

Structured interviews

Definition:	Interviewer follows a protocol so that everyone is asked the same questions in the same order
Advantages:	Completely generalizable across interviews
Disadvantages:	Limited breadth and depth; unless well-designed, may be frustrating for interviewees
Cost:	Relatively low for data collection; relatively high for analysis

Open-ended questionnaires

Definition:	Respondents are asked to write out answers to open-ended questions (no response format is provided)
Advantages:	Completely generalizable; relatively good depth
Disadvantages:	Somewhat limited breadth; responsiveness may vary greatly
Cost:	Very low for data collection; relatively high for analysis

Closed-ended questionnaires

Definition:	Respondents are asked to rate, rank, or otherwise choose between alternatives to indicate their responses
Advantages:	Completely generalizable; simple and quick to administer
Disadvantages:	Limited breadth and depth
Cost:	Very low for data collection; relatively low for analysis

Diaries

Definition:	Respondents keep diaries of how they spend their time, with whom they communicate, etc.
Advantages:	Relatively good depth
Disadvantages:	Unreliability; limited breadth
Cost:	Moderate for data collection; relatively high for analysis

Archival analysis

Definition:	Analysis of organizational records or archives, including computer-stored information
Advantages:	Accurate information on past events
Disadvantages:	Incompleteness; difficulties in retrieval and manipulation
Cost:	Nil for data collection; relatively low for analysis

2. Pointers for interviewing

- **Get help** from anyone in your organization whose job it is to design and conduct interviews: the market research and personnel departments will be the best places to look.
- **Always pretest** interviews with several people, and ask them to be candid about their reactions to the questions, how the questions were phrased, and the order in which they were asked. Revise until the interview seems to flow smoothly, and all the questions seem reasonable to the interviewee.
- **Interviewers should practice** until they have nearly memorized the interview. They should then interview each other and you, to make sure that their styles are similar.
- To record the information, interviewers must **take good field notes.** Interviews can also be tape-recorded. (Most people don't mind being tape-recorded if they are assured of confidentiality.) Even if tape-recording, however, interviewers should take as many notes as possible, and use the tapes only as a backup. **We recommend this because the process of**

transcribing and coding tape-recorded data is extremely time-consuming and expensive.

- **Ask interviewers to go over their interview notes** at the end of each day or half-day, and fill in anything they were not able to write down, before they forget it.

Finally, if you decide to use interviews as the main method of data collection, keep in mind that **the analysis will take two to three times as long as the time spent on the interviews themselves;** *that is 40 hours of interviews means 80 to 120 hours of analysis.*

3. Pointers for questionnaires

- Again, **get help** from someone who knows how to design a good, analyzable questionnaire, probably in the marketing research or personnel departments.
- As for interviews, **pretest** until respondents feel that what you are asking and how you are asking it makes sense.
- **Avoid double-barrelled questions** (questions that ask for opinions on two different issues at the same time) *for example, "Do you think the Information Centre is well-run, or should it offer more services?"*
- **Avoid leading questions** - *for example, "How dissatisfied are you with the time it takes to get help with a problem?* "
- **Use a mix of closed-ended** questions (where respondents choose between a set of responses or numbers) **and open-ended questions** (where respondents write out their answers in their own words).
- For closed-ended questions, make sure that all have the same or **similar formats**, and especially that all have the same number of choices.
- Leave lots of **space for comments**.

Appendix 3: Suggested measures for office automation evaluations

1. Productivity and performance

The approach we recommend to the measurement of productivity impacts is based on a method called **utility analysis.**[1] This method has been used to assess performance effects for several other types of organizational change. We recommend it for the following reasons:

1. It allows for stakeholder participation in the development of measures.
2. It provides a detailed and relatively objective measure of performance changes for the tasks that are affected by the automation;
3. It can also be used to measure changes in the structure of the automation-related tasks themselves;
4. It can be used to measure effects for all types of jobs, including professional and managerial work.
5. It is usually not threatening to those being measured.

Its major drawbacks, however, are that it requires measurements both before and after implementation, and that it is by no means "quick and dirty."

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[1] This presentation of utility analysis is based on:
Cascio, W. *Costing human resources: The financial impact of behavior in organizations*. Boston; Kent, 1982.

The main steps in this analysis are as follows:

- **Identify the principal tasks** of each category of employee affected by the automation, through interviewing.

- **Rate each task** in terms of the time it consumes or its frequency, its importance to overall job performance, the consequences of making errors, and its level of difficulty.

- **Multiply the ratings for each task** to get a weight for each task. Convert the weights arithmetically so that they add up to 100 percent.

- **Assign dollar values to each principal task** in the job category by finding the average annual pay for all the employees in the job category, and multiplying it by the weight obtained in the preceding step.

- **Rate the extent to which each principal task is affected by the automation.** These ratings should indicate what percentage of the task performance depends on the automation.

- **Rate each affected employee's performance on each principal task** (preferably, on a scale from 0 to 200 where 100 means the fiftieth percentile of performance). These ratings can be made by supervisors as in the usual performance appraisal process. **We recommend, though, that the procedure for measuring performance be developed with the participation of employees**, using a consensus-building, participatory method such as the Nominal Group Technique.

- **Compute the overall economic value of tasks affected by the automation:** for each principal task, multiply each employee's performance rating by the dollar value assigned to that task. Multiply the results by the rating of the extent to which automation affects that task. Then, add those values up for each employee, and find the average across employees.

These are the basic data for the utility analysis. There are several routes to go from here, but the most useful next step is to compare **the overall economic value of tasks affected by the automation, before and after the**

automation. You can also examine changes in weights for tasks within categories, or compare the distribution and weight of tasks between categories, before and after implementation. Many more sophisticated analyses, including forecasting of performance effects, can be accomplished using these data as well.

The most difficult aspect of utility analysis is the construction of meaningful scales to obtain the task weights and the performance ratings. Human resource professionals within your organization should be able to help you with these parts, if need be.

Other methods of measuring performance effects are certainly available. The best ones among these:

- rely on more than one person's impression of changes in performance;
- are based on what people really do in their jobs and what they really use the automation for;
- take into account that how much time people spend on a particular task is not necessarily strongly related to its importance for the organization.

2. User satisfaction

User satisfaction effects can be measured through informal or formal interviews or questionnaires (see Appendix 2). **We recommend using two or three close-ended questions to measure general satisfaction, and then some more open-ended probes about ways the system or implementation could be improved.** Other research has shown that the commonly used long questionnaires about user satisfaction are not very strongly related to how much people use the system, and are often uninformative about

specific improvements that could be made in. On the other hand, giving people a chance to tell you that the noise from the printers drives them crazy, or that they hate sharing a workstation, might be really helpful.

A scale measuring user attitudes toward information systems is described in:

Schultz, R., and Slevin, D., Implementation and organizational validity. In R. Schultz and D. Slevin (Eds.), *Implementing Operations Research and Management Science*. New York; Elsevier, 1975.

3. Level and quality of use

Overall usage levels and usage by application or function can be easily measured. There is no accepted method of evaluating quality or effectiveness of use, and indeed, it is very rarely done. **We suggest that you use the following procedure:**

- 1) **Determine the ideal:** in the documentary interviews, determine what would constitute the most effective possible use of the system (this often corresponds to the system designers' expectations about what will actually happen).

- 2) **Develop a way to measure the ideal:** Perhaps with the help of a technical expert and one or two users who are regarded by most people as the most expert users in the group, decide what indicators you would have to use to tell you how closely actual use approximates ideally effective use.

- 3) **Compare actual use to ideal use:** This can be done very systematically, for example by comparing real output to potential output. It can also be done by having users, their managers, or observers rate how closely actual use corresponds to the ideal.

4. Worker well-being

There are many standardized questionnaires available for measuring aspects of worker well-being. Of these, we suggest the following:

- The 5-item "overall job satisfaction" subscale in:

Hackman, J., and Oldham, R., Development of the Job Diagnostic Survey. *Journal of Applied Psychology,* Vol. 60, 1975, pp. 159-170.

- The 5-item "facet-free" job satisfaction scale", in:

Quinn, R., and Staines, G., *The 1977 Quality of Employment Survey.* Institute for Social Research, University of Michigan, Ann Arbor, 1979.

- 15 items measuring attitudes toward intrinsic and extrinsic aspects of work; suitable for all levels of worker, in:

Warr, P., Cook, J., and Wall, T., Scales for the measurement of some work attitudes and some aspects of psychological well-being. *Journal of Occupational Psychology,* Vol. 52, 1979, pp. 129-148.

- 5 items, very similar to the job satisfaction scales, in:

Miller, G., Professionals in bureaucracy: Alienation among industrial scientists and engineers. *American Sociological Review,* Vol. 32, 1967, pp. 755-768.

- 8 items each measuring "powerlessness" and "meaninglessness", in:

Shepard, J., Alienation as a process: Work as a case in point. *The Sociological Quarterly,* Vol. 13, 1972, pp. 161-173.

- A 29-item scale measuring the extent to which employees feel frustrated with their jobs, co-workers, and organization, in:

Spector, P., Relationships of organizational frustration with reported behavioral reactions of employees. *Journal of Applied Psychology,* Vol. 60, 1975, pp. 635-637.

Health. Although self-reports of health problems may have limited validity, questionnaire measures may help identify sources of stress and tension, for example:

- The 7-item "job-induced tension" subscale measures feeling of stress associated with the job, in:

House, R., and Rizzo, J., Role conflict and ambiguity as critical variables in organizational behavior. *Organizational Behavior and Human Performance*, Vol. 7, 1972, pp. 476-505.

5. Organizational Communications

There are several ways to measure communication impacts. If your current communication patterns are well-documented (through system logs, telephone logs, and paper-flow logs), you can get a pretty good idea of how formal communication patterns change when the system is introduced. However, a lot of very important organizational communication is informal. The total communication flow -- formal and informal -- can be measured by asking people to record with whom they communicate, when and about what, and using what media for a certain period of time. (Note however, that people often don't like doing this, and that this type of measure can have reliability problems.) More sophisticated network analyses can draw a communications map for the organization based on these data.

You may also ask users to tell you what they think the effects of office automation have been on their communication either in an interview, or through a questionnaire.

Perceptions of organizational communication effectiveness can be measured using questionnaires such as those described in:

Roberts, K., and O'Reilly, C., Some correlates of communication roles in organizations. *Academy of Management Journal*, Vol. 18, 1979, pp. 388-393.

Keller, R., Szilyagi, A., and Holland, W., Boundary-spanning activity and employee reactions: An empirical study. *Human Relations,* Vol. 29, 1976, pp. 679-710.

6. Organizational culture

Several scales have been developed to measure organizational climate. Of these, we suggest:

- A 22-item scale with national American norms; available only through the Institute, but containing a subscale measuring Technological Readiness, in:

Taylor, J., and Bowers, D., *Survey of Organizations.* Institute for Social Research, University of Michigan, Ann Arbor, 1972.

- With 64 items, the scale in the following article scale is a little too long for many applications, but it covers employee attitudes toward "intrapreneurship" quite thoroughly:

Siegel, S., and Kaemmerer, W., Measuring the perceived support for innovation in organizations. *Journal of Applied Psychology,* Vol. 63, 1978, pp. 553-562.

7. Job and operations design

Perceptions of important aspects of job design can be measured with the following questionnaires:

- The 21-item "job characteristics" subscale, in:

Hackman, J., and Oldham, R., Development of the Job Diagnostic Survey. *Journal of Applied Psychology*, Vol. 60, 1975, pp. 159-170.

- The 10-item subscale measuring perceived intrinsic job characteristics; suitable for all levels of employee, in:

Warr, P., Cook, J., and Wall, T., Scales for the measurement of some work attitudes and some aspects of psychological well-being. *Journal of Occupational Psychology*, Vol. 52, 1979, pp. 129-148.

- The 10-item "group practices" subscale measuring work group functioning (morale) described in:

Taylor, J., and Bowers, D., *Survey of Organizations.* Institute for Social Research, University of Michigan, Ann Arbor, 1972.

- A 6-item "coordination" scale, measuring the adequacy of resource flow, in:

Rousseau, D., Characteristics of departments, positions,and individuals: Contexts for attitudes and behavior. *Administrative Science Quarterly*, Vol. 23, 1978, pp. 521-540.

Your best source of information about impacts on operations design will be **interviews with people who have an overview of an integrated set of tasks**: forepersons, administrative assistants and senior managers. One of the best ways to document operations changes is to diagram the workflow in the group, verify the diagram with your interviewees, and then discuss whether or not the automation has had impacts on each piece of the diagram. If the jobs you are dealing with are unionized, then its representative can help you identify areas of concern for them.

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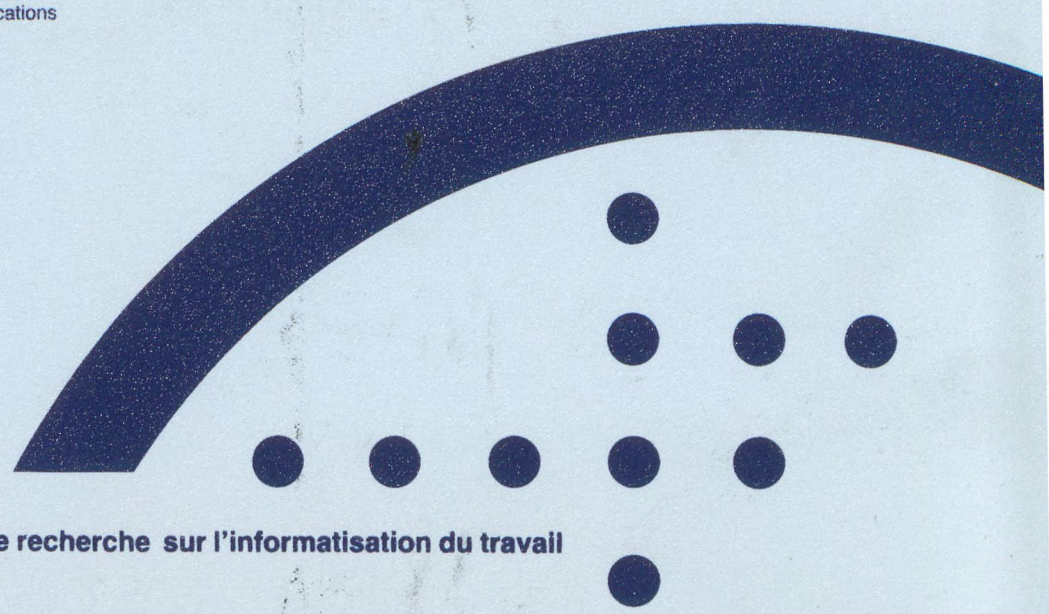

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