

INTEGRATED ACCESS TO INFORMATION  
UTILITIES: PROMISES, PROBLEMS  
AND PROFILES OF THE FUTURE

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ABSTRACT

This paper reviews, in a historical context, how some of the access techniques in current usage came about, what is the status of access techniques today, and what seem to be the immediate needs of users. The growing use of online information systems, and of user dependence on these systems accelerates the tendency to bring more information online and to improve access techniques.

L'accès intégré aux sources d'information: promesses, problèmes et profil de l'avenir.

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Cette communication fait la révision, selon un contexte historique, de comment les techniques d'accès pour l'usage courant se font, quel est l'état des techniques d'accès à l'heure actuelle et que semblent être les besoins immédiats des utilisateurs. L'utilisation croissante de systèmes d'information «online» et de la dépendance des utilisateurs à ces systèmes accélère la tendance à produire plus d'information «online» et à améliorer les techniques d'accès.

# INTEGRATED ACCESS TO INFORMATION UTILITIES: PROMISES, PROBLEMS AND PROFILES OF THE FUTURE

## INTRODUCTION

I am going to review some of the history of access to online information services. Access is a process very much affected by available technology and the behavior of its users. I am not going to review content, a wholly separate issue, even though changes in access technology affect the amount, quality and type of information that providers are motivated to put into online systems. Also, of course, the amount, quality and type of information available affects the behavior of users (how much they are willing to pay, for example) and the amount, quality and type of access systems entrepreneurs will make available to users. This is not news, but to explore both sides of the issue would take the entire week.

## 1. SOME HISTORY OF ACCESS TO INFORMATION RETRIEVAL SYSTEMS

As a practical matter, the kinds of data access systems we talk of and use today had their genesis in the 1950's when they were not interactive. Users had to work out a 'query,' and have it conveyed to a computer in a batch processing mode. Turn around time was on the order of a day or more.

The very earliest languages were extremely complex, as designers strove to offer users the opportunity as well as the obligation of being quite precise, since they could not offer quick resolution of errors, or change of direction. It was common to use role indicators to modify terms (such designations as product, process, material, ....) and various kinds of linkage codes for connecting terms (A located in B, A acting upon B, ...). Basically, these were attempts to reproduce much of the syntax of natural language without its redundancy and context dependency. But, redundancy and context dependency, while serving to confuse the reader also enable the writer to be creative in expression. In poetry, we use old words, in new way, to create new images. Instead of teaching the computer how to understand natural language, we tried in those days to teach

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the human users how to deal with a new, artificial, and cumbersome language. The computer cannot say "If I have to learn an uncomfortable new language to use your system, I simply will not use it." But, humans can say that, and do. And so, by and large, cumbersome languages, however logically powerful, do not sell well with the general user population.

Users in those days were few in number. Even fewer were users who were dependent on the systems. This is important: there was no habit of the use of information retrieval systems. Users either accepted the limitations imposed, or stayed away -- mostly the latter.

In the late 1960's to early 1970's, time-sharing computers and relatively inexpensive data communications networks were developed. They, together with some good software design, made online information retrieval a practical reality.

The speed of response improved immensely: a single command might be responded to in seconds. A complete query might be sent to the computer, tested, revised and run to completion in 15 minutes.

The languages of use simplified. Basically, as quick reaction became the order of the day, it was better to abandon the highly complex languages of the batch systems in favor of simple languages, whose statements could be easily and quickly tested. The idea of 'conversing' with a computer was born, not only in the information retrieval context, but also in computer programming and computer graphics. Basically, conversation means one can say something and see an almost immediate reply -- the effect of one's utterance. This is what we mean by human conversation and this is the process from which my company took its name -- immediate interaction compared with, say, making a speech or lecture in which the effect of one's utterances may not be felt for some time. With a truly interactive system, one can program a query as a series of probing steps, with confirmation at each step that the entire process seems to be going right.

Up to about about a year ago, our situation was that speed had improved and communication was cheaper and more reliable. Languages were growing somewhat more complex, as we added new functions and new variations on old ones. Users were becoming sophisticated. They were beginning to recognize that there were some capabilities they still did not have.

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The typical user was still an information professional. It still took a day or two of instruction for a person who understood the information and its structure to learn how to search the huge files that were appearing and growing.

### 2. THE SITUATION TODAY

Today, the effect of microcomputers is strikingly apparent. The proportion of new users of systems like DIALOG are about half individuals, rather than corporations or libraries. Communication speed continues to increase: 1200 baud is common, 2400 is now commercially available.

Systems are available world-wide. Users with reasonable financial support are nearly independent of the country of origin of their target systems.

Attention is being paid to the inexperienced user, especially to the user who is a busy professional in a field other than information science and who will simply not take the traditional path to learning how to use complex programs. To support such users, we see systems like Scimate, Search Helper, and INSEARCH which, each in its own way, help the user to perform a search, eliminating much of the burden for him to learn the intricate details of search language and syntax and of database structure.

The 'window' is upon us. Basically, this is a technique for splitting the screen of a CRT, allowing the user to see several displays at once, like overlaid pieces of paper on his desk. The advantage is that complex problems often require simultaneous attention to several sets of data: a sample of retrieved output, a search history, the most recent error message, the list of choices for next action, .... This technique is made possible by high resolution CRT screens and some clever programming.

sets of data: a sample of retrieved output, a search history, the most recent error message, the list of choices using the output of one retrieval operation directly in the next, as 'Find the CAS registry numbers of substances with these trade names: <...list...> and then retrieve citations concerning them,' or 'Find articles about <...list of terms...> and order the resulting set by frequency of occurrence of the terms to provide an approximation to relevance ordering.' For example, one might use word or descriptor frequencies to find the records of a set richest in the most interesting terms, thereby to drop off those that are less interesting. Another possibility would be to

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order a set of patent records, in a given technology, by assignee, thereby producing a list of the most active companies in the selected field.

To summarize our present situation, we have:

1. High speed communication, so that the time we have to wait for some action to be completed is becoming less and less a factor in searching time or economics.

2. Languages are becoming richer, enabling the knowledgeable user to be more precise in selection criteria or to get more work done per command.

3. Alternatively, for the user who is not skilled and does not want to invest the time to become so, we are seeing a new level of simple languages evolve. These may be simple command languages, menu systems, or other techniques for accomplishing work with little prior learning of search mechanics.

4. Greater resolution in display screens permits use of windows which provide more than one visual field in the display, such as a word list, a few retrieved records, a search history and a list of possible next commands. These might benefit users at all skill levels.

5. We have also achieved a very significant step in user behavior. The typical user is now dependent on the online information system. This has implications to cost and reliability. Costs in this industry have generally not risen with inflation. Technologically enabled productivity increases have aided the consumer whose relative costs are holding steady or even decreasing. Reliability has also increased. Neither the computers nor the communication systems are 'down' as often as they once were. At DIALOG, ninety eight percent is actually our desirable target. Again, there is circularity here: higher demand calls for higher reliability and higher reliability fosters user dependence, hence demand.

### 3. WHAT IS STILL MISSING?

It is no surprise that the combined computer-communications industry, ever producing new capabilities and raising consumer expectations for still more, leaves us today with some unfulfilled desires. We can see capabilities in related fields and want to have them in our field as well.

Some of these are:

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1. True multi-media output. Audio, in effect the 'voice over' of television, can be used to provide control and error information to the user, reserving the visual field for substantive information. I believe it would be both less distractive and more pleasing to the user to have more than one sense involved in receiving computer output. Audio could also be applied to aid the visually handicapped receive any kind of computer output. Video can be used in training, to increase the attentiveness of the user. It can also be used to transmit the pictorial part of a stored record. High resolution graphics would be an invaluable adjunct to the text of online scientific papers, patent documents or trademark records.

2. More active assistance to the users. We want not just instruction, or a passive reduction in complexity of language, but an active capability on the part of the search system to provide some comprehension of what the user is trying to do, or has done wrong, and to offer active help in proceeding.

3. Linkage of retrieval systems with processing systems, such as word processors or statistical, graphical or spread sheet systems. Retrieval, per se, is rarely the user's objective. The information to be retrieved is wanted as part of some next step. Why not provide the linkage directly? We are just beginning to see some of these come about, although there does not seem to be high use yet.

4. Direct problem-solving software. If a user wants a profile of a company or of a country's economy, or information about the side effects of a drug, why not ask the system essentially that question? I do not suggest that we need to go to the extent of full computer comprehension of natural language, certainly not to the extent of the talking, wise-cracking retrieval systems of the science fiction movies, but simply that we provide whole libraries of problem-oriented information retrieval software. These programs would be analogous to the specialized software we now see for budgeting, inventory control, bank account balancing, and the like, which in a sense replace general database management systems for the problem oriented user. The problem oriented user is one who is mainly concerned with the content of the results, as contrasted with a process oriented user whose main interest is the manner in which a result is obtained.

## 4. PROSPECTS

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Naturally, I feel that we shall soon see all the items I listed as lacking. As has always been true in computing, we shall also have developments which we do not foresee, and they may come to dominate the ways in which we use information systems. For example, few people were predicting, say ten years ago, the extent of the development and use of personal computers, which today seem to be revolutionizing the information seeking world.

I truly believe that information retrieval, like mathematics or writing, is a part of almost all other human endeavors, certainly those associated with management, research or technology. Everyone will use retrieval systems and everyone will have to know how. Systems will have to be effective, for many types of users. That is partly a challenge to education and partly to software designers and information providers.

PILOTING OFFICE SYSTEMS -  
A USER'S PERSPECTIVE

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ABSTRACT

An overview of the Office Communications Systems (OCS) Program within the Department of Communications of the Federal Government is presented. The three aims of the program - industry stimulus, government experience and impact assessment - are discussed along with their embodiment in four field trials of integrated office technologies addressed at multi-function knowledge workers in four different government departments. The trials are a learning experience for all concerned. The aims of impact assessment are outlined. Although results are only now beginning to come in, the experience to date with impact assessment has contributed to a clear framework from users' points of view of the critical steps which should be followed for successful implementation of these office technologies. Five steps are presented with stress given to needs analysis from users' points of view as the initial and most important step from which the other ones follow.

## Le pilotage des systèmes de bureau - Point de vue de l'utilisateur

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Un examen du Programme du système de communications de bureau du ministère fédéral des Communications est présenté. Les trois buts du programme - stimuler l'industrie, donner l'expérience aux services du gouvernement et évaluer l'impact du système - sont présentés, ainsi que leur incorporation dans quatre domaines d'essai de technologies de bureau intégrées s'adressant au personnel des connaissances aux fonction multiples dans quatre services gouvernementaux différents. Les essais sont une bonne expérience pour ceux qui sont concernés. Les buts de l'évaluation de l'impact sont étudiés. Bien que les résultats commencent seulement à revenir, on peut déjà voir comment cette évaluation a contribué à une meilleure perception, de la part de l'utilisateur, des opérations importantes à suivre pour introduire avec succès ces technologies de bureau. Cinq étapes sont proposées, en mettant l'accent, du point de vue de l'utilisateur, sur l'analyse des besoins qui doit être la première étape la plus importante et après laquelle suivent les autres étapes.

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### INTRODUCTION

The Office Communications Systems (OCS) Program is a joint industry/Canadian Federal Government initiative administered by the Department of Communications. The program has three aims. Its basic objective is to promote the development of a Canadian industrial capacity for supplying integrated office systems to domestic and world markets. By providing selected federal government departments as test beds for technology, a second aim, government experience with such systems, is achieved. Thirdly, the mandate of the program calls for research within the test departments on the psychological, social and organizational impacts of the technologies.

### INDUSTRY STIMULUS

The program's basic aim derives from present and forecast Canadian trade deficits in office technologies. A study by Arthur D. Little, Inc., showed that the world market for office products in 1983 was about \$100 billion, and that for Canada was about \$5 billion. These figures were projected to double by 1990. With Canada's share of the world market at \$1 billion and of the domestic market at \$0.7 billion in 1983, a net trade deficit of \$3 billion resulted in that year. This deficit could more than double by 1990 if present trends continue and this represents a great deal of money by Canadian standards. The OCS Program was set up to aid in turning this deficit situation around by the stimulation of Canadian industrial effort.

### GOVERNMENT EXPERIENCE

The kind of technologies being addressed by the OCS Program, integrated office systems, are primarily aimed at multi-function knowledge workers (managers and professionals). This segment of the workforce is quite costly in terms of salaries. The second goal of the Program, namely experience with integrated systems in government departments, is hoped to pave the way for increases in the efficiency and/or effectiveness of this expensive group of workers. Until now, computer technologies in the office have been primarily directed at highly structured support functions. Many plausible reasons can be put forth for the low penetration of the new technologies into knowledge work until now. These include, the lack of development of suitable technology configurations (except in very special instances), rejection by executives of keyboard operation, the absence of productivity measures to justify equipping this workforce segment. However, integrated systems are now believed to be a real growth

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area for automation. This is still a further reason for industrial stimulation of these particular technologies, as well as for obtaining experience in their use within government departments.

### IMPACTS

Various scenarios of expected impacts of office technologies have been presented and widely publicized in the media. These range from doom and gloom to utopia. Beyond plausible speculation, however, little hard data exist to evaluate, and thence to anticipate and influence, the personal, social, organizational and societal effects of these technologies. Thus, the third aim of the Program is to gather sound evidence for appropriate evaluation of these scenarios by a thorough examination of events in the trials.

### THE TRIALS

With funding of \$13 million, these three Program objectives are embodied in four field trials, each one in a different government department with a different systems vendor. During the planning phase of the OCS Program, various committees and sub-committees were formed, and a number of systems vendors as well as a number of potential site departments came forth with strong interests in participation. It was felt that the best results could be obtained from multiple sites and vendors, rather than from one large trial, but not with so many sites as to dilute the scope of effort within any one trial. The four trials resulted after a careful matching of vendors' and site departments' interests and outlooks to their mutual satisfaction.

### DIFFERENCES AMONG THE TRIALS

While all the trials are focused on multi-function knowledge work, they differ in interesting ways. These differences support the wisdom of spreading the OCS Program's dollars among several vendors and site departments since it cannot be foreseen which system approaches and which site department's applications will become winners in the Canadian and world marketplace.

On the technology side, the differences include interconnection via co-axial cable versus a fibre optic local area network versus a telephony-based twisted pair approach. Also, three of the trials are attempts at fully integrated systems. Such systems might

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include electronic mail, text editing, storage and retrieval, decision support, voice messaging, teleconferencing, calendaring, reminder services, and so on, all accessible from a single workstation.

The fourth trial is a more limited one with the software customized to entry, storage, update and retrieval of the policies and procedures of a government department. This smaller trial represents a different strategy from the other three. This is a gradual, stepwise strategy where a clearly delimited problem is solved in modular fashion, with the way open to adding modules aimed at other functions later on. But even in the three larger trials which, on the surface, appear similar, the details of how the software is worked out, how well it addresses the work functions at the site department, and how "user-friendly" it is, may produce quite different patterns and degrees of usefulness and acceptance. This in turn will help to determine the marketplace fate of each of these integrated systems.

On the applications side, we have already mentioned the work content of the smaller trial. But the three larger trials differ among each other as to which of the integrated functions are expected to provide major work effectiveness payoffs in their respective departments. At one site, emphasis is on data base access and report preparation, filing and retrieval; in another trial, decision support via spreadsheet capabilities, and financial management functions loom larger. Also, some of the trials are at a horizontal slice of a department, where similar knowledge work is done by a more-or-less homogeneous group, while another site covers a vertical spectrum from very senior management to technically oriented professionals.

All in all, these differences in technologies, approaches and applications among the trials, make for an interesting mix that promises to serve all three Program objectives much more effectively than would have been the case in a single large trial. Besides spreading the eventual market place risk among four systems vendors, the government experience is rendered considerably broader in the kinds of multi-function work addressed, and, consequently, a wider possible range of impacts is available for examination.

### TIME SCALE

The first year of the Program was a planning phase at the end of which the vendors and site departments had been selected and matched. A needs analysis phase followed, taking up the next six months to one year at the various sites. Systems specification and development was next, also taking six months to one year. User training and

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initiation of the pilot phase with hands on testing is currently underway. The four trials are at varying points in this final pilot phase, with one almost completed, others barely begun. The OCS Program has about one year left to run to the end of the pilot phase although impact assessment activity may extend six months to one year beyond that.

### THE FUTURE

After the pilot phase is over, the host departments may decide to go fully operational at their sites with the systems that have been developed for their departments. In the larger trials, this would mean expanding from the 100 or so workstations of the pilot phase, to as many as 2000 stations in regional offices from coast to coast. Such expansion would require financing by the host departments since there will be no further monetary involvement from the Program after the pilot phase.

We should mention that the OCS Program has a role in other pilot automation trials in the government besides the four for which it is directly responsible. Two such trials have gotten underway more recently but the funding for them has had to come from other sources within the government since the OCS funds are totally exhausted by the four trials we have described. But these two newer trials have continuing advisory input from OCS personnel. These trials are following OCS guidelines and are both benefiting from as well as adding to the Program's experience. Beyond these two newer trials, the OCS Program personnel are frequently called upon in a consulting capacity in related endeavours elsewhere in the government since they are recognized as having a considerable body of expertise in management, technology and social science.

### LEARNING EXPERIENCE

It should be stressed that the entire OCS exercise is a learning experience for all concerned - vendors, host departments, the government in general, and the OCS Program itself. Although the vendors are experienced in developing software systems, only one has had previous experience developing office automation systems. For this reason, the hands-on practical exposure they will get developing and implementing systems in the field trials should be invaluable.

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As is true of government and business in general, the site departments have lived through the electronic data processing movement of the '60's and 70's, but this, of course, was aimed at relatively routine, highly structured support functions. Systems intended for multi-function knowledge workers are quite new although one of the site departments has been and continues to be pioneering in exploring technology directed at such workers. This department has a number of related projects underway apart from its OCS Program trial.

Since knowledge worker systems are so new, the OCS Program is, by definition, a pioneering effort. While personal computers are beginning to proliferate throughout the government as they are in the business world, they generally fall short of the kind of integration of functions and inter-machine communications which the OCS technologies represent.

Since the trials are a learning experience, it follows that all concerned would do things in different and better ways were they now to begin similar endeavours anew. And so, even if one or another of the players decides against proceeding directly to a larger scale operational phase after the pilot phase is over, for whatever good reasons they may then have, then they will do so out of the wisdom gained in the trials. Achievement of wisdom about the new office technologies is one important justification for the entire OCS adventure for both industry and government.

### IMPACT ASSESSMENT

The authors are both social scientists. We are directing the impact assessment of the four OCS trials and we also have advisory input to related government endeavours including the two newer trials mentioned above. It is still too early in the process to talk in any detail about impact assessment outcomes in the trials. The hard and soft evidence is just beginning to come in. However, partly as a result of the trials, we have learned much about procedural matters which, we feel, have crucial significance for office systems success. Before turning to these, we will briefly outline what we are trying to achieve.

### ASSESSMENT OBJECTIVES

In general terms, impact assessment is an attempt to examine the events in the trials as systematically and objectively as possible,

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in order to learn about the intended and unintended effects of integrated office technologies on work, productivity and people. What is learned should enable some degree of future control over impacts. A second goal is to provide feedback during the course of the trials so that corrective actions might be taken when impending or actual problems are suspected or revealed. In this way, the assessment process is intended to contribute to successful implementation of the technology.

Formulation of the issues being examined was facilitated by an Impact Assessment Committee formed by the Department of Communications. The committee included representatives from various interested groups in the government.

The issues were grouped into five categories:

1. System Performance
2. Users' Acceptance
3. Human/Social Factors
4. Organizational Variables
5. Productivity

These categories encompass detailed concerns such as system usage statistics, ergonomics, user attitudes, functionality, quality of work life, health/safety/stress, morale, work transformation, social effects, training effects, demographic implications, employment effects, labour relations, organizational structural effects, work effectiveness and efficiency and system cost justification. It is intended that information on all of these categories will be useful to industry, the host departments, the government in general and the public at large.

### CARRYING OUT THE ASSESSMENT

Rather than acquire the rather large staff that would have been necessary to do the detailed assessment work, the expertise of outside consultants with the necessary social and behavioural science background was sought. Another committee was involved in evaluating the responses from outside contractors to a Request For Proposals to do the work. This committee included the project director from each host site. Many excellent proposals were received. As it turned out, the best outcome, one which satisfied each project director for his own site as well as satisfied the rest of the committee for high expected quality, was obtained by hiring four contractors, a different one for each site. Spreading the work among four contractors rather

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than hiring a single one for all trials, has an effect analagous to that obtained by having four different system vendors; it is a better stimulus to the development of consulting expertise in the office technologies area than would have been obtained were only a single consulting firm hired. As will become clearer below, we feel that a most important element in the success of the new technologies is an appropriate understanding of offices and how people work. Social science can contribute much to this element. To now, with data processing technologies, such understanding was not as critical since the focus was on repetitive, well understood processes that could be performed by computer without a tight interaction between the person and the computer.

### THE USERS' VIEW OF OPTIMAL PLANNING, IMPLEMENTATION AND ASSESSMENT

Going back now to the procedural matters alluded to previously, we will adopt the point of view of an end user, be this an individual, group or organization. This view differs in important ways from, for example, the view of a systems vendor. Planning, implementation and assessment of an office technology system can be broken down into the following five steps which are sequential except for the last one.

1. needs analysis from the users' point of view
2. baseline measures
3. system/vendor choice
4. training and learning
5. ongoing assessment

### NEEDS ANALYSIS

The first step, an appropriate needs analysis is, beyond question, the first priority in any scenario of office change. All subsequent steps critically depend on and follow from the needs analysis. Errors or misconceptions at this initial stage will prove very costly to rectify later. As important as this first step is, it is the one that is least well understood. This alone may account for the bulk of failures and system rejections which preoccupy office automation professionals.

The basic problem is that an appropriate understanding of the specific, unique configuration of people, goals and events that comprise any particular office group or organization is not easy to achieve. But its difficulties do not excuse inadequate approaches. Among these, and perhaps the dominant one in use is what we will call the behaviouristic approach. Underlying this approach is something

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akin to a child's view of what goes on in an office. One observes fingers at keyboards, telephones being used, marks on paper, paper being circulated and being put into and taken out of metal boxes, people gathering in small and large groups in special rooms, perhaps extensive travel to get to these special rooms, and so on. With the behaviouristic approach one tries to measure the frequencies of these events by observation, counts and questionnaires. Recommendations are then made about using electronic means to accomplish high frequency events more efficiently. If the events get done faster, that is interpreted to mean a productivity increase.

Let us emphasize again, that we are dealing with the frequently unstructured work of managers and professionals and not with highly structured support functions. Although the behaviouristic approach may be quite appropriate for certain classes of events in multi-function work, we contend, a functional approach, which tries to understand the goals that are intended to be achieved both by organizations and knowledge worker individuals, is more likely to lead to the kind of analysis which will yield alignment with electronic technologies that will be viable.

The behaviouristic approach tends to lead to substitution of one means for another. A functional approach tends to lead to transformations in work. As a very simple-minded example, electronic messaging may seem to be needed from a behaviouristic perspective when two people make very frequent phone calls to each other but are often caught in telephone tag. However, if these calls are mostly about bottlenecks on a production line, then the problem is on the production line and not in telephony or messaging. More complex instances are not rare. If you have recently moved within Toronto, you will have found out that moving your telephone service is now extremely simple and fast. A single phone call to the business office will settle most matters. With his or her fingertips, the Bell representative can access all the information about whether jacks are present at your new address, and, if so, can program in the changeover date and time and can tell you your new number, right then and there. The previous long sequence of events, involving many persons, green trucks, appointments and delays, are gone. The new way did not involve more or faster trucks but a complete transformation in the way of doing things. The end goal, efficient service to subscribers, was rethought in functional, not in behaviouristic terms.

Because we don't have adequate general tools yet, reaching an understanding of organizational and individual goals may be very time consuming. It needs to involve a team, where, in addition to knowledge of the potential technical possibilities, various kinds of

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social science expertise is also present. Discovering the real goals of an organization requires considerable digging and analysis. A set of simple questions and observations will not do because different offices and people vary enormously in many dimensions. Workers themselves may not be able to see clearly beyond the boundaries of their present ways of doing things. Partly as a result of the difficulty in performing an adequate needs analysis, considerable uncertainty often surrounds the feasibility of an office automation system. For this reason, many organizations have opted for pilot projects before installing larger, more expensive operational systems. One of the purposes of a pilot project is to determine whether the system in fact really meets an organizational need, hence justifying the expense of a fully operational system. The OCS Program has adopted this perspective. It provides funding for the pilot phase of the project but the host department must decide whether the system should become operational and obtain the necessary funding.

It is at the needs analysis stage that the goals to be achieved by implementing technology have to be settled, as well as specification of how it will be known later, whether, or to what degree, the goals have been achieved. Much is made of the "productivity" issue, with inappropriate questions such as "how do you measure office productivity"? The real question is, "is the technology implementation (or other transformations) suggested or described by the needs analysis going to be truly useful in accomplishing the goals of this specific office or organization and its people"? If it is, then measuring later whether the technology brought about the desired changes should be relatively straightforward since detailed specification of just what changes were planned to be achieved is part of a properly executed needs analysis. The important thing here is that what is truly useful may be something quite different from office to office and organization to organization - even from person to person since knowledge workers are well-known to have idiosyncratic patterns of working. The "measuring office productivity" question is stated at the wrong level of generality and simply cannot be answered in that form. The office doesn't exist!

In this light, the cost justification issue is not, whether the new way will be cheaper or more expensive than the old. That is a substitution question. If the proposed new way is a significantly better way to achieve organizational goals, then that is what justifies it. To decide whether the costs of the new way are worth the dollars requires the usual business judgement that takes into account the same variables as any other decision on expenditure. Unlike the simple-minded substitution question, these are complex variables that can't be expressed in a simple equation.

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It should be noted too that the thorough understanding of an organization, its goals and means, which a proper needs analysis will provide, does not necessarily implicate new technologies. In some instances, other means (e.g. organizational changes, job redesign, etc.) may be proposed in order to achieve improvements in goal attainments. More often than not, a combination of means, including new technologies, will be called for.

We will deal with the remaining four steps in planning, implementation and assessment, quite briefly.

### BASELINE MEASURES

This is the stage where impact assessment proper begins, although the kind of expertise to do these measures resides in the team membership that performed a proper needs analysis. Unless one is a single-person organization, it is always necessary to justify major changes. Which pre-implementation measures are to be taken will follow directly from a proper needs analysis. The latter will have specified the planned effect of the new technologies and other change agents. The baseline measures are a pre-implementation series designed to be repeated post-implementation. They directly assess the effects of the events intervening between measures.

Of course, other uncontrolled and perhaps unknown events besides the implemented, planned changes can produce differences between pre and post measures. However, the incredible expense of an experiment involving a control group identically treated except for the planned changes will rarely allow this more rigorous approach to be taken. The expense includes, of course, the cost of the severe disruption to ongoing business affairs of allowing a control group. But, even ignoring the cost factor, it is almost impossible to create a group of workers that would be "identically treated except for the planned changes" since the planned changes are a great multitude of events and not some single, easily defined step. In technical terms, we are not sure what the relevant independent variables are, hence a true experiment is not feasible. In most practical situations, a case study approach is the best that can be achieved. Professional judgement will need to be exercised to interpret obtained pre and post measured changes.

### SYSTEM/VENDOR CHOICE

This too should be comparatively straightforward after a proper needs analysis, since the latter would have produced a detailed

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specification of requirements. The competitive bid route will often be feasible. One caution here is that it may be that no vendor can meet all requirements as specified. Clear prioritization of requirements may then be necessary for effective choices among vendors. Also, given that there is a choice among two or more vendors, other considerations such as the user interfaces, "user friendliness", and ergonomics should play a large role in choices.

### TRAINING AND LEARNING

These issues too should have been addressed to some extent in the needs analysis phase. However, effective decisions may not be possible until after vendor choice. The vendor can frequently provide training; in other cases, in-house training staff may be used. Remembering again that we are dealing with multi-function knowledge workers, the luxury of "days" of training may not be available. The preferred route may be very brief, hours rather than days, of initial training to enable immediate, if very incomplete, usefulness of the technologies. Thence, a long term support function, preferably in-house and always on call, for gradually extending the training on both an "as needed" and a "you should next learn" basis.

We distinguish training from learning, with the latter a long-term proposition of gradually increasing mastery toward truly effective use of the new technologies in a job. Overall planning will have to anticipate the high likelihood that initially, and perhaps for a long time, individuals may become far less effective in their jobs as the jobs are transformed by the technologies. Such productivity drops are entirely normal and have to be accommodated in the often slow progress toward eventual organizational effectiveness enhancements.

### ONGOING ASSESSMENT

Formally, assessment began at the second step above, with baseline measures. Ideally, assessment will be ongoing throughout the changeover, with repeated measurements being re-administered until all detectable changes cease and a new stability is attained. One constraint is not to overwhelm the workers with assessment. That will be a matter of reasonable judgement regarding both the frequency of measurement and the nature of the measures, and also a matter of establishing and maintaining rapport.

Besides providing a picture across time, repeated, ongoing assessment can play a vital role by aiding the detection of sub-optimal events.

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Appropriate actions can then be taken. Such continual feedback can facilitate the total transition to the new ways of accomplishing work. Properly done, ongoing assessment becomes an integral part of the long term learning process.

### CONCLUSIONS

In this paper we have described the objectives of the OCS Program and have provided a brief overview of the field trials underway. Although impact assessment results are only beginning to come in, it has become clear that an adequate needs analysis is crucial to successful office systems implementation. Currently no general techniques are available to ensure an appropriate analysis. This is unfortunate because, as we pointed out, a mistake made in the needs analysis tends to affect all of the subsequent work done on a project adversely. Indeed, it can be argued that a mistake originating in any subsequent phase of the project, can be corrected just by spending more money. However, when a mistake is made in the needs analysis, not only will much more money need to be spent, but, even then, a truly viable system may still not be obtained. This indicates the importance of conducting further research to deepen our understanding of the office and to provide a set of general tools for functional description and analysis.