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STUDY OF INFORMATION PROCESSING PLANNING AND PRODUCTIVITY IN 56 LARGE ORGANIZATIONS

by

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Canada

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Foreword

This is a report on a survey of over 50 large organizations conducted in early 1986 in the Montreal area. The objectives of the survey were to determine mechanisms used for information processing planning and productivity measurement and to poll information processing managers and manager/users on various subjects related to productivity measurement.

We interpreted the term "information processing" to include data processing by computer, telematics and office automation, among other convergent technologies, all of which are aimed at providing information for decision-making. We did not wish to bias the survey or analysis of results by interpreting the term too narrowly, since some of our questions were designed to determine how managers distinguish between these technologies.

The organizations who participated in the survey included industrial and commercial firms as well as governments. We refer to them generally as organizations.

Information processing user productivity measurement is a popular subject in many organizations and in scientific literature. Unfortunately, although several approaches to measurement have been proposed, very few have actually been implemented effectively. We therefore hope that our study will provide new and useful information on the subject.

We would like to thank all the organizations who agreed to participate in our project (listed in Appendix I), as well as all those who answered our questions (not listed for reasons of confidentiality). We would also like to express our gratitude to the members of the CWARC Organizational Research Branch who helped conduct the study.

Table of Contents

1- Introduction and objectives

We surveyed large organizations in the Montreal area to find out about information processing planning mechanisms and productivity of information processing, and to gather managers' opinions on both subjects. Information processing managers and manager/users representing a number of organizations were interviewed, while information processing managers in many other organizations filled out questionnaires.

This survey was conducted while I was a visiting scientist at the Canadian Workplace Automation Research Centre (CWARC) between September 1985 and February 1986, during a sabbatical from my position as professor of computer science at Laval University. The general objective of my work at CWARC was to develop a tool for measuring the productivity of organizations with respect to workplace automation.

At first, we thought it would be possible to develop a general approach to evaluating information processing productivity in most organizations by coming up with a synthesis of the models presented in the abundant scientific literature on the subject, the results of our own projects, and the results of two major Government of Canada programs (the Department of Communications Office Communications Systems Program [OCSP] and the Treasury Board Task Force on Informatics).

Although many models were available in the scientific literature, very few had been effectively applied or had produced sufficiently valid measurements to be transposed to other contexts. The same was true for the results of the OCSP projects. As for the Task Force on Informatics, we were able to consult only a small number of the reports it produced because distribution was limited by Treasury Board.

There are models for predicting the macroeconomic impact of information processing (eg: job creation, balance of payments) as well as microeconomic impact (eg: increased efficiency of secretaries on word processors), but quantitative data on productivity measurement

between these two extremes is scarce. In any case, many authors point out that the impact of office automation on such things as the quality of working life and employee motivation is very difficult to measure.

Thus we conducted the survey to get a better overview of the subject, to find out what planning was carried out for the different aspects of information processing, including productivity measurement, to establish the main characteristics of such productivity measurement, and to obtain the opinions of managers (both data processing managers and manager/users) on various related topics.

Questionnaires were filled out by information processing managers in 56* organizations; questions covered the organization (annual sales, number of employees), characteristics of information processing (staff, total budget and breakdown by main categories of expenditure, including office automation), the identification of information processing components and components associated with information processing subject to formal planning, and the identification of information processing components subject to formal measurement.

Opinions were also gathered in interviews with 15 information processing managers and 26 manager/users on the distinction between information processing and office automation, the best ways to measure productivity, the possibility of expressing productivity in economic terms, the usefulness of measuring productivity, human impact, planning of measurement, the role of users and application of results of measurements.

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* We actually received questionnaires from 57 organizations, but the results in this report are from only 56, because the 57th questionnaire was received too late to be included.

The various chapters of this report describe the procedure followed to establish the sample of firms and gather opinions, discuss the main characteristics of the sample in terms of breakdown of organizations and expenditures on information processing and office automation, detail formal information processing planning mechanisms and productivity measurements used (or being introduced) in these organizations, and outline the opinions of managers on various subjects related to information processing productivity. The conclusion synthesizes all of this information. The two appendices contain the list of organizations who participated in our project and a copy of each of the questionnaries used.

2- Procedure

We started with a list of several hundred members of the Canadian Information Processing Society in the Montreal area. The list included the names and addresses of data processing managers in one hundred of the largest organizations. It enabled us to choose a preliminary sample representative of these organizations. We contacted information processing heads in about twenty organizations to describe the main characteristics of the planned survey and ask if they would agree to answer our questions and introduce us to manager/users who would be willing to share their opinions.

We came up with 15 large organizations who agreed to participate in our project and whose managers (information processing managers and users) agreed to meet with us and answer our questions. We sent an explanatory letter and a questionnaire to the person in charge of information processing in each organization; the letter also asked to identify manager/users who would be willing to meet us and answer our questions. We then visited these firms and met with the information processing manager and manager/users.

We then identified several dozen other interesting organizations from our original list and contacted the person in charge of information processing to ask whether he would agree to fill out and quickly return a questionnaire on the productivity of information processing; we received several dozen duly completed questionnaires.

Four questionnaires were prepared: one of closed questions for the information processing managers of the firms visited, one list of open questions for these managers, a list of open questions for manager/users of these firms, and a questionnaire including closed and open questions for information processing managers of firms that we would not be able to visit. The questionnaires and covering letters were produced in French and English (a copy of each questionnaire appears in Appendix II).

The survey objectives, procedure and questionnaires were established in December 1985 and early January 1986, the data were gathered in late January and February, and the analysis was conducted in March and April 1986.

3- Sample

3.1- Breakdown of organizations

Since the aim of our survey was to analyse variables connected with information processing, and since these variables are better defined in large organizations than in small organizations, we chose large organizations for our sample. Table 3.1 shows the breakdown of organizations by number of employees.

Number of employees	Number of organizations
less than 500	6 (11%)
500 to 999	15 (27%)
1,000 to 1,999	15 (27%)
2,000 to 4,999	4 (7%)
5,000 to 9,999	5 (9%)
10,000 to 19,999	7 (12%)
over 20,000	4 (7%)
Total	56 (100%)

Table 3.1 - Breakdown of organizations by number of employees

The average number of employees per organization was 4,850, and the median of the organizations surveyed was 1,450 employees; the median is used further on to separate organizations into two categories: "larger" and "smaller".

We asked the organizations to tell us their annual sales figure (or budget), by specifying either the amount or the range. Most of the organizations (40 of 56) indicated an absolute amount. Table 3.2 shows the breakdown of these 40 organizations by annual sales.

Annual sales	Number of organizations
less than $50 million	8 (20%)
$50 to $99 million	3 (7%)
$100 to $199 million	10 (25%)
$200 to $499 million	8 (20%)
$500 to $999 million	5 (13%)
$1 to $1.999 billion	4 (10%)
over $2 billion	2 (5%)
Total	40 (100%)

Table 3.2 - Breakdown of organizations by sales figure

Table 3.3 shows the breakdown of organizations, both visited and not visited, by main activity.

Main activity	Number of organizations		
	visited	not visited	total
Manufacturing	3	18	21
Finance	4	5	9
Public & para-public	2	6	8
Transportation	2	4	6
Distribution	2	1	3
Other	2	7	9
Total	15	41	56

Table 3.3 - Distribution of organizations by main industry

This information was provided by information processing managers and manager/users in the 56 organizations, both visited and not visited. Table 3.4 shows the breakdown of respondents by organization.

Category of respondents	Number of respondents in organizations		
	visited	not visited	total
Information processing managers	15	41	56
Manager/users	26	0	26
Total	41	41	82

Table 3.4 - Breakdown of respondents by category of organization

In addition to the above tables, the information at our disposal might enable us to break manager/users down according to the nature of their duties (eg: sales director, chief treasurer, administrative head, etc) or according to employees under their supervision.

3.2- Budgets and personnel

We asked information processing managers to detail information processing and office automation expenditures; we asked for total expenditures and a breakdown by major categories such as personnel and equipment. We also asked them to specify their information processing structure and the number of employees involved.

Table 3.5 shows the breakdown of organizations in terms of information processing operating budget; the budget includes ordinary operating expenditures, such as salaries and equipment rental, and annual depreciation of equipment purchased. This information is supplied for the 42 organizations that have earmarked a specific amount of their annual budgets for information processing.

Information processing budget	Number of organizations
Less than $1 million	5 (12%)
$1 to $1.9 million	7 (17%)
$2 to $4.9 million	12 (29%)
$5 to $9.9 million	9 (21%)
$10 to $19.9 million	3 (7%)
over $20 million	6 (14%)
Total	42 (100%)

Table 3.5 - Breakdown of organizations according to information processing budget

It is interesting to compare information processing expenditures to the annual sales figure. Table 3.6 shows the ratio for the 40 organizations which specified their information processing budget and sales figure.

Information processing budget as a percentage of annual sales figures	Number of organizations
Less than 1%	7 (17%)
1% to 1.9%	15 (38%)
2% to 4.9%	9 (23%)
5% to 9.9%	4 (10%)
over 10%	5 (12%)
Total	40 (100%)

Table 3.6 - Breakdown by relative size of information processing budget

We could also break down information processing budgets by main category of expenditure, such as equipment or personnel, but we do not feel that such a breakdown would be particularly useful or accurate.

Note that in Tables 3.5 and 3.6, "information processing" under "information processing budget" should be understood in the broadest sense of the term, which is how we asked respondents to interpret it. As the case may be, this budget may or may not include office automation expenditures. In our survey, we wished to know the distinctions made by participants between information processing and office automation. We did not provide definitions for the two terms because we did not want to bias participants' responses.

We asked respondents to specify annual office automation expenditures and to indicate whether this amount was included under information processing expenditures. Tables 3.7 and 3.8 show the breakdown of organizations by office automation expenditures and ratio

to total information processing budget (excluding office automation expenditures). In most organizations, office automation expenditures are almost exclusively for equipment.

The results shown are for 25 organizations only, because some of those surveyed did not provide us with sufficiently specific information on the subject.

Office automation expenditures	Number of organizations
Less than $100 thousand	5 (20%)
$100 to $199 thousand	4 (16%)
$200 to $499 thousand	11 (44%)
$500 to $999 thousand	2 (8%)
over $1 million	3 (12%)
Total	25 (100%)

Table 3.7 - Breakdown of organization by office automation expenditures

Office automation expenditures as a percentage of information processing budget	Number of organizations
Less than 5%	7 (28%)
5% to 9.9%	7 (28%)
10% to 19.9%	6 (24%)
20% to 49.9%	4 (16%)
over 50%	1 (4%)
Total	25 (100%)

Table 3.8 - Breakdown by ratio of office automation expenditures to total information processing budget

Table 3.9 shows the breakdown of 55 organizations by number of employees in information processing, while Table 3.10 shows the breakdown of these organizations in terms of the percentage of total

staff represented by information processing employees. (The data are taken from only 55 organizations because one of the 56 organizations provided us with imprecise information on the subject).

Number of information processing employees Less than 20	Number of organizations
Less than 20	10 (18%)
20 to 49	19 (35%)
50 to 99	9 (16%)
100 to 199	7 (13%)
200 to 499	5 (9%)
Over 500	5 (9%)
Total	55 (100%)

Table 3.9 - Breakdown of organizations by number of information processing staff

Percentage of staff in information processing	Number of organizations
Less than 1%	5 (9%)
1% to 1.9%	12 (22%)
2% to 4.9%	23 (42%)
5% to 9.9%	9 (16%)
over 10%	6 (11%)
Total	55 (100%)

Table 3.10 - Breakdown of organizations by percentage of information processing staff

It is interesting to note that the breakdown of organizations by percentage of information processing staff (Table 3.10) is different from the breakdown of organizations by information processing budget (Table 3.6); one must be careful in interpreting this observation, however, because in the case of some multi-branch organizations, it is possible that "information processing staff" and "information processing budget" do not correspond to exactly the same things.

We asked the 26 manager/users we met to indicate their knowledge and direct use of information processing and office automation (according to their own definitions of these terms). Responses to these questions appear in Tables 3.11 and 3.12.

Information processing knowledge	Manager/users by frequency of direct use			
	Frequent	Occasional	Rare	Total
Excellent	4	2	1	7
Average	4	4	6	14
Weak	2	1	2	5
Total	10	7	9	26

Table 3.11 - Breakdown of manager/users in relation to information processing

Office Automation knowledge	Manager/users by frequency of direct use			
	Frequent	Occasional	Rare	Total
Excellent	4	0	1	5
Average	4	5	4	13
Weak	2	2	4	8
Total	10	7	9	26

Table 3.12 - Breakdown of manager/users in relation to office automation

The two tables show that manager/users make about the same direct use of information processing and office automation (although the same people are not necessarily represented in the equivalent boxes in both tables) and that the frequency of direct use varies according to level of knowledge. However, these managers have slightly greater overall knowledge of information processing than of office automation.

4- Information processing in organizations

4.1- Planning

We asked information processing managers to identify formal planning mechanisms presently in use (or being implemented) for certain information processing components and for certain components associated with information processing.

The questionnaire contained a list of 11 information processing components and components associated with information processing, and the respondents were asked to check off each component where an official planning mechanism was either in use or being implemented. Table 4.1 shows total answers given by managers in the 56 organizations.

Components of information processing or associated with information processing	Number of organizations where planning is presently either	
	used	being implemented
Development of applications of information processing	42	9
Equipment (including networks)	40	9
Expenditures for information processing	40	4
Personnel	37	6
Integration of computer-based systems	31	13
Policies for management of information processing	29	9
Benefits of systems	25	11
Applications of office automation	22	18
Information required for the whole organization	17	19
Global data modelling	9	18
Measurement of productivity of users	6	18

Table 4.1 - Planning mechanisms in use in 56 organizations

By formal planning, we mean the preparation of plans that are valid for at least three years, and approved and revised at least once a year by senior management of the organization and by users.

The main components for which formal planning is carried out are those that correspond to traditional aspects of information processing, in other words development of applications, and resources used to develop and exploit applications. The development of a system or an application generally takes several years, and implementation involves a great many people during this period; it is therefore natural that formal planning for this component take place in most organizations. The choice of an equipment configuration has consequences that also extend over several years, and although not all details may be taken into account, it is a component that must be planned well in advance.

To ensure the quality and quantity of personnel required by an information processing department, a plan spanning several years is practically mandatory: approval in principle must be obtained for creating positions, position levels must be determined, staff must be recruited and career plans must be set out. Planning is particularly important because it is so difficult to recruit and keep experienced personnel. Information processing expenditures include all resources used to develop and operate systems, and formal planning of such expenditures is therefore justified. The fact that these expenditures grow every year is all the more reason for planning.

Also subject to planning are integration of systems, information processing management policies, and benefits of systems. Related problems appear when an organization has developed and operates several systems. Although many organizations do conduct formal planning for these components, fewer do than for the first category, because this means planning for a second generation of components.

The final category of components, which comprises applications of office automation, information required for the whole organization, global data modelling and measurement of productivity of users, corresponds to more recent aspects of information processing management. Although these aspects exist in a number of organizations, they are not important enough to justify formal planning; this is particularly true in the case of productivity measurement.

We divided the organizations into two categories, according to whether they had more or fewer employees than the median of 1,450. Thus our sample contained 28 "larger" organizations, with more than 1,450 employees, and 28 "smaller" organizations, with fewer than 1,450 employees.

Table 4.2 shows the number of organizations where formal planning mechanisms are used or being implemented, for all organizations, larger organizations and smaller organizations, respectively. In the case of most components, information processing planning is generally more formal in larger than in smaller organizations, and the relative importance of the various components in planning is about the same for both categories.

Component of information processing or associated with information processing	Number of organizations where planning is used or being implemented		
	All (56)	Larger (28)	Smaller (28)
Development of applications of information processing	51	28	23
Equipment (including networks)	49	26	23
Expenditures for information processing	44	23	21
Integration of computer based systems	44	23	21
Personnel	43	26	17
Applications of office automation	40	21	19
Policies for management of information processing	39	23	16
Information required for the whole organization	36	18	18
Benefits of systems	36	22	14
Global data modelling	27	13	14
Measurement of productivity of users	24	13	11

Table 4.2 - Planning mechanisms by size of organization

4.2- Productivity measurement

4.2.1- General

The objectives of this survey were to achieve a better overview of information processing productivity in general, to determine how particular aspects of information processing, including productivity measurements, are planned, and to identify what the main characteristics of currently used productivity measurements are.

We wanted to determine mechanisms used to measure the productivity of information processing and office automation users, but since we also wanted to know how respondents distinguished between these two terms, it was not possible to provide a definition without biasing answers.

We therefore established a list of 13 components that could be used to measure productivity of users and presented the list on two pages of the questionnaire, asking respondents to indicate information processing productivity measurements on the first list and office automation productivity measurements on the second.

In cases where organizations formally measured changes in user productivity as a direct or indirect result of information processing or office automation, respondents were asked to specify what components were measured.

They answered by checking off each component in the list: yes if the component was included in most cases of productivity measurement and in most sectors of the organization, partly if the component was included only in certain cases, and no if the component was never included.

The next two sections of this report show the results for both information processing and office automation.

4.2.2- Information processing productivity

Table 4.3 shows the breakdown of the 56 organizations according to components used to measure productivity of information processing users.

Components included in formal information processing user productivity measurements	Yes	Partly	No
Reduction in costs following the implementation of systems	28	9	19
Time savings by different categories of personnel	21	9	26
Efficiency in the production of goods or services	16	13	27
Effectiveness in the production of goods or services	16	15	25
Increase in revenues following the implementation of systems	15	13	28
Number of documents prepared by clerical support staff	14	8	34
Number of documents prepared by professionals	12	11	33
Number of documents prepared by managers	9	11	36
Quality of working life	9	16	31
Quality of managers' decisions	8	10	38
Employee motivation	8	16	32
Absenteeism	7	8	41
Quality of work performed by professionals	6	17	33

Table 4.3- Information processing productivity measurements, all organizations

In most organizations, the development of applications is economically justified through reduction of expenditures; so it is natural that the most common method of measuring productivity associated with the use of systems, or the relationship of certain "outputs" to certain "inputs", is to check whether investment in a system has actually resulted in savings. Another reason why organizations primarily use this component as a measurement of productivity is that it is easy to express in tangible terms.

The second most important measurement of information processing productivity is time saved. Introducing a system should make it possible to accomplish some tasks more quickly: clients are provided with better service and receive invoices sooner, decision makers receive more recent information more quickly, and so on. Such time savings can sometimes easily be translated into reduced expenditures and may be reflected in efficiency and effectiveness of goods and services production.

Many organizations measure increase in revenues, or the number of documents produced by administrative support or professional staff, but the importance of these components is somewhat limited. Other components subject to measurement, including human aspects such as quality of working life and motivation of employees, are not very important.

The sample included a total of 56 organizations (represented below by TO), which we broke down into 28 "larger" organizations (LO) and 28 "smaller" organizations (SO) according to the median of 1,450 employees. Table 4.4 shows the breakdown of each of the three categories of organization, according to information processing productivity measurements totally or partly in use. Note that larger organizations assign greater importance to productivity measurement than smaller organizations.

Components included in formal information processing user productivity measurements	Organizations		
	TO (56)	LO (28)	SO (28)
Reduction in costs following implementation of systems	37	20	17
Effectiveness in production of goods or services	31	16	15
Time savings by different categories of personnel	30	17	13
Efficiency in the production of goods or services	29	14	15
Increase in revenues following implementation of systems	28	15	13
Quality of working life	25	13	12
Employee motivation	24	12	12
Number of documents prepared by professionals	23	13	10
Quality of work performed by professionals	23	12	11
Number of documents prepared by clerical support staff	22	13	9
Number of documents prepared by managers	20	13	7
Quality of managers' decisions	18	8	10
Absenteeism	15	8	7

Table 4.4 - Information processing productivity measurements by organization

4.2.3 - Office automation productivity

Table 4.5 shows the detailed breakdown of the 56 organizations by components used in whole or in part to measure office automation productivity. Note that respondents had to use their own definition of office automation because we did not want to bias their answers by providing our own definition (see section 5.2).

Components included in formal office automation user productivity measurements	Yes	Partly	No
Reduction in costs following implementation of systems	24	9	9
Time savings by different categories of personnel	20	11	25
Number of documents prepared by clerical support staff	19	9	28
Number of documents prepared by professionals	13	8	35
Employee motivation	12	12	32
Effectiveness in the production of goods or services	12	10	34
Increase in revenues following the implementation of systems	12	7	37
Efficiency in the production of goods or services	11	10	35
Quality of working life	10	15	31
Number of documents prepared by managers	10	9	37
Quality of work performed by professionals	9	14	33
Quality of managers' decisions	8	13	35
Absenteeism	7	5	44

Table 4.5- Office automation productivity measurements, all organizations

In general, office automation productivity measurement mechanisms are less popular than those used to measure information processing productivity. The hierarchy of mechanisms is basically the same in both areas. Thus, the first two components for both information processing and office automation are reduction in costs and time savings.

The number of documents prepared by clerical support staff is more important in measuring office automation productivity than it is in information processing; this is because of the importance of word processing in office automation. Similarly, it can be assumed that personal microcomputers, which typically include tools such as spreadsheet programs, play an important role in the productivity of professionals and explain the importance of this parameter.

Effectiveness and especially efficiency in the production of goods or services are less important measurements of productivity in office automation than information processing because office automation is less directly related to production than information processing.

On the other hand, human aspects, such as quality of working life and employee motivation, have a greater importance in office automation than in information processing, given the greater proximity of office automation to its users.

Table 4.6 shows the breakdown of the 56 organizations (TO), the 28 larger organizations (LO) and 28 smaller organizations (SO) according to components used in whole or in part to measure office automation productivity. Here again, note that larger organizations are more formal in user productivity measurement than smaller organizations.

Components included in formal office automation user productivity measurements	Organizations		
	TO (56)	LO (28)	SO (28)
Reduction in costs following the implementation of systems	33	17	16
Time savings by different categories of personnel	31	16	15
Number of documents prepared by clerical support staff	28	16	12
Quality of working life	25	13	12
Employee motivation	24	10	14
Quality of work performed by professionals	23	14	9
Effectiveness in the production of goods or services	22	11	11
Number of documents prepared by professionals	21	13	8
Quality of managers' decisions	21	12	9
Efficiency in the production of goods or services	21	10	11
Number of documents prepared by managers	19	12	7
Increase in revenues following the implementation of systems	19	10	9
Absenteeism	12	7	5

Table 4.6 - Office automation productivity measurements by organization

5- Opinions of respondents

5.1- General

One important objective of this survey was to get the opinion of information processing managers and manager/users on information processing planning and mechanisms used to measure productivity. To this end, we asked nine questions: one question for all 82 participants, seven questions for all 41 managers with whom we met, and one question only for the last 32 managers with whom we met.

The opinion questions were open questions; participants freely stated their answers, and we noted them down. Some respondents to the first question wrote down the answers themselves. The answers to each of the nine questions were analysed as follows: we read all the answers, determined the general drift of each answer, and determined categories into which answers fell. We then produced tables breaking down the answers by category, for all respondents, as well as by size of organization (all, larger and smaller) and by function (information processing manager or manager/user).

The next nine sections of the report analyse the answers to each of the nine opinion questions. In general, each section states the question, presents a table of answers broken down by answer category, function (information processing manager or manager/user) and size of organization (larger or smaller), and analyses the answers according to these parameters.

5.2- Distinction between office automation and information processing

This section analyses answers to the question:

"What distinction(s) do you make between information processing and office automation?"

All 82 participants answered this question, and some provided more than one answer.

In Table 5.1 and subsequent tables, the abbreviations TO, LO and SO stand for "all organizations", "larger organizations" and "smaller organizations".

Answer category	Nb. of managers by answer category								
	Information processing			Users			Total		
	TO /56	LO /28	SO /28	TO /26	LO /14	SO /12	TO /82	LO /42	SO /40
Functions	35	18	17	19	11	8	54	29	25
Proximity	31	17	14	11	7	4	42	24	18
Information processing (or OA authority)	13	6	7	8	7	1	21	13	8
Equipment	6	4	2	10	7	3	16	11	5
Information processing includes office automation	11	6	5	3	2	1	14	8	6
Volume of data processed	4	2	2	4	2	2	8	4	4
Software	4	2	2	2	2	0	6	4	2
No distinction	4	3	1	2	1	1	6	4	2

Table 5.1 - Distinctions between information processing and office automation by category of manager

The main distinction made between information processing and office automation, according to Table 5.1, lay in the functions performed by one means or the other. This is an interesting distinction. It reflects the general perception of managers that the range of possible functions differs considerably. Many managers feel that information processing functions are limited in range and that those of office automation are quite varied, while many others have the opposite impression!

The "proximity" distinction was the second most frequent answer. It was mentioned by the majority of managers and reflects the fact that information processing, remote from individual users, is used mainly to provide the entire organization with a service, while office automation can provide a "personalized" service closer to their needs.

The "authority" criterion reflects the perception of nearly all managers that information processing is the responsibility of senior management or of specialists, whereas office automation is the responsibility of users.

Distinctions were made according to "equipment". For most managers, information processing necessitates the use of large computers, while office automation involves personal computers; some respondents did, however, indicate that information processing is also possible on personal microcomputers.

Fourteen managers said that office automation is part of information processing, in the sense that information processing, in addition to possessing its own characteristics, also has all the characteristics of office automation.

"Volume of data processed" reflects the impression of some managers that information processing is used to process large volumes of data, whereas office automation is used to process small volumes.

The distinction according to "software" is that with information processing, one must "program", while with office automation, one uses ready-made software; however, two managers expressed exactly opposite opinions.

Finally, six managers indicated that they make no distinction, for all intents and purposes, between information processing and office automation.

There seems to be no significant difference between the answers of larger and smaller organizations. There are slight differences of opinion between the different functions. Manager/users distinguish more according to volume of data processed, authority and equipment, while information processing managers have a slight preference for proximity and consider that information processing includes office automation or that there really is no distinction between the two.

5.3 - Best productivity measurements

This section analyses answers to the question:

"What is (are) the best way (ways) to measure the productivity of users of information processing?... of office automation?"

This question, together with the next six questions, was put only to the 41 managers with whom we met.

Answer category	Nb. of managers by answer category								
	Information processing			Users			Total		
	TO /15	LO /9	SO /6	TO /26	LO /14	SO /12	TO /41	LO /23	SO /18
Quality of output	4	3	1	18	12	6	22	15	7
Time savings	3	2	1	16	9	7	19	11	8
Quantity of output	8	4	4	8	4	4	16	8	8
Cost reduction	7	3	4	7	6	1	14	9	5
Human benefit	3	2	1	7	6	1	10	8	2

Table 5.2- Best productivity measurements by category of manager

It was not possible, based on the answers given, to make a distinction between productivity associated with information processing and productivity associated with office automation.

In the above table, "output" corresponds to the products of users working with information processing or office automation systems, while "human benefits" includes customer satisfaction, employee motivation and development of new tasks.

The best way to measure productivity for most managers would thus be to measure the quality of the work performed by users; this would be very difficult, however, as many respondents pointed out. This opinion was more common among managers of larger organizations than smaller organizations and was also more frequent among manager/users than among information processing managers.

Cost reduction, time savings and quantity of output are considered to be important measurements by the majority of managers, and these views roughly correspond to the actual use made of measurement mechanisms in organizations (see Tables 4.3 to 4.6).

Human benefits are mentioned equally by both information processing managers and manager/users, but managers in larger organizations attach far more importance to this aspect of measurement than those in smaller organizations.

5.4- Expression in economic terms

This section analyses answers to the question:

"Do you believe that an expression in economic terms (costs and benefits) is a correct representation of the productivity of information processing? ... of office automation?"

Answer category	Nb. of managers by answer category								
	Information processing			Users			Total		
	TO /15	LO /9	SO /6	TO /26	LO /14	SO /12	TO /41	LO /23	SO /18
Yes	4	2	2	11	3	8	15	5	10
Yes, with reservations	6	4	2	6	4	2	12	8	4
No	5	3	2	9	7	2	14	10	4

Table 5.3- Economic expression of productivity

Expressing productivity in economic terms is valid to a certain degree. The reservations indicated in the table concern the fact that although one may easily measure costs, there are "qualitative" benefits that are extremely difficult to measure. Similar arguments were also used to justify most of the negative answers.

There was no significant difference between the answers of information processing managers and those of manager/users.

There was also very little difference between the answers of managers in either size of organization, except that reservations with respect to human aspects of qualitative benefits were formulated more frequently by larger organization managers than by smaller organization managers.

5.5- Usefulness of measuring productivity

This section analyses answers to the question:

"What is your opinion on the usefulness of measuring user productivity?"

Note that categories of answers to this question are not mutually exclusive, as some respondents gave more than one answer.

Answer category	Nb. of managers by answer category								
	Information processing			Users			Total		
	TO /15	LO /9	SO /6	TO /26	LO /14	SO /12	TO /41	LO /23	SO /18
Useful for checking whether investment was worthwile	8	5	3	5	4	1	13	9	4
Useful for other than economic reasons	2	1	1	9	4	5	11	5	6
Useful, but to a limited extent	5	3	2	5	4	1	10	7	3
Useful in general, not just in information processing	0	0	0	3	3	0	3	3	0
Mechanisms are difficult to determine	1	1	0	3	1	2	4	2	2
Virtually of no use	0	0	0	2	0	2	2	0	2

Table 5.4- Usefulness of productivity measurements

Most respondents consider that it is useful to measure productivity. The main purpose is to check whether investment has been worthwhile, that is, whether expected reductions in expenditures or increases in revenues have actually come about and have justified the costs of systems. This is in line with the importance assigned to reduction in expenditures among productivity measurements actually in use (see Tables 4.3 to 4.6).

Many managers indicated that there were other than economic reasons for measuring productivity, for example, verifying whether users are properly trained, whether equipment is being used correctly, or determining the human or organizational impact of systems. Such measurements may also be used to compare the relative performance of various sectors within an organization or of an organization in relation to its competition.

Differences in answers according to size of organization were not significant, but there was an important distinction between the answers of information processing managers, a majority of whom saw an economic justification in productivity measurements, and those of manager/users, who favoured other justifications.

5.6- Human impact of measurement

This section analyses answers to the question:

"Do you think that the sole fact of measuring user productivity might result in a productivity increase? ...in a productivity decrease?"

Answer category	Nb. of managers by answer category								
	Information processing			Users			Total		
	TO /15	LO /9	SO /6	TO /26	LO /14	SO /12	TO /41	LO /23	SO /18
Increase, due to greater awareness	3	2	1	7	4	3	10	6	4
Increase or decrease depending on individuals	2	1	1	8	4	4	10	5	5
Increase, but only temporary	2	2	0	1	1	0	3	3	0
Increase, but quality suffers	1	1	0	1	1	0	2	2	0
Mention of union opposition	2	1	1	0	0	0	2	1	1
Practically no effect	5	2	3	7	2	5	12	4	8
Decrease (sometimes temporary)	2	1	1	2	2	0	4	3	1
Mention of stress, fear, psychological effects	2	1	1	7	7	0	9	8	1

Table 5.5 - Human impact of productivity measurement

We were a little surprised at the answers to this question. We had thought that the problems of stress, fear, etc, caused by the introduction of productivity measurements (and mentioned by nine of the managers with whom we met) would result in decreased productivity in most cases, or at the very least, would not have any significant effect; the answers show opposite opinions, in that a majority of managers perceive positive effects on productivity, which may be temporary or sectoral for some, for a variety of interesting reasons. Only two respondents said that productivity would decrease because of union opposition.

Three categories varied according to size of organization: "increase, but only temporary" and "stress, fear, psychological effects" were singled out by more managers in larger organizations, while "practically no effect" was given more weight by managers of smaller organizations.

There was very little difference between the opinions of information processing managers and those of manager/users, except that the latter more often mentioned aspects depending on individuals and human behaviour (stress, fear, etc).

5.7- Planning

This section analyses answers to the question:

"Should a formal planning mechanism ("strategic plan") be a pre-requisite to productivity measurements?"

We told all managers with whom we met that formal mechanisms of this kind would involve at least a three-year plan, revised annually by all those concerned.

Answer category	Nb. of managers by answer category								
	Information processing			Users			Total		
	TO /15	LO /9	SO /6	TO /26	LO /14	SO /12	TO /41	LO /23	SO /18
Yes	6	5	1	11	4	7	17	9	8
Yes, but not in all sectors	3	1	2	3	1	2	6	2	4
Yes, in principle, but a method must be found	2	2	0	3	3	0	5	5	0
No	4	1	3	6	4	2	10	5	5
Not an element that should be included in master plan	0	0	0	3	2	1	3	2	1

Table 5.6- Planning of productivity measurement

Although some said planning was not appropriate in all sectors or that a method must be found, most managers felt that if an organization wished to measure information processing productivity, such measurement would require formal planning. There is, however, a certain

contradiction between this majority opinion and the actual situation reported in organizations (see Tables 4.1 and 4.2); very few actually plan formally for productivity measurement. Perhaps the managers we spoke to were more avant-garde than the organizations they represented.

About 20% of the managers did not see a need for formal planning, feeling rather that it is necessary, or at least possible, to introduce a system before measuring the productivity of its use. Three managers noted that a master plan should contain strategic objectives or organizational policies for implementation and that productivity measurements are too specific to be included in such a plan.

Only managers in the larger organizations said that planning methods were necessary. There were more managers in smaller organizations who indicated that planning cannot be done for all sectors.

More information processing managers saw a need for formal planning than manager/users.

5.8- Role of users

This section analyses answers to the question:

"What should the role of users be in the determination of the productivity measurements to be used?"

Answer category	Nb. of managers by answer category								
	Information processing			Users			Total		
	TO /15	LO /9	SO /6	TO /26	LO /14	SO /12	TO /41	LO /23	SO /18
Final responsibility, assisted by specialists	8	6	2	17	10	7	25	16	9
Advisory role, specialists' responsibility	4	1	3	5	1	4	9	2	7
Joint responsibility, users-specialists	3	2	1	4	3	1	7	5	2

Table 5.7- Role of users in selecting productivity measurements

Respondents almost unanimously agreed that users have an important responsibility in determining productivity measurements. Analysis of answers indicated three mutually exclusive answer categories: user responsibility, specialist responsibility and joint responsibility.

It is interesting to note that information processing managers and manager/users have relatively similar answer profiles. Discrepancies in answers given by organizations of different sizes were more marked. Managers of larger organizations assigned more responsibility to users, unlike managers of smaller organizations.

5.9- Use of results

This section analyses answers to the question:

"Should the results of productivity measurements be used for planning purposes? ... control purposes? ... other purposes?"

Answer category	Nb. of managers by answer category								
	Information processing			Users			Total		
	TO /15	LO /9	SO /6	TO /26	LO /14	SO /12	TO /41	LO /23	SO /18
For planning and control purposes	11	6	5	16	7	9	27	13	14
Mention of another purpose	1	1	0	2	1	1	3	2	1
More for planning than for control	3	2	1	5	3	2	8	5	3
More for control than for planning	1	1	0	5	4	1	6	5	1

Table 5.8- Use of results

From the first few interviews we realized that the analysis of the answers to this question would not allow us to uncover any significant phenomenon because practically all managers, regardless of the size of their organization or their function, indicated that the results of the productivity measurements should be used both for planning and control, with certain distinctions. This is shown by the above table.

However, we did note that it would be interesting to explore an aspect directly related to control, ie the possible use of coercive measures. We made this a specific question and asked it systematically of all subsequent respondents.

5.10- Coercion

In response to the comments of participants during initial interviews, we felt it would be useful to add the following supplementary question:

> "If your organization had adopted productivity standards for use of information processing, and employees failed to meet these standards, should coercive action be taken against them?"

This was an oral question which we asked the last 32 persons with whom we met: 7 information processing managers and 25 manager/users.

Answer category	Nb. of managers by answer category								
	Information processing			Users			Total		
	TO /7	LO /3	SO /4	TO /25	LO /13	SO /12	TO /32	LO /16	SO /16
No coercive action	4	1	3	5	2	3	9	3	6
No coercion, but other types of measures	2	2	0	7	5	2	9	7	2
Possibly coercion, but only after other measures	1	0	1	7	5	2	8	5	3
Yes to coercive measures	0	0	0	6	1	5	6	1	5
Coercion, including possibility of dismissal	0	0	0	3	3	0	3	3	0

Table 5.9- Possibility of coercive measures

The majority of managers did not think it was possible or useful to take coercive action in the case of low information processing productivity. This observation held for both larger and smaller organizations. It should be noted, however, that most manager/users agreed with coercive measures, while the idea found favour with only one information processing manager.

Judging by the nature and detail of the answers given, we had the impression that they reflected more about the personalities of respondents than their administrative responsibilities. Thus, one manager specifically said that he would not be capable of dismissing employees in such a case, another said that in his position a younger manager would probably have a more severe opinion, and some managers said that they would have to take into account the age of the employees involved before considering coercive action.

6- Conclusions

Many conclusions may be drawn from this survey; in fact, the analyses in each preceding section may in themselves be taken as conclusions. Nevertheless, we would like to draw attention to certain basic trends that seem to correspond to the main answer categories for all questions, chiefly with respect to information processing user productivity measurement. The presentation follows a different order from that of the previous sections.

(a) Usefulness of measurements:

Most of the respondents felt that it is useful to measure productivity. The main purpose was to verify whether there had been any return on investment, that is, whether expected cost reductions or revenue increases had come about and had justified the cost of systems. Also cited were other-than-economic reasons, for example, to check whether users were properly trained, or whether equipment was properly used, and to determine the human or organizational impact of systems. Such measurements might also make it possible to compare the performance of different sectors in an organization, or of the organization in relation to its competitors. The majority of information processing managers saw an economic justification for productivity measurement, while manager/users favoured other types of justification.

> We therefore conclude that it is possible but sometimes difficult to measure productivity in most information processing sectors. As the objective of most investment in new technology is to increase user productivity, the only way to measure attainment of objectives is to measure user productivity, however difficult this may be.

(b) Nature of measurements:

We asked information processing managers to describe mechanisms used in their organizations to measure information processing and office automation user productivity. We also asked all managers with whom we met to give us their opinion on the best means of measurement.

In most organizations, the most common method of measuring user productivity with respect to both information processing and office automation was to check whether investment actually resulted in savings, for a variety of reasons. The second most important component among information processing and office automation productivity measurements, here again for various reasons and in different respects, was time saved. Such savings are in some cases easily translatable into reduced costs and are reflected in organizations' operating procedures.

In information processing, the next most important productivity measurements were efficiency and effectiveness of production of goods or services, in that order. Increases in revenues and the number of documents prepared by clerical support staff or professionals, as well as human aspects such as quality of working life and employee motivation were also measured, but the importance of these components was somewhat limited.

The number of documents produced by clerical staff was much more important as a measurement of office automation productivity than as an information processing productivity measurement, and the same was true of the quantity of work performed by professionals. We attribute this to the importance of word processing and personal microcomputers in office automation. Effectiveness and efficiency of production of goods or services played a less important role. However, the human aspects were much more important, given the greater proximity of office automation to its users.

Managers' opinions did not enable us to distinguish between productivity associated with information processing use and productivity associated with office automation use.

The best way of measuring productivity, according to most managers, would be to measure the quality of the work performed by users; this would be very difficult, however, as many respondents pointed out. Other important but difficult aspects to measure are qualitative benefits, such as human benefits. Cost reduction, time saving and output quantity were considered important measurements by most managers, and opinions reflected mechanisms of measurement actually used in organizations.

We conclude that there are two main categories of mechanisms that can actually be used to measure productivity: a general category that applies to both information processing and office automation productivity and that comprises cost reductions and time savings; and a category specific to each of these two sectors: efficiency and effectiveness of production for information processing, and the number of characteristic tasks performed by clerical support staff and professionals for office automation. This, however, is not sufficient.

We also conclude that, while there are different ways of expressing productivity, only an expression in economic terms, such as a cost/benefit ratio, can integrate other forms of expression as well as results from various sectors of an organization. Human aspects, such as quality of working life and employee motivation, and other benefits that are difficult to quantify may be used as subjective weighting factors in decision-making, for example, investment decisions based on productivity measurements.

(c) Nature of technologies:

In order to avoid biasing answers of participating managers, we did not define information processing or office automation; but we did ask them to indicate what distinction they made between the two. Their answers fell into a few major categories.

The main category reflected managers' perception of the range of possible functions of these technologies; this distinction was not significant, however, because a large number of managers believed that information processing functions were limited in range and that those of office automation were quite varied, while many managers had the opposite impression. Contradictory impressions were also expressed as to the nature of equipment and software used. In addition, some indicated that they did not see any important difference between information processing and office automation.

However, two classes of distinction were expressed without any contradiction: "proximity", which refers to the fact that information processing is used to provide an entire organization with a service, while office automation is used to provide its users with "personalized" service, and "authority", because information processing is under the responsibility of organization management or specialists, while office automation is the responsibility of users. A similar opinion, though expressed by only a few managers, was that information processing was used to process large volumes of data, while office automation was used to process small volumes.

> We therefore conclude that the distinctions between office automation and information processing are not highly significant, and that for the purposes of user productivity measurements, office automation should not be isolated among the various convergent technologies, such as data processing, data management or telematics, generally known as information processing; these technologies do sometimes use similar tools and have similar objectives.

(d) Planning:

We observed that three main groups of components are subject to formal information processing planning. The first group corresponds to traditional information processing uses, which include development of applications and resources used to develop and operate systems: personnel, equipment and costs. Development of a system or an application is a process that generally takes several years and involves many people; it thus entails formal planning in the majority of organizations. Choice of equipment configurations has consequences that also extend over several years, and although not all details may be taken into account, it is a type of resource that must be planned well in advance. Information processing costs reflect all resources used to develop and operate systems; the fact that these costs are constantly increasing justifies formal planning.

A second group of components consists of systems integration, information processing management policies, and system benefits. Related problems appear when an organization has developed and is operating several systems. Although many organizations do plan formally in this area, it is to be expected that fewer organizations do so than for the first group of components, because it means planning for a second generation of components.

The last group of components -- office automation applications, information required throughout the organization, global data modelling and user productivity measurements -- corresponds to more recent facets of information processing management. This type of management exists in a number of organizations, but it is not important enough to justify formal planning; this is particularly true in the case of productivity measurements.

The preceding comments reflect the planning situation in the organizations that took part in our project. We also observed that planning, like most management functions, is more formal in larger organizations than in smaller organizations.

We asked managers we met to provide us with their opinions on the importance of formally planning productivity measurements to be used, and most managers felt that if an organization wished to implement information processing use productivity measurements, these should be formally planned. However, there was a certain contradiction between this opinion, held by a large majority of managers, and the actual situation reported in the organizations, only a few of which had formal productivity measurement planning mechanisms; it is possible that the managers we met are more avant-garde than their organizations.

> We therefore conclude that, whatever the mechanisms used to measure user productivity, it is only possible to apply any method after all the technical, human and organizational aspects have been formally planned; in addition, given the interdependence of sectors of an organization and of employees in each sector, mechanisms should generally be applied in all (or most) sectors.

(e) Role of users:

Respondents almost unanimously considered that users have an important responsibility in determining productivity measurements. Sixty per cent of managers believed that users should have the final responsibility in this area; twenty per cent of managers felt that users should form joint committees with information processing and other specialists; only twenty per cent of managers believed that users should advise information processing and other specialists, who have the final responsibility.

> We therefore conclude that in the formal planning of productivity measurements, users should play a very important role, and that in most cases, they should take final responsibility.

(f) Effects of measurements:

One opinion question dealt with the effects of measuring user productivity on this productivity. We thought that problems such as stress associated with the implementation of measurements would result in a decrease in productivity in most cases. We were a little surprised at the answers because a majority of managers perceived positive effects on productivity for a variety of interesting reasons. Certain reservations were also expressed concerning the limited duration of possible increases and the importance of human impact.

> We therefore conclude that the implementation of information processing user productivity measurements, in addition to the data that may thus be obtained, may increase productivity in many cases.

We observed that cost reductions and time savings were the most frequently used productivity measurements. The main costs that can be reduced are labour costs, through the automation of human tasks. Moreover, time savings result because less effort is required to accomplish certain tasks. Consequently, increases in productivity of information processing users may be reflected, in the short term, by reduced labour costs; such productivity increases might, however, result in new employment-generating activities in the medium and long term.

In addition, several managers feel that if information processing users do not reach a sufficient level of productivity, then training and technical procedures should be checked, and that once such verifications have been conducted, coercive action, including dismissal, might be taken.

> We therefore conclude that productivity increases among information processing users through cost reductions or time savings should in many cases be reflected, at least in the short term, by reduced labour costs.

Appendix I- List of participating organizations

Managers in the following 57* organizations participated in our project; we wish to thank them and ask them to excuse any errors in the names below.

Air Canada
ALCAN
Benson & Hedges
Bibliothèque national du Québec
British American Bank Note
Caisse de dépôts et de placements
Canada Post
Canadelle Inc
Canadian Liquid Air
Canadian National
CF Cable TV
City and District Savings Bank
City of Laval
City of Longueuil
City of Montreal
Clarke Transport
CN-CP Telecommunications
Confédération des Caisses populaires
Consolidated Bathurst
Les Coopérants
Coopers & Lybrand
Crane Canada
Domtar Forest Products
Drummond Formules d'affaires
École polytechnique
Épiciers Unis Métro-Richelieu
Fiducie du Québec
Gaz métropolitain
Gillette Canada
Hewitt Equipment
Hydro Quebec
Institut de cardiologie de Montréal
JE Seagrams
Johnson and Johnson
Kruger Inc
La Laurentienne Générale
Loto Quebec
McGill University
Merk-Frost
Montreal Trust
MUCTC
National Bank of Canada
Pratt & Whitney Canada
La Presse
QIT Fer & Titane
Radio Canada
Rolland Inc
Rolls-Royce Canada
Scott Paper
Steinberg Inc
Sûreté du Québec
Teleglobe Canada
Télémédia Communications
Transport Brazeau
Via Rail
Vic Métal
Zeller's

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* We actually received questionnaires from 57 organizations, but the results presented in this report cover only 56 organizations because the 57th was received too late for processing.

Appendix II- Questionnaires

Four questionnaries were prepared: one with closed questions for information processing managers in the organizations we visited, one with open questions for information processing managers, one list of open questions for manager/users in these organizations, and one questionnaire containing closed questions and open questions for information processing managers in organizations we could not visit. Questionnaires and covering letters were prepared in French and English. A sample of each is included in this appendix. They are as follows:

II-1 Closed questionnaire for information processing managers (1) in organizations visited (French version)

II-2 Open questions for information processing managers (2) in organizations visited (French version)

II-3 Open questions for manager/users (3) in organizations visited (French version)

II-4 Closed questionnaire for information processing managers (4) in organizations not visited (French version)

II-1 Closed questionnaire for information processing managers (1) in organizations visited (English version)

II-2 Open questions for information processing managers (2) in organizations visited (English version)

II-3 Open questions for manager/users (3) in organizations visited (English version)

II-4 Closed questionnaire for information processing managers (4) in organizations not visited (English version)

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