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Productivity Measurement Methods and Tools

by

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Communications Canada
Canadian Workplace Automation
Research Centre
Organizational Research Directorate

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FOREWORD

This document presents the results of a research project on productivity and performance measurement methods and tools that would be applicable to the office environment.

The results of this work are based on previous studies conducted by the Organizational Research Directorate in the area of productivity, which included an annotated bibliography on Office Automation and Productivity, a critical analysis of the various schools of thought, a review of a number of documents dealing specifically with evaluation methods as well as those from the "underground" literature in this field, and discussion with international specialists in evaluating the human impacts of office automation and new technologies in general.

This research project was carried out by Robert Blake, a student at the Université de Sherbrooke, from September 1986 to April 1987, as part of an eight-month training period with the Organizational Research Directorate of the Canadian Workplace Automation Research Centre. As his supervisor I endorse this report entirely, and take this opportunity to congratulate the author on his excellent work.

George Wybouw
Guest Researcher, CWARC, and
Professor, Université de Moncton

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Introduction

Before venturing into the field of productivity and how to measure it, it might be good to take a brief look at a few essential definitions. Measurement may be defined as the act or process of finding the extent, size, quantity, capacity, etc. of something, especially by comparison with a standard. Productivity is normally defined as the ratio of outputs to inputs. Thus productivity measurement would be an evaluation of the output/input ratio. This definition might appear simplistic, but it is nevertheless the only acceptable one from a theoretical viewpoint. There is considerable confusion in the literature at the present time about productivity and how it is defined. This is due to the fact that many workers confuse productivity and performance. Productivity is an integral part of performance, which also includes efficiency and effectiveness:

Efficiency	➠	Doing things properly
Effectiveness	➠	Doing the right things
Productivity	➠	Outputs/inputs

Performance would thus consist of doing the right things properly, based on the desired output/input ratio. This definition is a good one, but applies only at the individual level, since we would speak rather of achievement of objectives when dealing with organizational performance. For the purposes of this text, we will consider that the methods and tools presented are intended to measure productivity as defined above.

There are three main families or types of approach to measuring productivity. The first is that of activities, that is, an attempt is made to measure productivity by measuring the activities of the unit under study. The second is termed economic or administrative because it attempts to quantify the benefits of office automation (on

productivity or other areas) using management techniques such as "rate of return on investment," "present value," cost/benefit analysis, etc. The third is known as the participative and/or normative approach, since it promotes participation by the people concerned in developing standards or indicators to measure productivity.

Before thinking about measuring, individuals or organizations should answer the following questions:

1) Why measure?
2) What to measure?
3) Where to measure?
4) How to measure?
5) Who should measure?

There are two main reasons for measuring. First, for purposes of control: "some ways of measuring productivity, no matter how imperfect, should be developed, since activities that are not measured cannot be controlled" (Wybouw, Kanaan and Blake, 1987). The second most important reason is that measurement is a prerequisite for improving productivity. How can we tell if we have improved productivity if we have not measured it? Other reasons may also be invoked, such as planning, expansion, human resources, etc. As a general rule, it is recommended to measure results rather than activities (Ruch, 1980), but this may sometimes prove too difficult. Where to measure is another important consideration. We may wish to measure productivity in the individual, the department (working group) or the entire organization. We must also answer questions 4 and 5 in order to determine who (inside or outside the organization) should measure and how, that is, using which tool or method. The answers to

these questions depend upon the requirements of each organization or unit wishing to measure its productivity.

Everyone recognizes that it is more difficult to measure white-collar productivity than that of workers in the manufacturing sector. What exactly is the problem? Why is it so difficult to measure the productivity of white-collar workers when this problem was solved long ago in the manufacturing sector? First, there is the difficulty of defining the output or contribution of a white-collar worker. Just try to imagine the output of a manager. Add to this the diversity of outputs and inputs and the problem of placing them in a time framework. We cannot speak of homogeneity when inputs or outputs are information, since that obtained during period **t** may only be used in the period $\mathbf{t+1}$. There is also the fact that, when we speak of white-collar productivity, we cannot separate quantity from quality, and the latter is difficult to quantify. In the case of the manufacturing sector, it is considered that quality is implicit in the product, which is not the case for white-collar workers. Lastly, the degree of difficulty and accuracy in measurement depends on the complexity and size of the unit studied (Kettinger, 1983). For example, it is much harder to measure the productivity of a government department than that of a company department or individual.

Another problem arises when we wish to measure productivity; that the fact that productivity frightens people, and it is generally poorly understood. There is fear that measurement will show that we work poorly or not at all. Even the most competent and hard-working employee may be frightened of measurement. We also fear that measurement and the ensuing results may be misinterpreted and that people are not aware of the limitations of measurement. Employees have no guarantee that some temporary, uncontrollable variation will not have deplorable consequences (firing, demotion, etc.). The data collected is often used as an excuse

for eliminating or reducing personnel. Employers and managers mainly fear that productivity measurement will bring with it extra work and a load of paperwork and thus will not justify the costs it generates. All these fears are justified if we have poor measurement tools, poor managers and poor employees. If a good manager chooses a good tool or method to measure good employees, all these fears are groundless. While it is an unfortunate fact that good measurement tools are rare, this may also be true of managers and employees. As a general rule, a good manager will be able to make an intelligent choice of both tools and the means of implementing them, while minimizing employee fears, provided of course that these employees are working to the best of their ability.

Many people wonder what the ideal measurement tool would be. A rapid review of the literature on this subject yields five important criteria. A measurement tool should:

1) Accurately reflect changes in productivity;

2) Allow all components of both input and output to be taken into account (total productivity);

3) Justify the costs it generates and thus, insofar as possible, not disturb the normal activities of the unit under study;

4) Favor objectivity over subjectivity;

5) Allow comparisons between units of the same type as well as comparisons over time.

It is obvious that no existing tool satisfies all these criteria in the area of white-collar work. But the closer a tool comes to satisfying these criteria, the lower the resistance and the better the results.

The pages that follow provide a classification of tools and methods for measuring productivity. Each type of measurement is represented, starting with those based on activities, followed by those termed economic or administrative, and ending with the type known as participative and/or normative. Each of these approaches will be illustrated using two or three methods (tools), along with an explanation of objectives, a brief summary of the methodology and the advantages and disadvantages of each.

1. Activities-based approach

This approach is an important one in the field of productivity due to the applicability of its methods. It is much easier to measure activities than outputs and inputs. We may, however, no longer speak of productivity measures, but rather of productivity-related measures. What for some may seem to be merely juggling with words is nevertheless an important consideration. When we measure the activities performed by a person, we are by no means measuring the ratio of outputs to inputs. For example, a person may spend 25% of his time preparing documents (activity), but that does not tell us how many documents that person has produced, nor whether anyone reads them!

1.1 Booz Allen & Hamilton

The method that follows was used in a now-classic study on productivity by the firm of Booz Allen & Hamilton, Inc. It might, however, be helpful to take an overall look at this study, which was carried out in 1980.

Booz Allen & Hamilton spent some $1.5 million in time and expenses in a little over 11 months making a detailed examination of 15 case studies (14 large manufacturers, banks, insurance companies and one U.S. government agency). The purpose was to determine how managers and professionals spent their time, as well as whether office automation could improve productivity and the quality of work. The study involved some 300 managers and professionals (Booz Allen & Hamilton, 1980).

The ten main conclusions of the study were:

1) Managers and other professionals spend approximately 25% of their time on activities termed non-productive (See Figure 1).

2) Effective use of office automation will save an average of 15% of the time spent on non-productive tasks.

3) Document research, word processing and electronic mail systems are especially powerful tools; these will account for nearly 65% of the time saved by 1985.

4) New office automation tools may also improve work quality when they form part of a program to improve support resources and some professional practices (work methods).

5) The value of the time it will be possible to save by 1985 will equal 15% or more of the before-tax operating income of major manufacturers, banks and insurance companies.

6) This value may be reinvested to increase production capacity, output quality or quality of working life, or it may simply bring a decrease (or stop the increase) in personnel.

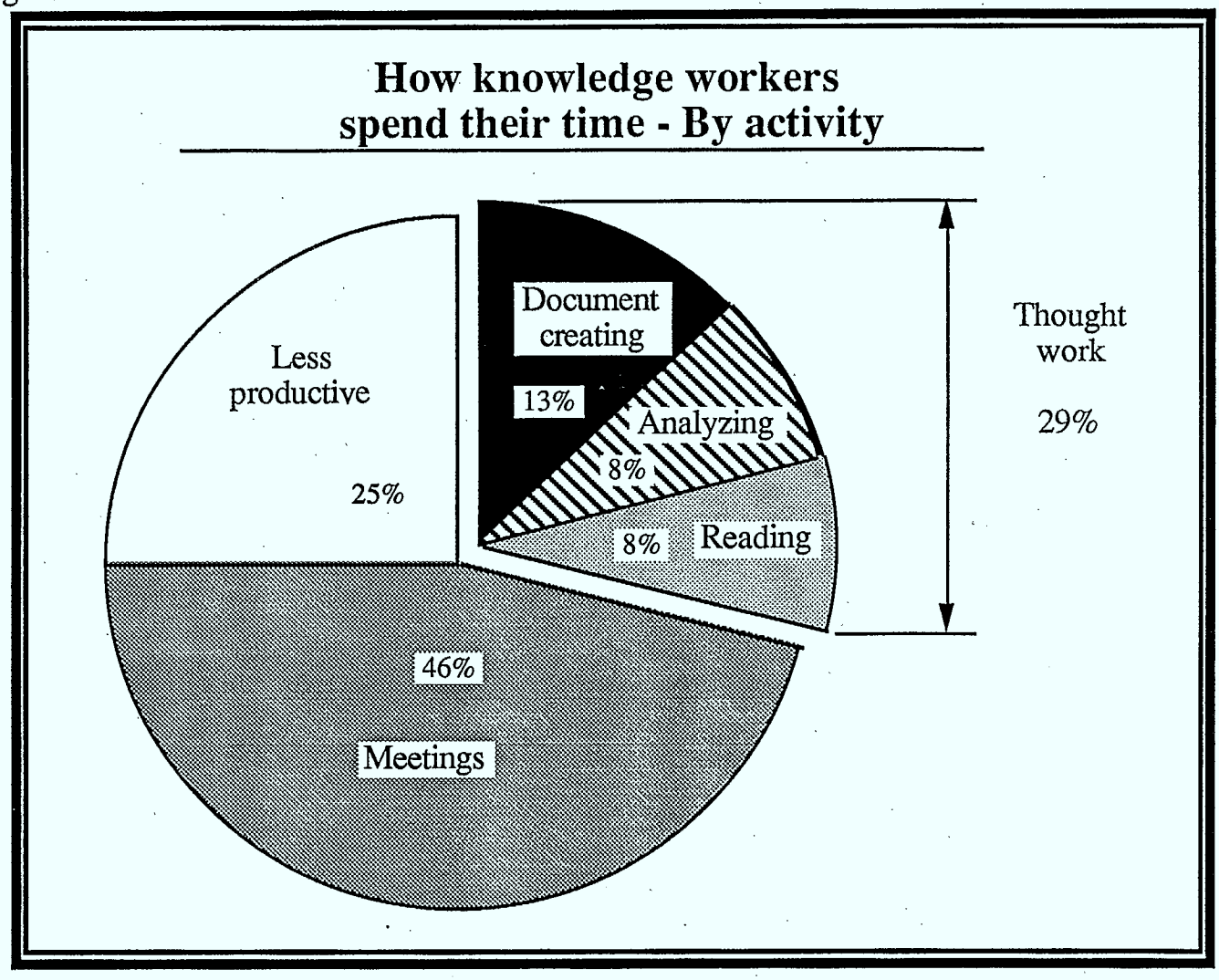
7) It is the strategy adopted by the company that will determine what avenue it adopts under Point 6.

8) Receptiveness by knowledge workers and their managers to office automation should be high if they perceive work -improvement goals and objectives as reasonable.

9) The big winners will be those who can provide the human and financial resources and manage change.

10) It is possible for well-trained workers to save up to 9% of their time during the first 18 to 24 months.

Figure 1



The following is a description of the Booz Allen & Hamilton methodology for measuring the activities of managers and other professionals. It is applied at the departmental (working group) level. Each case study required approximately three months work.

1) A study team is first formed by the firm Booz Allen & Hamilton. This team is made up of twelve people (professionals) who are employed by Booz Allen & Hamilton and are thus not involved in the organization under study.

2) A preliminary interview with the head of the group to be studied takes place 2 or 3 weeks before the study team begins work; this provides a good understanding of all aspects (objectives, success factors, etc.) of the department or group to be studied. This also enables representative persons to be identified by name and allows the team enough time to advise the individuals chosen, as well as their colleagues, of the purpose of the study, its objectives and the proposed schedule.

3) The first week begins with a half-day orientation session with participants that includes the following:

- A review of the objectives of the study;
- Development of hypotheses on the impact of office automation;
- Explanation of study plan;
- Instructions on the self-logging procedure.

4) Self-logging begins the following day. This day serves as a test, and the team is present to provide any needed assistance. The true self-logging period normally begins a day or so later. Self-logging is done as follows:

- Participants receive a leather folder containing a buzzer the size of a credit card, which they keep on them at all times. (Receiving the buzzer promotes greater participant co-operation.)
- Each participant receives a small notebook for each day, with a page for each time sample.
- Participants are asked to set their buzzers at the beginning of each working day to go off at 20-minute intervals.
- When the buzzer sounds, they take out their folders, stop the buzzer and note the activity the buzzer interrupted, indicating on a 9-point scale whether this activity made good use of their time.

- The completed notebooks are sent to the research team as quickly as possible.
- A "hot line" enables participants to contact the study team at any time.
- The first self-logging period lasts 10 days, and is divided into two periods of five consecutive working days, with the first five days serving as a breaking-in period.

5) During the last five days of the first period, a second group session lasting two to three hours is held to give each participant a statement of the activity profile for the first week (breaking-in period) and to present hypotheses on office automation.

6) Participants are then asked to log themselves for a second 10-day period. They are also requested to note, should they so desire, any technique(s) that might help improve the interrupted activity.

7) Once the first orientation session is completed, the team interviews participants one by one, using an interview guide that was given to the interviewees beforehand to enable them to be properly prepare.

8) The study team also observes all support systems, both manual and automated, and conducts interviews with some support employees and analysts.

9) All data are entered into the computer.

10) The first results collected form the basis for a half-day session with the project manager. The study group perfects its analysis and develops cost/benefit forecasts for the entire group. Each report runs from 70 to 100 pages, with 40 to 50 tables or figures.

11) In the final stage, participants are requested to reply anonymously to a questionnaire giving their evaluation of the methodology and their reactions to the potential improvement in productivity through office automation. The results of the questionnaire show that, in the opinion of respondents (60% of participants replied), the information obtained through self-logging is quite accurate, and the process did not disrupt their work to any great extent.

Advantage(s):

- Seems fairly easy to apply.
- Requires relatively little employee time and causes very little disruption in the routine of the organization or department studied.
- Makes it possible to compare groups of the same type.
- Leads to discovery of new productivity (performance) improvement opportunities.
- The reputation of the study firm enhances the credibility of the method.

Disadvantage(s):

- Measures effectiveness rather than productivity.
- Depends on participant co-operation.

1.2 Cost Justifying O.A.

The method that follows falls midway between the activities-based approach and that termed economic or administrative. Peter G. Sassone and Perry A. Schwartz have developed a method applicable at the departmental level that makes it possible to quantify the benefits of office automation. This is actually a combination of two methods, the Work Profile Analysis and the Hedonic Wage Model. In broad terms, the method is as follows:

1) The first step is to identify the main employee classifications as well as the main activities performed. This information is generally obtained through meetings with key managers and some experienced professionals (Sassone and Schwartz, 1986). It should be noted that a distinction is made between employee classification and the kind of work (activity) performed. Thus a manager (an employee classification) may, in the course of his work, perform activities normally classified as professional, technical or clerical. For example, the manager (see Table 1) might co-ordinate projects as part of his work, whereas this activity normally falls into the specialized professional category. Sassone and Schwartz discovered that as a general rule there are four to six employee classifications and some 15 to 25 activities carried out in a department.

2) The second step is to determine the activities performed by each member of the department under study. All professionals are requested to record their activities on two different, specified working days, so as to provide data that is not skewed by any peculiar circumstances.

Table 1

MANAGEMENT AND PROFESSIONAL MARKETING ACTIVITIES		
MANAGEMENT	**SPECIALIZED PROFESSIONAL**	**ROUTINE PROFESSIONAL**
Personnel action Budgeting Resource allocation Planning Monitoring	Project co-ordination Concept development Research design Formal presentations Research evaluation	Data analysis Report writing Data reduction Research

3) Next, all this information is aggregated and entered in a Work Profile Matrix, that establishes a baseline activities profile (See Table 2).

4) The entire process is repeated to produce a second matrix showing the anticipated situation after office automation. The figures entered in the matrix could be projected to provide estimates of the benefits of office automation in terms of activities. This could serve to justify or guide the choice of investment in office automation (see Table 3). As Table 2 shows, 30% of a manager's time is spent on management work, 16% on administrative and support work, 7% on clerical work and 18% on non-productive activities. If we compare Tables 2 and 3, we can see that an improvement is anticipated in the allocation of managers' time, from 30 to 35% for management work, for 16 to 20% for specialized professional work, etc.

5) The use of the Hedonic Wage Model makes it possible to place a value on these shifts in time. First, it is assumed that workers are worth what they

cost the company in wages, salaries, benefits and overhead. The basic idea of the model is quite simple and is easily explained using an example:

Suppose secretaries spend 85% of their time doing clerical work and 15% on unproductive activities. If the average secretary costs the company $20,000 for 2,000 hours of work, the implicit cost of clerical work is $11.76 per productive hour ($20,000 divided by 85% of 2,000 hours).

Table 2

BASELINE COMPOSITE WORK PROFILE MATRIX
[N = 587, FOUR DEPARTMENTS]

Employee class	Higher Value Work			Lower and No-Value Work		
	Mgt & Supv. %	Spec. Prof. %	Rout. Prof. %	Admin. & Support %	Cler'l %	Non prod. %
Managers	30	16	13	16	7	18
Senior Professionals	2	35	26	13	12	12
Junior Professionals	1	10	50	13	14	12
Administrators and Technicians	0	0	1	58	27	14
Secretaries	0	0	0	10	76	14

Table 3

ANTICIPATED POST OFFICE AUTOMATION
COMPOSITE WORK PROFILE MATRIX

Employee class	Higher Value Work			Lower and No-Value Work		
	Mgt. & Supv. %	Spec. Prof. %	Rout. Prof. %	Admin. & Support %	Cler'l %	Non-prod. %
Managers	35	20	15	15	5	10
Senior Professionals	2	42	29	11	8	8
Junior Professionals	1	15	55	11	10	8
Administrators and Technicians	0	0	1	65	25	10
Secretaries	0	0	0	12	78	10

Next, let us assume that professionals cost $40,000 for 2,000 hours of work and spend 50% of their time on professional work, 35% on clerical work and 15% on unproductive activities. Since we know the value of clerical work ($11.76 per productive hour), the value of clerical work performed by a professional will be $11.76 x 35% of 2,000 hours, or $8,232. The difference between $40,000 and $8,232 ($31,768) must be the implicit minimum value of professional work performed by a professional ($31,768 divided by 50% of 2,000 hours equals $31.77 per productive hour). While a professional costs $20 an hour to hire ($40,000 divided by 2,000 hours), the implicit value of a professional is $31.77 per productive hour. This is entirely consistent with the assumption mentioned above, that workers are worth what they cost. For example, the value of all the work done by a professional ($40,000) equals his cost (50% of 2,000 hours multiplied by $31.77 plus 35% of 2,000 hours multiplied by $11.76 plus 15% of 2,000 hours multiplied by $0 equals $40,000).

Another example will enable us to better see how the Hedonic Model operates. Assume the hourly costs of the five employee classifications, from managers to secretaries, have been estimated at $50, $45, $40, $30 and $20 respectively (see Table 4). Using this assumption and the Hedonic Model equation, we may calculate the implicit value of each activity performed in the company (bottom of Table 4). Technically, the model involves defining and solving a set of simultaneous equations. In this case, the implicit value of managerial and supervisory work is $83.99 per hour, that of specialized professional work is $65.11, and so on.

Table 4

Value / Labor = Cost / Labor

	CAT.1: Mgt. & Supr.	CAT.2: Spec. Prof.	CAT.3: Routine Prof.	CAT.4: Admin & Support	CAT.5: Clerical	CAT.6: Non-prod.	
Mgr.	.30 x V1	+ .16 x V2	+ .13 x V3	+ .16 x V4	+ .07 x V5	+ .18 x V6	= 50.00
Sr. Pro.	.02 x V1	+ .35 x V2	+ .26 x V3	+ .13 x V4	+ .12 x V5	+ .12 x V6	= 45.00
Jr. Pro.	.01 x V1	+ .10 x V2	+ .50 x V3	+ .13 x V4	+ .14 x V5	+ .12 x V6	= 40.00
Admin. & Tech.	.00 x V1	+ .00 x V2	+ .01 x V3	+ .58 x V4	+ .27 x V5	+ .14 x V6	= 30.00
Sec'y	.00 x V1	+ .00 x V2	+ .00 x V3	+ .10 x V4	+ .76 x V5	+ .14 x V6	= 20.00
Lost	.00 x V1	+ .00 x V2	+ .00 x V3	+ .00 x V4	+ .00 x V5	+ .00 x V6	= 0.00

Solution

The hedonic wage equations are expressed in Fig. 4.

The solution values [in dollars per hour] are:

V1 [implicit value of managerial work] = $83.99
V2 [implicit value of specialized professional work] = $65.11
V3 [implicit value of routine professional work] = $48.75
V4 [implicit value of administrative work] = $41.15
V5 [implicit value of secretarial work] = $20.90
V6 [implicit value of nonproductive work] = $0.00

If we refer to the estimated shifts in time allocation (Table 3), we can calculate the value of benefits due to the introduction of office automation. These benefits are obviously in terms of time savings. Let us take the example of managerial work (Table 5) and multiply the number of productive hours gained or lost for each activity by the corresponding implicit value. For example, we know that once office automation has been introduced a manager spends 5% more time than previously doing managerial work. Five per cent of 2,000 hours equals 100 hours, and 100 hours multiplied by $83.99 equals $8,399. The same calculation is carried out for each activity and the figures obtained are added together to obtain the value of changes in managerial time allocation caused by introducing office automation, or $13,898.50.

Table 5

EXAMPLE BENEFIT CALCULATION FOR MANAGERS

WORK CATEGORY	Implicit Value [hourly]	Initial Hours *	Final Hours **	Value
Management	$83.99	600	700	$8,399.00
Spec. Professional	$65.11	320	400	$5,208.80
Rout. Professional	$48.75	260	300	$1,950.00
Administrative	$41.15	320	300	($823.00)
Clerical	$20.90	140	100	($836.00)
Non-productive	$0.00	360	200	$0.00
TOTALS		2,000	2,000	$13,898.80

* Before Office Automation ** Estimated Post-Automation

Advantage(s)

- This method is known to be applicable.
- According to Sassone and Schwartz, the results obtained from applying the model are satisfactory and valid.
- It applies to all types of organizations.

Disadvantage(s):

- Does not measure productivity.
- The two days of logging seem insufficient, particularly in the case of managers.
- depends on employee co-operation.
- The proposed definition of work is not "immutable."

2. Economic (administrative) approach

The methods included in this approach have one point in common, they are based to a great extent on the judgment of the executives or managers of the units studied. For some, this may be a weakness, while for others, it is a good way of getting around all the problems involved in measuring the productivity of white-collar workers.

2.1 Method developed by Pierre Ardouin

Pierre Ardouin's method is intended to measure the productivity and impact of computerization (office automation and/or EDP) based on cost/benefit analysis. The level of application is that of information systems, which he defines as a collection of hardware and software elements and procedures applicable to some or all components, that supply information for decision-making and in support of other activities in some or all components (Ardouin, 1986). Examples of information systems are given in the tables that follow. Pierre Ardouin distinguishes two types of benefits: tangible and intangible benefits. The former are mainly associated with time savings, while the latter refer to such things as better decision-making or increased employee motivation. Benefits can be estimated by executives. In the case of tangible benefits, they can calculate the personnel required to perform manually the work done automatically by each system. For intangibles, they can calculate what they would be prepared to pay to obtain these benefits if they were not available automatically, that is, through EDP or office automation systems.

Ardouin tested his model in a major Canadian financial institution, Industrial. Three methods of data collection were used: a questionnaire given to all managers,

meetings with chief users and discussions with EDP managers. The data in the tables on the next page were collected during the trial at Industrial. The net benefits of a system are the difference between the gross benefits and the total cost. The net benefit to cost ratio gives the rate of return on investment. In certain cases, it was possible to collect data on a monthly basis, but all of these were converted to an annual basis. The method involved three stages:

1) Identification of information systems
2) Data collection
3) Analysis of results

Advantage(s):

- This method is easy to apply and can produce results that may be used in future decision-making.

Disadvantage(s):

- Only approximately reflects changes in productivity.
- Does not encourage objectivity.
- Makes comparison difficult.
- As Pierre Ardouin puts it, *"the model, as applied, does not seem to yield good enough results to draw any strict conclusions."*
- Failure to define the terms "office automation" and "EDP" may lead to some misinterpretation.

Table 6

SYSTEM COSTS AND BENEFITS
[in $ thousands]

SYSTEM	COSTS			BENEFITS			NET VALUE
	Users	EDP	Total	Tangible	Intangible	Total	
Sales staff	179	353	532	5672	885	6557	6025
Accounting	509	96	605	3946	927	4873	4268
Individual life ins.	466	2316	2782	3812	1385	5197	2415
Group life ins.	429	1052	1481	2185	1103	3288	1807
Individual annuities	197	134	331	683	288	971	640
Mortgages	158	318	476	996	65	1061	585
General insurance	35	716	751	995	278	1273	522
Investments	99	0	99	401	183	584	485
Payroll	263	82	345	504	124	628	283
Group annuities	319	28	347	368	175	543	196
Records	946	10	956	162	80	242	-714
TOTAL	3600	5105	8705	19724	5493	25217	16512

Table 7

PERFORMANCE RATIOS
[costs and benefits in $ thousands]

SYSTEM	TOTAL COSTS	TOTAL BENEFITS	NET VALUE	PERFORMANCE RATIO
Sales staff	532	6557	6025	11.33
Accounting	605	4873	4268	7.05
Investments	99	584	485	4.90
Individual annuities	331	971	640	1.93
Mortgages	476	1061	585	1.23
Group life ins.	1481	3288	1807	1.22
Individual life ins.	2782	5197	2415	0.87
Payroll	345	628	283	0.82
General insurance	751	1273	522	0.70
Group annuities	347	543	196	0.56
Records	956	242	-714	-0.75
TOTAL	8705	25217	16512	1,90

2.2 Value-Added (Dean Meyer)

Along the same lines as Pierre Ardouin, Dean Meyer begins with the idea that managers are the best people to determine the effects of office automation. Meyer does not attempt to measure productivity. He claims that white-collar workers cannot be measured in terms of productivity, but this does not mean they cannot be measured. It means that we need to find different terms and new approaches to measurement (Meyer, 1987). The term "Value-Added" is one of these new terms; it refers to office automation applications that focus on organizational effectiveness.

Meyer uses the term "Value-Added" to describe the benefits of office automation in terms of business mission and strategy. Office automation increases effectiveness by granting three types of freedom:

1) It frees time, by relieving managers of administrative tasks and by giving them access to their work at any time, in or out of the office.

2) It frees thinking, by allowing managers faster access to information.

3) It frees collaboration, by expanding communications and permitting managers to work with worldwide project teams on a daily basis.

Dean Meyer believes that value-added measurements would recognize these impacts of office automation on business effectiveness. To achieve this, he uses management techniques such as present value and return on investment.

Here is an example of how the method works:

Coin Financial is a company that designs, manufactures and sells computer systems to automate the processing of loans. The company headquarters is located in Norcross, Georgia. Because there are no regional offices, the company had serious problems communicating with its sales force nation-wide. The only means of communication was the telephone, and this was no longer adequate to handle the company's ever-growing needs.

The solution was to install a voice message system to encourage and maintain contact between the headquarters and the sales force. This system made it possible to stay in touch with the sales force and respond more quickly to customers. Sales representatives were able to provide better service and close more

Revenue increased by $7.7 million in one year, and company president Mark Singleton claims that 50% of this increase was due to office automation (see Table 8).

Table 8

Selling Computer Systems

1985 revenues	$15,100,000
1984 revenues	$7,400,000
One-year revenue growth	$7,700,000
Credit given to OA	50%
Incremental revenue per year	$3,850,000
Average profit margin	10%
Net benefit per year	$385,000
Present value, five year, 10%	$1,460,000
Development cost	$80,000
One-year return on investment	380%
Five-year return on investment	1,700%

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One-year return on investment	380%
Five-year return on investment	1,700%

Office automation thus increased the company's annual revenue by $3.85 million. Meyer sets the average profit margin at 10%, for annual net earnings of $385,000. The present value for five years at 10% is $11,460,000. The rate of return on investment is 380% for the first year and 1,700% for five years. In this example, the value-added leverage is in the better utilization of headquarters resources, providing the needed support sooner and at far less cost than a regional network of offices could.

Advantage(s):

- The management techniques used by Meyer are well-known and relatively easy to use (Meyer's merit lies in having integrated these techniques).
- Results are obtained with little difficulty.

Disadvantage(s):

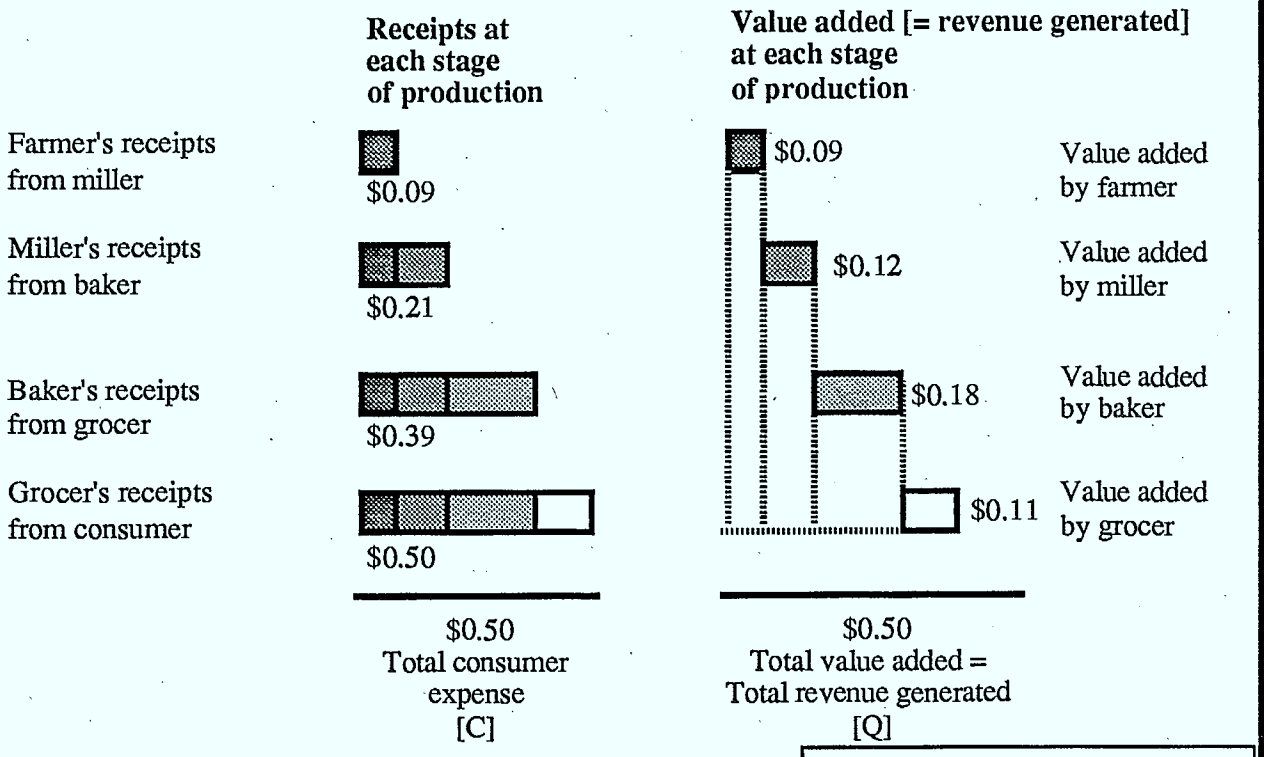
- This method is very subjective when dealing with anticipated results and is thus relatively unreliable in predicting the impact of office automation on business effectiveness.
- In cases where an attempt is made to measure after implementation, the degree of subjectivity will vary with the availability of data.
- This type of measurement would be difficult to apply in the public sector.
- No comparisons are possible with the exception of those with the same unit over time.
- The use Meyer makes of the term "value-added" is incorrect and might lead to confusion for those who are familiar with the commonly accepted definition where value-added corresponds to the difference between income from the sale of products and the costs incurred in buying producer goods. For more details, see the next page, where we explain the use and normally accepted definition of value-added.

Table 9

Value added: Revenue generated [wages, profits, etc.] by the various factors of production during the production process. Value added corresponds to the difference between the amounts received from the sale of products and the expenses incurred in purchasing producer goods. [Gagnon and Khoury, 1981]

THE END PRODUCT IS EQUAL TO THE TOTAL REVENUE GENERATED

EXAMPLE: CONTRIBUTION OF A LOAF OF BREAD TO CONSUMER COST AND REVENUE GENERATED



Gordon, Carrier and Pottier 1984

The main weakness of this method is related to subjectivity. In his book, Meyer gives this answer to those who question the use of managers' judgement: "There are those who will question the use of judgement in analyzing benefits, preferring to stick to results that can be measured with a high degree of accuracy. This attitude may result from a lack of trust in the degree to which executives

understand their businesses or are able to make judgements, or from an unfamiliarity with techniques for making decisions in conditions of uncertainty.

When readers don't believe an executive's judgments, we suggest that the problem lies outside the domain of OA. Our methodology captured the best estimates of those in the best position to know."

2.3 Multi-Factor Productivity Measurement Model

The next method differs from the two presented earlier in that the level of application is the firm and the method is mainly applied in the manufacturing sector. This is an almost perfect tool when applied to that sector, but it is unlikely that MFPMM can be applied to white-collar workers in the form described below. There is some hope, however, that it might eventually serve as a basis for developing a method applicable to white-collar workers, and this is why we present it here.

MFPMM is based on the premise that profitability is a function of productivity and price recovery (Sink, Tuttle and Devries, 1984). Productivity relates to quantities of output and quantities of input while recovery price relates to prices of output and costs of input. The data required for this method are periodic (monthly, annual, etc.). MFPMM compares data for one period (the base period) with the data from a second period (the current period). This comparison forms the basis of the productivity/price recovery/profitability analysis. The choice of the base period is a critical decision since it should be representative of the normal business activities of the company. This method generates a series of indexes and ratios calculated from the data collected. The basic structure is shown on the next page (see Table 10). Table 11 shows an example of the method, which enables the

reader to see more clearly how it operates. The case presented is that of a fiberglass boat manufacturer. Only a portion of the output is shown here, but it is sufficient to show how the method works. Each column in Table 11 corresponds to those of Table 10, so by running through the example, we can also explain the basic structure of the method.

- Columns 1-6 show the price, quantity and value of every output and input for the base period and current period.
- The weighted change ratios in columns 7-9 give the percentage increase/ decrease in the quantity, price and value of each output/input for the current and base periods. The figures in Table 11 indicate that total output increased 27.27% while prices increased 15% and total value rose by 46.36%. Less labour was used (-5%), although the cost was 13.11% more, etc.
- Cost/revenue ratios (columns 10 and 11) show the percentage of revenue used by an input for periods 1 and 2. Total material costs were 20.41% of total revenues for period 1 ($112,250/$550,000), and this rose to 32.05% ($258,000/$805,000) in period 2.
- Output/input ratios (columns 12 and 13) show productivity figures for periods 1 and 2. For example, labor productivity was 28.18 in period 1, rising to 37.75 in period 2 (this calculation cannot be made from the table as some of the output figures are not shown).

Table 10

BASIC STRUCTURE OF THE MULTI-FACTOR PRODUCTIVITY MEASUREMENT MODEL

	Data Input Cols. 1-6						Cols. 7-9			Cols. 10-11		Cols. 12-13		Cols. 14-16			Cols. 17-19		
	Qty & Price						Weighted Change Ratios			Cost / Revenue Ratios		Productivity Ratios		Weighted Performance Indexes			Dollar Effects on Profits		
	Period 1			Period 2															
	Q_1	P_1	V_1	Q_2	P_2	V_2	Q	P	V	Per. 1	Per. 2	Per. 1	Per. 2						
OUTPUTS Goods Services Information																			
INPUTS Data Capital Labor Energy Materials										Individual Cost Revenue Ratios for Each Period				Productivity Indexes	Price Recovery Indexes	Profitability Indexes	Change in Profits Due to Productivity	Change in Price Recovery	Total Change in Profits

Key
Q = Quantity
P = Price
V = Value

Table 10

Table 11

Outputs/ Inputs	Period 1			Period 2			Weighted Change Ratios		
	Quantity (1)	Price $ (2)	Value $ (3)	Quantity (4)	Price $ (5)	Value $ (6)	Quantity (7)	Price $ (8)	Value $ (9)
Boat A	50	5000.00	250000.00	70	5500.00	385000.00	1.4000	1.1000	1.5400
Boat B	30	10000.00	300000.00	35	12000.00	420000.00	1.1667	1.2000	1.4000
Total: Outputs			550000.00			805000.00	1.2727	1.1500	1.4636
Labor-Management	320	20.00	6400.00	304	22.00	6688.00	.9500	1.1000	1.0450
Labor-Glass	800	8.00	6400.00	760	9.00	6840.00	.9500	1.1250	1.0687
Labor-Assembly	1120	6.00	6720.00	1064	7.00	7448.00	.9500	1.1667	1.1083
Total Labor			19520.00			20976.00	.9500	1.1311	1.0746
Fiberglass	2200	50.00	110000.00	3000	85.00	255000.00	1.3636	1.7000	2.3182
Wood	750	3.00	2250.00	1000	3.00	3000.00	1.3333	1.0000	1.3333
Total Materials			112250.00			258000.00	1.3630	1.6863	2.2984
Electricity	8000	.10	800.00	8200	.10	820.00	1.0250	1.0000	1.0250
Natural Gas	90	4.00	360.00	90	4.00	360.00	1.0000	1.0000	1.0000
Total Energy			1160.00			1180.00	1.0172	1.0000	1.0172
Multi Inputs			132930.00			280156.00	1.2994	1.6220	2.1075

Outputs / Inputs	Cost/Revenue Ratios		Productivity Ratios		Weighted Performance Indexes Change in:			Dollar Effects on Profits Change in:		
	Period 1 (10)	Period 2 (11)	Period 1 (12)	Period 2 (13)	Productivity (14)	Price Recvy. (15)	Profitability (16)	Productivity (17)	Price Recvy. (18)	Profitability (19)
Boat A										
Boat B										
Total: Outputs										
Labor-Management	.0016	.0083	85.94	115.13	1.34	1.05	1.40	2065.45	613.82	2679.27
Labor-Glass	.0116	.0085	85.94	115.13	1.34	1.02	1.37	2065.45	461.82	2527.27
Labor-Assembly	.0122	.0093	81.85	109.65	1.34	.99	1.32	2168.73	218.91	2387.64
Total Labor	.0355	.0261	28.18	37.75	1.34	1.02	1.36	6299.64	1294.55	7594.18
Fiberglass	.2000	.3168	5.00	4.67	.93	.68	.63	-10000.00	-84000.00	-94000.00
Wood	.0041	.0037	244.44	233.33	.95	1.15	1.10	-136.36	-429.55	-293.18
Total Materials	.2041	.3205	4.90	4.58	.93	.68	.64	-10136.38	-83570.44	-93706.81
Electricity	.0015	.0010	687.50	853.66	1.24	1.15	1.43	198.18	152.73	350.81
Natural Gas	.0007	.0004	1527.78	1944.44	1.27	1.15	1.46	98.18	68.73	166.91
Total Energy	.0021	.0015	474.14	593.22	1.25	1.15	1.44	296.36	221.45	517.82
Multi Inputs	.2417	.3480	4.14	4.05	.98	.71	.69	-3540.38	-82054.44	-85594.81

Note: The circled numbers are those utilized in the text for illustration

- Columns 14-16 present productivity, price recovery and profitability indexes. These show the rate of change in productivity, price recovery and profitability from period 1 to period 2. It may be seen that labor productivity is up 34%, while material productivity is down 7% and total productivity has declined by 2%. It will be noted that material price recovery dropped 32%, which means that the cost of materials rose faster than output prices. Column 16 depicts these two changes simultaneously. Profits increased 36% from period 1 to period 2 due to productivity and price recovery gains in the labor area, and overall profits decreased by 31% due to a slight decline in overall productivity and a significant decline in overall price recovery.

- Columns 17-19 depict the dollar effect on profit changes from the base period to the current period of productivity and price recovery. It will be observed that this company's profits declined by $85,594.81 from period 1 to period 2.

Advantage(s)

- Sink, Tuttle and Devries note that 50 to 100 companies in the United States use this method;

- Accurately reflects changes in productivity;

- Takes all input and output components (total productivity) into consideration;

- Promotes objectivity;

- Permits comparisons between similar companies and over time;

- Most of the required data are already being collected for financial or accounting purposes.

Disadvantage(s)

- This method has mainly been used in the manufacturing sector, and we do not know how it will work when applied to white-collar workers.

- It is acceptable not to take quality into account when measuring productivity in the manufacturing sector where quality is implicit in the product, but this may cause significant distortion in the case of white-collar workers.

3. Participative and/or normative approach

This approach seems to be the most popular of all among organizations wishing to measure white-collar productivity. It is termed participative because each method of this type basically encourages participation by those concerned with developing indicators or standards for measuring productivity. The Nominal Group Technique (NGT), which we will examine later, is now a classic and has enabled many organizations to develop useful measurement tools that meet their needs.

3.1 Common Staffing System

Before looking at NGT, let us first examine the Common Staffing System (sometimes known as the Common Staffing Study), which was developed in the mid-1960s by IBM. This method emphasizes assessing the productivity of indirect labor groups, that is, those whose work brings about no change in the product. CSS compares the productivity of similar units over a given length of time. The philosophy behind this method is to foster co-operation between operating units (Gregerman, 1981). In the case of IBM, these units are plants operating in various countries. The primary purposes of the method are as follows:

1) To identify areas for potential productivity improvement.

2) To enable each location to measure and track indirect labor productivity.

3) To provide productivity measures that allow management to compare plants in different locations.

4) To measure changes in productivity at the plant level.

5) To provide a foundation for estimating labor requirements for new plant locations.

Implementing this method requires five major steps. It should be noted that all the units involved in or affected by the method participate in each step. These are:

1) The first step is to define the activities performed by indirect labor groups. These must be consistent over time, no matter where the plant is located. For example, secretarial services in a plant in Mexico must be similar to those of a Canadian plant. Note that the term "activity" as used by IBM refers mainly to the employee classes described by Sassone and Schwartz rather than to the activities themselves. This explains why CSS cannot be included with the activities-related approaches. The Table 12 gives examples of activities as defined by IBM.

Table 12

ACTIVITIES	INDICATORS
• Production buying	• Purchase dollars
• Vendor billing	• Number of invoices
• Production scheduling	• Shipping dollars
• Facility maintenance	• Plant floor space
• Secretarial services	• Plant population

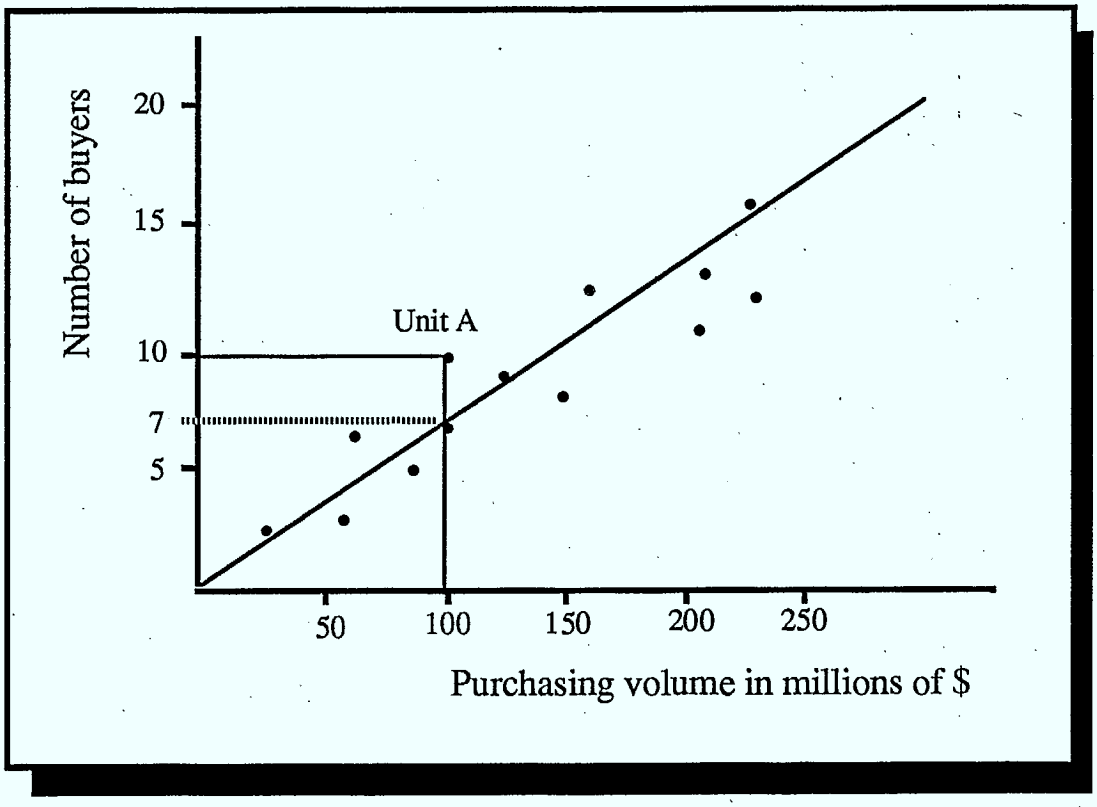
2) The second step is to establish indicators for each activity (see Table 12). These indicators are always related to labor input, that is, the number of

people employed to perform that activity. For example, we would speak of purchasing volume in millions of dollars compared with the number of buyers or plant population compared with the number of secretaries, etc.

3) The third step is to collect survey data, and this should be done annually.

4) The fourth step is to analyze the data. It is during this stage that the Norm Index and Productivity Index are calculated. These indexes are used to identify opportunities for productivity improvement. Let us take "production buying" as an example. The graph below represents this activity in terms of the number of buyers for the purchasing volume in millions of dollars, for 12 units or plants.

Figure 2



This figure shows that the smallest plant uses 2.5 buyers for purchases of approximately $25 million and the largest employs 15.5 buyers for purchases of $225 million. The trend line is calculated on the average of all 12 plants. This average is 7 buyers for purchases of $100 million. The Norm Index is calculated by dividing the actual activity value by the average of this activity for all plants. The Norm Index for Plant A is:

$$\text{Norm index} = \frac{\text{Actual activity value}}{\text{Trend activity value}} = \frac{10}{7} = 1.43$$

The Productivity Index is calculated by measuring the change between successive periods. For example, Plant A employed 10 buyers for a purchasing level of $80 million in period 1. In the second period, it employed the same 10 buyers but for a purchasing level of $100 million. The Productivity Index would be calculated as follows:

Productivity ratio (Period 1) = 10/80 = 0.125
Productivity ratio (Period 2) = 10/100 = 0.100

$$\text{Productivity Index} = \frac{\text{Productivity ratio (Period 2)}}{\text{Productivity ratio (Period 1)}} = 0.80$$

5) The fifth and last step is interpreting the results. If the Norm Index is greater than 1, this means that the plant employed more people for the activity than average, if not, it employed less. A Productivity Index of less than 1 indicates an improvement in productivity, while an index greater than 1 indicates a deterioration or decrease.

The Common Staffing System is now used throughout IBM's plants, in Europe, North America and elsewhere; however, the program originates in

the company's European operations. In all, 135 activities have been defined and can be measured, and these activities involve 26,000 employees. For the activity "order entry" alone, IBM has achieved savings of some 200 person-years (Charon, 1984). Considering an average salary of $25,000, this means annual savings of $5,000,000!

Advantage(s)

- Known to be applicable.
- Permits comparison between indirect labor groups of the same type over time.
- Seems to justify the costs involved.
- Fosters objectivity.

Disadvantage(s):

- Applies only in organizations with a minimum of two comparable units or labor groups (that is, of the same type).
- CSS is more applicable to very large organizations with several comparable units and produces better results in assessing support workers than managers or professionals (Sassone and Schwartz, 1984).
- Does not take into account labor input, which may cause skewing when assessing productivity and productivity changes.

3.2 Nominal Group Technique

It would be inconceivable to discuss the participative and/or normative approach without mentioning the Nominal Group Technique. This is, without a doubt, the dominant method in this approach. Developed by Delbecq and Van de Ven in 1968, NGT was first used for problem solving, establishing priorities, determining resource allocation and as a planning tool. It is now used for identifying productivity improvement opportunities and establishing productivity measurement tools (Gregerman, 1981). NGT is in fact a method that enables the unit under study to develop its own measurement tool and identify its own improvement opportunities. The method is applicable at the departmental level and involves five main steps:

1) An experienced outside consultant or facilitator chosen in advance holds a session for 8 to 12 employees (Conn, 1984). The consultant explains the objectives and how the method works, and asks participants to draw up their own individual list of means, ideas or solutions that would make them more productive and more satisfied with their jobs. He also asks them to indicate how each should be measured. Proceeding in this way avoids the problem of one individual dominating or influencing the group. This first stage is called "silent generation."

2) In the second, "round-robin" stage, the consultant calls upon each participant individually and asks for their ideas, methods or solutions listed.

3) During the third, clarification stage, a second group session takes place, where all the ideas proposed are discussed. The consultant ensures that all participants understand the ideas, and the objectives of the program. At this

point, the group may modify or combine some ideas. No evaluation is permitted at this time.

4) Next comes the voting and ranking stage. Each participant selects a certain number of ideas (eight, for example) and ranks them from first (best) to last.

5) When the results are known, all participants discuss and assess the solutions chosen. Another vote may be held if it is felt that this is necessary. This last stage is called the "discussion" stage.

The Nominal Group Technique is not particularly complicated; however, the choice of a consultant or facilitator is an important one, since it is this person who is responsible for leading the groups and ensuring the method works smoothly. NGT may be adapted in any number of ways, and this no doubt explains why organizations find it so attractive.

Advantage(s):

- It has great potential for developing measurement tools and discovering improvement opportunities (Devilliers, 1980).
- It is applicable to all types of organizations.
- Participants do not have to be very knowledgeable about technology.
- It contributes to fostering a sentiment of involvement and commitment among employees.

Disadvantage(s):

- It does not allow comparisons over time.
- It is highly dependent on employee co-operation.

3.3 Multi-Criteria Performance / Productivity Measurement Technique

The objective of MCP/PMT, developed by the Oregon and Oklahoma productivity centres, is to establish a set of natural scales used to measure performance against given criteria and to match levels of performance on that scale to levels of performance on the common utility scale (Sink, Tuttle and Devries, 1984). This method is based on the Nominal Group Technique and Objective Matrix methods, and works as follows:

First, the NGT process is used to obtain a ranked list of measures (e.g. from 1 to 8). The next step is to weight each measure, that is, to establish its relative importance:

- Each measure is assigned a rating: 100 points for a very important measure, 90 for a less important, etc. In other words, each measure is given a score out of 100 corresponding to its importance. Two or more measures may receive the same score. In the example in Table 13, three criteria have a rating of 100, two obtained 90, two 85, and one 80.

- The ratings are totalled (100 + 100 + 100 + 90 + 90 + 85 + 85 + 80 = 730) and then the rating assigned to each criterion is divided by the total, which yields their relative weight. For the first criterion, for example, this would be 100 / 730 = .137.

Table 13

#	CRITERION	Ranking / Priority	Rating	Weight
1.	Reports / projects completed and accepted / Constant value budget $	1	100	100 / 730 = .137
2.	Customer satisfaction	2	100	100 / 730 = .137
3.	Quality of decision support from systems developed	3	100	100 / 730 = .137
4.	Meeting user flexibility requirements	4	90	90 / 730 = .123
5.	Existence of and use of work scheduling / project management	5	90	90 / 730 = .123
6.	Projects completed on time / Total projects completed	6	85	85 / 730 = .116
7.	Number of requests for rework or redoing a project	7	85	85 / 730 = .116
8.	Existence of and quality of strategic planning for facilities, equipment, staffing, management, processes, and systems	8	80	80 / 730 = .111
			730	1.000

The next step is to integrate the performance function graphs in order to link them to the common utility scale (1 to 10) and the natural scale, which varies depending on the criteria. The common utility scale is represented on the Y axis, while the natural scale is represented on the X axis. The performance levels of the two scales are linked through the Objectives Matrix. This matrix enables the performance level of the common scale to be determined based on the natural scale

(see Table 14). In examining the matrix, we can see that column 9 represents the Y axis and that lines 3-13 represent the X axis. Any essential subcriteria, measures or ratios may be added in Row 1. Row 2 shows actual performance levels based on the natural scale, while Row 14 gives actual performance levels according to the common utility scale. This latter figure is calculated from the former using the matrix. Let us take Criterion 1 as an example. We know from the natural scale that actual performance is 2.0. From there, we move down the matrix (rows 3-13) to the figure 2.0. In this case, 2.0 corresponds, or is linked, to 6 on the common scale. As another example, actual performance according to the natural scale for Criterion 3 is 50, which corresponds to a performance level of 2 according to the common scale. In this way, we can determine all the performance scores shown in Row 14. These scores are next multiplied by their weighting (Row 15) to obtain the weighted scores of Row 16. The last step is to add together all the weighted scores. The total obtained gives us the performance level of the unit under study. It should be noted that the data in rows 3 to 13 are predetermined by an analyst, consultant or study group.

Table 14

PRODUCTIVITY/PERFORMANCE MEASUREMENT MATRIX GENERAL FORMAT [OBJECTIVES MATRIX]

Criteria

Column:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

Row:

1	Subcriteria, measures, ratios, etc.								
2	Actual performance this period	2.0	8	50	.6	.9	.9	1	1
3	Performance Matrix	3.0	10.0	100	1.0	1.0	1.0	0	10
4		2.5	9.0	98	.9	.99	.97	1	9
5		2.4	8.0	95	.9	.97	.95	2	8
6		2.2	7.9	90	.8	.9	.92	3	7
7		2.0	7.7	80	.7	.9	.91	4	6
8		1.9	7.5	75	.6	.8	.9	5	5
9		1.8	5.0	70	.6	.65	.9	6	4
10		1.6	1.5	60	.5	.6	.8	7	2
11		1.5	1.3	50	.5	.55	.7	8	1
12		1.2	1.0	25	.5	.5	.5	9	.5
13		1.0	1.0	0	.5	0	0	10	0
14	Performance Score	6	8	2	5	6	5	9	2
15	Subjective Weighting	.137	.137	.137	.123	.123	.116	.116	.111
16	Weighted Score: 5.391	.822	1.096	.274	.615	.738	.580	1.044	.222

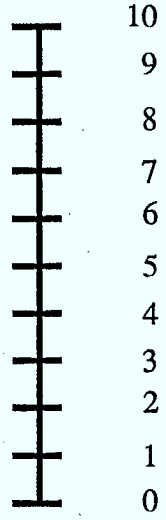
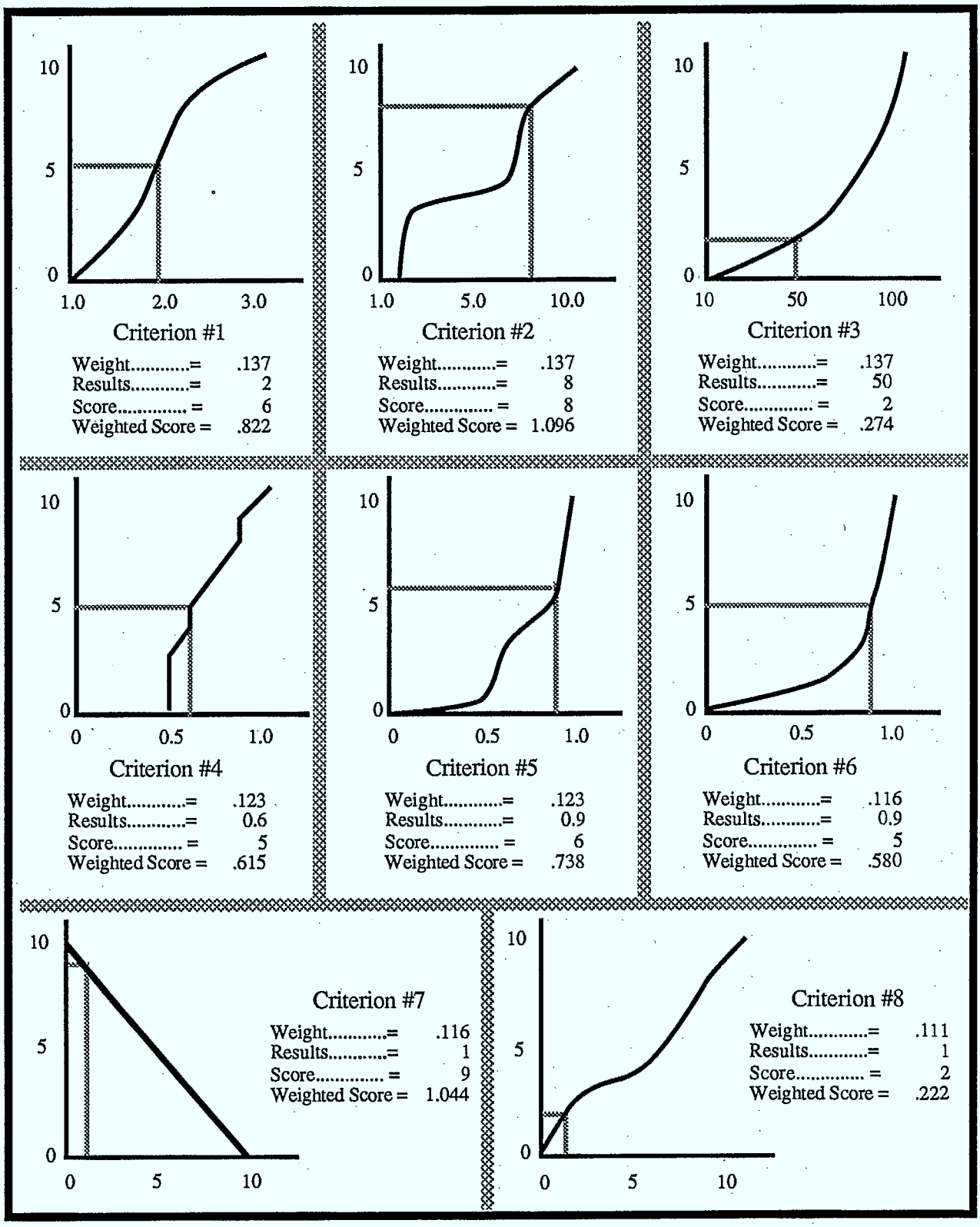


Figure 3


10
5
0
1.0
2.0
3.0
Criterion #1
Weight.....= .137
Results.....= 2
Score..... = 6
Weighted Score = .822
10
5
0
1.0
5.0
10.0
Criterion #2
Weight.....= .137
Results.....= 8
Score..... = 8
Weighted Score = 1.096
10
5
0
10
50
100
Criterion #3
Weight.....= .137
Results.....= 50
Score..... = 2
Weighted Score = .274
10
5
0
0
0.5
1.0
Criterion #4
Weight.....= .123
Results.....= 0.6
Score..... = 5
Weighted Score = .615
10
5
0
0
0.5
1.0
Criterion #5
Weight.....= .123
Results.....= 0.9
Score..... = 6
Weighted Score = .738
10
5
0
0
0.5
1.0
Criterion #6
Weight.....= .116
Results.....= 0.9
Score..... = 5
Weighted Score = .580
10
5
0
0
5
10
Criterion #7
Weight.....= .116
Results.....= 1
Score..... = 9
Weighted Score = 1.044
10
5
0
0
5
10
Criterion #8
Weight.....= .111
Results.....= 1
Score..... = 2
Weighted Score = .222

Advantage(s):

- This method has enormous potential (Sink, Tuttle and Devries 1984).
- Applies to all types of organizations.
- Allows comparison over time or between units of the same type.
- Participants do not have to be very knowledgeable about technology.
- Contributes to fostering a sentiment of involvement and commitment among employees.

Disadvantage(s):

- Nothing is known about its application.
- It is dependent on employee co-operation.

4. Classification

The table below gives a classification of the tools and methods presented in this report. Methods marked with an asterisk (*) are considered capable of measuring performance, effectiveness, efficiency or productivity at the level indicated. A dot (.) means that the method may be used for measurement, but is only considered more or less dependable. It should be noted that in the case of NGT or MCP/PMT, this capability obviously depends on the measurements or criteria chosen.

Table 15

Method[s] / Level[s]	Booz	S.S	P.A.	V-A Meyer	MFPMM	CSS	NGT	MCP/PMT	Measure
Organization									Performance
				•					Effectiveness
									Efficiency
					*				Productivity
Department [work group]							*	*	Performance
	*	*					*	*	Effectiveness
	•						*	*	Efficiency
						•	*	*	Productivity
Individual							•	•	Performance
	•	•					•	•	Effectiveness
	•						•	•	Efficiency
							•	•	Productivity

Conclusion

It is not encouraging to see so much confusion in the literature about productivity and how to define it. For some, the classical definition (outputs/inputs) does not apply to white-collar workers because it is too narrow. These people will thus seek to broaden the definition. Others avoid talking about performance so as to satisfy those who are accustomed to hearing the word productivity. We must put an end to all these differences and carry on with the term performance. Furthermore, where the definition of performance as doing the right things properly according to the desired output/input ratio is quite difficult to apply, we must then speak of performance in terms of achievement of objectives. For example, an office automation training program will perform to the extent that it meets its objectives. We might in fact consider the first definition as an objective per se, meaning that a effective unit (individual, department, organization) is one that achieves its objectives.

It is of prime importance to know what our needs are when we talk about measuring. These needs may vary depending on the culture, economic situation or specific problems of the unit studied. "Tell me what your needs are, and I will tell you why to measure, what (performance, effectiveness, efficiency, productivity), where (at the organizational, departmental or individual level), how (using what method or tool) and who should do the measuring (whether from inside or outside the organization)."

What is the current status of white-collar productivity measurement problems? These problems are certainly not insurmountable obstacles. It is just that they have only recently been encountered. Now that they are known, all that remains is to find ways to overcome them. This will no doubt be accomplished

very rapidly, since the phenomenon of white-collar workers is growing and attracting ever-increasing numbers of researchers.

There is really only one way to completely eliminate the fear of measurement, and this is to have good managers who, once they have properly defined the needs of their unit, choose the right tool or method to measure good employees. This utopian situation will, of course, not come into existence until the ideal tool has been invented. While it is impossible at the present time to eliminate this fear, we can certainly attempt to minimize it. One way to do this is to encourage employees to participate in developing measures (e.g., NGT). All classes of employees should be involved, managers and secretaries alike, and all should be aware of and understand the objectives and limitations of the measure.

Of the measurement methods and tools presented in this report, the first prize undoubtedly goes to the Nominal Group Technique, which has long proved effective. The most promising method is the MCP/PMT which, if it is applicable, is the most likely to meet the criteria of the ideal tool. Honorable mention should go to the Common Staffing System, which has proved satisfactory to IBM, and to Booz Allen & Hamilton and Sassone and Schwartz, whose methods may, with some modifications, be extremely useful to departments that want to know more about the potential impact of office automation on their effectiveness. The methods proposed by Pierre Ardouin and Dean Meyer, although weaker, are unfortunately often the only possible way to evaluate the impact of office automation. It would not be fair to evaluate MFPMM here, since this method is intended to measure productivity in the manufacturing sector.

We thus seem a long way from the ideal tool, particularly if we are looking for the ideal performance measurement tool that should satisfy the following criteria:

1) Accurately reflect changes in performance (effectiveness, efficiency and productivity);

2) Justify the costs it generates;

3) Foster objectivity;

4) Allow comparisons between units of the same types as well as comparisons over time.

We might be tempted to regard this task with some pessimism, but this would be a serious mistake. Given the growing number of researchers working on this issue, the day is not far off when it will be just as easy to measure white-collar performance as it has been to measure the productivity of workers in the manufacturing sector.

Avenues are open for research and development into methods and tools. Field tests of current methods and scientific evaluation of these experiments are the first step. The next is to develop specific measurement tools for knowledge workers and to produce systems to select the most appropriate methods for the particular evaluation objectives and the corporate culture involved.

Bibliography

ARDOUIN, Pierre. Critical Analysis of Productivity Models and Measurement in Information Processing. Laval: Canadian Workplace Automation Research Centre (CWARC), April 1986.

BOOZ ALLEN & HAMILTON. Multi-Client Study of Managerial/ Professional Productivity. New York: Booz Allen & Hamilton Inc., 1980.

CHARON, Kenneth A., "White-Collar Productivity Measurement", Strategy for Productivity. New York: Unipub 1984, pp. 69-81.

CONN, Henry P., "Improving Use of Discretionary Time Raises Productivity of Knowledge Workers in Offices", Industrial Engineering, Vol. 16, No. 7, July 1984, pp. 70-77.

DEVILLIERS, Ann M., "Understanding White-Collar Productivity: How to Solve the Problem", Journal of Micrographics, Vol. 13, No. 6, July/August, 1980, pp. 43-46.

GAGNON, Jean-Marie and Nabil Khoury. Traité de gestion financière. 2nd edition. Chicoutimi: Gaétan Morin, 1981. 592 p.

GORDON, Robert J., Charles-A. Carrier and James Pottier. Macro-économique. Chicoutimi: Gaétan Morin, 1984, 820 p.

GREGERMAN, Ira B. Knowledge Worker Productivity. New York: American Management Association, 1981.

KETTINGER, William J., "Models of Office Productivity: What Really can be Expected?," Papers from the 4th Office Automation Conference, Philadelphia, February 21-23, 1983. American Federation of Information Processing Societies. Office Automation Conference Digest. Washington: AFIPS Press. pp. 31-35.

MEYER, N. Dean and Mary E. Boone. The Information Edge. Toronto: Holt, Rinehart and Winston of Canada, 1987. 333 p.

RUCH, William A. Measuring Knowledge Worker Productivity. Houston: American Productivity Center, 1980.

SASSONE, Peter G. and Perry A. Schwartz, "Cost-justifying OA", Datamation, Vol. 32, No. 4, February 15, 1986.

SINK, D. Scott, C. Tuttle and Sandra J. Devries, "Productivity Measurement and Evaluation: What is Available?", National Productivity Review, Vol. 3, No. 3, Summer 1984, pp. 265-287.

WYBOUW. George, Richard Kanaan and Robert Blake. Office Automation and Productivity: Status Report. Laval: Canadian Workplace Automation Research Centre (CWARC), June 1987.

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