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IN OFFICE AUTOMATION   TR 193

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Abstract

Increased productivity is the most frequently cited benefit of office automation. However, little is known about the measurement, or even the meaning, of productivity for office workers. Office workers, particularly non-clerical or knowledge workers, have complex, often ill-defined, jobs that do not allow simple measures of productivity such as those used on the assembly line. Thus productivity assessments in offices have frequently used such fragments of the total job as number of messages sent by managers and number of pages typed by secretaries as indicators of productivity. Two methods, projections from task analyses and pilot projects followed by assessment, are commonly used to measure office productivity. While these methods are useful there are definite limitations to their application which, if ignored, may result in erroneous conclusions. This paper discusses these limitations and develops a framework for the analysis of productivity issues in office automation.

1. DEFINING PRODUCTIVITY

The productivity of a process is typically defined as the value of its outputs divided by the value of its inputs. Thus to measure productivity we must determine two things: the value of the outputs and the value of the inputs. The value of the inputs may be defined in several ways: [4]

(1) Labor productivity is the output per unit of labor, typically measured in man-hours.

(2) Total productivity is the output per unit of labor and capital. The value of labor and capital is usually measured by the sum of "weighted man-hours" and "weighted machine-hours". Here man-hours are weighted by relative pay of the labor involved and machine-hours by the rental value of the machinery involved.

(3) Weighted labor productivity, the output per weighted man-hour, has been popular with office automation analysts. The use of weighted man-hours suggests that office automation technologies may be evaluated by the amount of "leverage" they allow. Thus, office automation technologies that support the work of highly paid employees, such as managers, are more likely to produce gains in productivity than those supporting lower paid employees such as clerical workers. [19]

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Most studies of the effect of office automation on productivity limit their definition of inputs to the weighted man-hours of direct users. This ignores the substantial capital investments necessary and the costs of supporting personnel for the automated office. [18] Costs for automating the office include not only hardware and software but also operating personnel, software maintenance, data management and computer facilities and operations management. The costs of computing are considerably higher than usually estimated and, contrary to the claims of most office automation proponents, rising. [6] Most analyses do not consider hidden costs such as computer staff and resources located in user areas and staff time of individuals in peripheral areas who must deal with intrusions or disruptions in their work. [6]

Assessing the value of outputs is particularly problematic in the office setting. Analyses frequently focus on simple quantitative measures such as pages typed by word processing centers. [10] Such analyses ignore the problems of quality and value of outputs. Clearly computers and copiers have contributed enormously to the quantity of paper produced by offices. It is highly doubtful that the value of this flood of paper has increased commensurately. Some analysts have suggested that office automation may produce similar effects. [13]

The problem of identifying quantifiable outputs is much more difficult for workers with relatively unstructured jobs, such as managers. Thus, many analysts have turned to such indirect methods of measuring productivity as estimation of time saved through elimination of wasted time associated with conventional technologies or suggest that much change occurs through "intangible benefits". [19,1] While some progress has been made in approximating the value of intangible benefits, they are weak bases for judgement and should not make up a major portion of the analysis. [7]

2. SOURCES OF PRODUCTIVITY CHANGES

Office automation is a complex of technologies and organizational changes. It may be important to determine how each of these changes contributes to changes in productivity. A partial list of potential sources of productivity change includes:

(1) Procedural changes: Office automation implementation involves a large number of changes in the organization of work. That such streamlined office procedures may result in major gains in productivity before automation is

demonstrated by Citibank's rationalization of its letter-of-credit department which resulted in a forty percent improvement in productivity (as measured by staff reductions). [9] Automation may allow further changes such as a reduction in transfers of control of messaging activities between principal and secretary. [14] However, as demonstrated by the current debate over the effectiveness of word processing centers, not all changes in office procedures made to accommodate automation are beneficial. [13]

(2) Changes due to automation: Automated office technologies can perform or aid in the performance of many tasks now done by humans. Thus, it is possible to eliminate much of the labor involved in distributing, filing, and retrieving documents, producing revised documents and preparing statistical reports. However, automated technologies often have high set up costs relative to their conventional counterparts. It may take less time to manually type a brief document than to produce it with a word processor. (14)

(3) Changes in decision making: Office automation proponents have argued that decision making will be improved through increased availability of better and more timely information. [1] Against this, it may be argued that office automation will narrow the decisionmaker's view of the world to the information contained in the computer. (22)

(4) Quality of Working Life: Office automation involves the redesign of jobs. Some analysts suggest that this may result in richer, more satisfying jobs, where secretaries become entry-level managers or data base managers, while others fear that office automation will negatively affect worklife by deskilling and fragmenting jobs. [20, 19,21] Large productivity increases may be dependent on improvement in (or at least maintenance of) the quality of working life. [3]

(5) Side effects: Complex changes, such as those involved in office automation, may be expected to produce unanticipated side effects which may be major sources of productivity changes. For example, the benefits of word processing may be negated by an increase in the number of drafts and drops in morale among clerical staff or computer-

based messaging users might be swamped by electronic junk mail. [5] Studies that are too narrowly defined and executed may overlook such side effects.

3. LEVELS OF MEASUREMENT

The third major question in productivity assessment is the organizational level at which the assessment is made. There are three frequently used levels:

(1) Organization wide: The goal behind the use of automated office technologies to increase office productivity is to increase the productivity, and hence the profitability, of the entire organization. Although measurement of total organizational productivity is fairly straightforward,' as the needed data are usually collected for accounting purposes and it is possible to extract the costs of office activities, it may be difficult to definitely attribute productivity increases of office automation. Many office automation applications take place in large complex organizations and any changes in productivity could be due to a multitude of factors. Nonetheless, measurements of total organizational performance remain the only way of assessing the impact of improved strategic decision making.

(2) Department or group: By working with a defined department or group, it may be possible to control extraneous variables more effectively through comparison with other groups. [19] One problem is that heightened group productivity may not contribute meaningfully to increased organizational productivity. A classic case of this is a word processing center, where increases in simple typing productivity (e.g. number of pages typed per person-hour) are counteracted by an increased number of drafts and revisions requested by clientele. [5] It is essential to determine the actual costs involved in the application and to include costs for software development and support that are frequently charged to general overhead. [16]

(3) Individual: Predictive productivity assessment is frequently done at the individual level. This approach has frequently been used in assessing potential productivity gains for knowledge workers. In this case, however, it may be difficult to identify products

ducts and to quantify productivity increases. No measurement schemes have been devised to quantify the contribution of such claimed office automation benefits as better decision making to productivity. [18] Instead, analysts have attempted to determine the amount of time spent in various tasks that may be saved through office automation, assigned values to this time (by considering wages and overhead) and used these figures to demonstrate productivity. [1,19,11] (We shall consider this methodology in greater detail below). As in the case of departments, it is possible that increased individual productivity may be counteracted by other factors and not, in fact, contribute meaningfully to increased organizational productivity.

4. METHODOLOGIES

4.1 PREDICTIVE TASK ANALYSIS

Potential productivity gains, particularly for knowledge workers, are often assessed by task or functional analysis. [19,11] Using the "value added" approach, time spent in various tasks before and after office automation may be compared. [8] Communication has been a popular example. Since estimates of management time spent communicating vary from sixty percent to ninety percent, this is clearly an area where dramatic impacts are possible. [15] Bair suggests that some two hours of nonproductive time per day associated with nonclerical communication may be eliminated through computer-based messaging. [19] While such analysis may certainly suggest possible areas for substantial productivity gains, assessments based on them are questionable for several reasons:

(1) Knowledge workers' jobs are highly variable and average distributions may not apply to particular cases.

(2) Most analyses assume that office automation will completely replace conventional activities. In the case of communications, for example, it is unrealistic to assume, as some analysts have, that computer-based messaging will completely replace telephone use. To obtain a more reasonable distribution of time between conventional and office automation technologies requires establishment of discriminant functions between the choices and the assignment of a "market share" to these choices based on the discriminant functions. [12]

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