

**PROCEDURES FOR OFFICE ANALYSIS:
A CRITICAL REVIEW**

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Abstract

Because office automation has not fulfilled its promise of making work more productive and satisfying, researchers have developed techniques for specifying better requirements for office automation and support. Four such office analysis techniques have been publicly proposed, differing in how much of the complete analysis-to-prescription cycle they cover, what aspects they analyze, and how they bound the "office." Review of these analysis processes points to three key issues:

1. Office analysis is weak on prescribing specific support/automation products;
2. we do not know how to evaluate different analysis techniques; and
3. we have not yet specified the criteria by which we would decide which technique is good.

In answer to these issues, we suggest that extensions of some promising schemes for prescribing specific products be explored; that techniques be compared using an efficient "transcript experiment" approach; and that the criteria for acceptability for an analysis method be that its descriptions be reliable and valid, and that its prescriptions be valuable to the workers in the reorganized, computer-supported office.

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Office automation promises to enhance the *productivity* of office workers by supporting their labor with tools of modern information technology. Moreover, this technology promises to improve their *quality* of work life by relieving them of routine, algorithmic, boring tasks. In practice, however, office automation has often failed to achieve these goals. Paper consumed does not necessarily decrease; nor does the work force necessarily shrink or become more satisfied. This has led to a growing appreciation among practitioners and researchers in the area of office automation that the concepts of "office" and "office work" entail greater complexity than we had originally envisioned. This realization has given rise to the development of procedures for "office analysis,"¹ where an analyst describes the information handling activities performed in an "office" for the purpose of:

1. Suggesting how these activities may be improved or streamlined at their current level of technological support, and
2. Identifying those activities (or groups of activities) that may be automated or supported by the application of modern information technology.

This paper describes the current state of the art of office analysis. This section identifies those who will potentially profit from the practice of office analysis. The second section presents the general steps involved in the process and uses these steps to compare and contrast four publicly-reported procedures for office analysis. The third section identifies a set of key issues facing practitioners and researchers in this area. These include:

1. The weak prescriptive linkage between office analysis and office automation.
2. Our current inability to evaluate procedures for office analysis, which stems from our lack of both evaluative criteria and evaluative techniques.

¹For the sake of clarity, we will use the term "office analysis" to refer to the analytical process itself; we will refer to the product of this process, a report describing the office and identifying opportunities for its enhancement, as an "office description".

We conclude by suggesting and elaborating three evaluative criteria (reliability, validity, and utility) and describing how experimental techniques may be applied to evaluate these procedures in terms of these criteria.

What is the *practical value* of office analysis? There are different advantages that apply to different players involved in office automation:

1. Office analysis is important to the *developers* and *vendors* of office systems, because it can facilitate the identification of office needs, the first step in the design of marketable office automation products.
2. It can assist *purchasers* of office systems by enhancing their ability to compare their processing requirements with the capabilities of the office automation products available in the marketplace.
3. The practice of office analysis can provide a meaningful vehicle for user participation in the in-house systems development process, should the office automation needs of the organization prove sufficiently unique that the use of commercially available software is not a feasible solution. It can also provide a vehicle for user participation in the purchase/selection of packages.

Overall, office analysis has practical value because it can pinpoint aspects of an office that can be improved with reorganization or support, enhancing the productivity of our growing white-collar work force.

Furthermore, office analysis has a great deal to offer *researchers* in the areas of information systems and organizations. In the words of Simon(1984):

We need more systematic case studies, tracing organizational phenomena over time in careful detail. Longitudinal work is very important, in part because information procedures and interpretations are dynamic, changing over time.... In order to proceed with this learning, we need much more careful, well-documented descriptions of real organizations. Consider the hundreds of careful case studies of phenomena in the world of natural science...geology and botany, for example. Do we have even one hundred good descriptions of organizations?

While the truth of Simon's observations is lamentable, it is also understandable. Organizations are enormous, complex, and dynamic. Within the constraint "in careful detail," who could begin to describe the machinations of General Motors or the Department of Defense? But

office analysis, by enabling us to restrict ourselves to a subset of the organization (i.e., to a particular "office"), enables us to divide the organization into meaningful pieces, to be studied either longitudinally or across different organizations with the careful detail Simon calls for.

The State of the Art in Office Analysis

A five-stage outline of the general process involved in office analysis captures the essence of current office analysis methodologies. We use this five-stage outline as a referent framework for describing and comparing four office analysis methodologies.² Some significant similarities and differences that distinguish these methodologies are then highlighted.

Office analysts proceed in five basic steps:

1. Target the particular "office", i.e., establish the boundaries of the particular office analysis study.
2. Acquire information describing the office's activities, objectives, and resources from personnel associated with the office.
3. Assemble a preliminary description of the office.
4. Circulate the office description for comments and suggestions and revise it accordingly.
5. Analyze the revised description to determine where significant problems or opportunities exist, and to generate appropriate recommendations.

Several procedures have been developed to structure and support the task of analyzing the office. These include:

Office Activity Methodology

Conrath, *et al*, 1981; Conrath, *et al*, 1983.

Office Analysis Methodology and Office Analysis and Diagnosis Methodology

Sirbu, *et al*, 1983; Sutherland, 1983.

Critical Task Method Harris and Brightman, 1985.

Task Analysis Methodology

²These are all in the public domain. Some private analysis schemes exist inside consulting firms such as Arthur Andersen or in software development companies, such as Bell Labs and IBM. Because of their proprietary value, these are not available to researchers.

Sasso, 1984.

In the following, we use the five-stage outline as a basis for describing and comparing these procedures.

Office Activity Methodology (Waterloo-OAM). ³ The Office Activity Methodology, developed at the University of Waterloo's Centre for the Evaluation of Communication-Information Technologies, is intended to assist in "...the specification and evaluation of office automation services" (Conrath, 1983). The procedure focuses on describing the work of a set of people at a particular level, such as managers or professionals. Data are collected about *tasks*, defined as "... unit[s] of work which [are] typically performed by a single individual and which when accomplished results in an identifiable output" (Conrath, 1983).

To collect these data, analysts make extensive use of forms. First, the analyst targets the set of personnel to be studied, generally a set of managers, professionals, and their immediate support staff (e.g., secretaries) in an organization or fairly large subdivision of an organization. At the beginning of the data acquisition process, a target group is first presented with the goals of the study then asked to complete forms detailing the types of work they do and their use of office support mechanisms. They also receive instruction about how to complete a communications log form, describing the patterns of communication in the organization, which they are asked to fill out for a week. At the end of the week, each participant is interviewed by an analyst for additional information on *how* the individual's tasks are accomplished; these data are recorded on a fourth form.

Waterloo-OAM does not specify a format of the final office description *per se*. Instead, its results have been reported in narrative form as scholarly articles in journals and conference proceedings. While this format is a concise vehicle for the dissemination of findings to a general

³This designation is to distinguish the Office Activity Methodology from MIT's Office Analysis Methodology, described later.

audience, it appears less suitable as a basis for organizational action to improve a particular office automation system.

Thus, in the third stage of our five-stage outline of the office analysis process, Waterloo-OAM stops. An office description is assembled, but its intended audience is the research community, rather than the participants themselves. Furthermore, because of this orientation toward research rather than practice, Waterloo-OAM does not provide the analyst with any assistance in the fifth stage of the process. There are no general rules suggesting how to generate recommendations for automation and support. At most, it offers suggestions about linkages between managerial tasks and classes of commercially available software.

The Critical Task Method. The Critical Task Method (CTM), developed by Harris and Brightman (1985), is similar to the Waterloo-OAM in that it focuses on the people who do the work, i.e., on who does what. In the single analysis it reported, it analyzes the activities performed by a set of researchers working on a broad range of research questions in a large university. This sample was divided into two subsamples, one to be used for initial data acquisition, and the other for independent review and evaluation. Descriptive information was acquired from the initial subsample, using open-ended interviews that asked about activities involved in research work and the kinds of support modes used. From these data, an office description was written, with each task described in its specific context and coded as to whether it belonged in the "genesis," "conduct," or "communication" stages of the research process.

Members of the original subsample reviewed the description and selected from it "critical bottleneck" tasks, helping the analyst focus on places where improved support could have a significant impact. The analysts generated a list of support types that could be applied to these tasks in the research context: Text processing, modeling, image processing/graphics, communications, information management, and expert systems.

Prescriptions about support that could increase researchers' productivity were made. Thus, while it has been applied only in a single context (i.e., research activity), the Critical Task Method does include all five steps of office analysis. The list of support tools offered, though generated in the research domain, has the potential of being useful in other domains.

Office Analysis Methodology (OAM)/Office Analysis and Diagnosis Methodology (OADM). Both OAM and OADM were developed at MIT's Laboratory for Computer Science. OAM's original goals were to increase knowledge about how offices operate and to enhance our ability to *describe* those operations, previewing Simon's call for building a collection of cases from which we could describe general characteristics of organizations. OADM adds the goal of being able to aid the analyst in *prescribing* potential improvements in the functioning of the office.

The OADM process begins by targeting a particular *organizational unit* as the office under study. The data acquisition process then begins, using a combination of forms and structured interviews to collect information about the department's mission, functions, procedures, resources, and objects. Also during this process, descriptions of database schemas and files, as well as samples of standard documents and forms are collected. At the same time, the analyst records any symptoms, problems, or opportunities which arise in conversation. These provide a basis for possible recommendations later on in the study.

OAM's office description has a well-defined format. It consists of four sections: Introduction, description of procedures, an exception handling description, database descriptions and document samples.

This description is circulated to the interviewed personnel for their comments and suggestions and revised accordingly. This interview-describe-circulate process continues until all the interviewees agree that the description is accurate.

As the original version of OAM was used, the value of enhancing its prescriptive capabilities became more and more evident. Thus, OADM reports include an additional section detailing the symptoms, problems, and opportunities the analyst noted in the office. Beyond this, it suggests identifying Critical Success Factors (Rockart, 1979) so that the analyst could better determine which aspect of the office could most benefit from having support/automation. Though this is an interesting approach, focusing the analyst's attention on important aspects of the office, OADM contains nothing further to suggest what specific information technology would best support each specific activity.

Task Analysis Methodology (TAM). TAM was developed at the University of Michigan (Sasso, 1984). As its name implies, its basic focus is on the task, defined as "...the smallest amount of information processing work which has meaning to the organization." Tasks are aggregated into work flows or sequences of tasks linked in a stimulus-response fashion, with the completion of the first task initiating the execution of the second, etc. An important distinction between TAM and the methodologies discussed earlier is TAM's focus on information central to a function (such as payroll) as it is transformed and transported, rather than on the people or the organizational unit doing the work.

The TAM office analysis process consists of two major stages: the descriptive and the analytical stages. During the descriptive stage, the analyst acquires necessary information about an office's workflow by interviewing the personnel responsible for the work. Inferring from changes in the information represented in forms and objects, the analyst then codes the tasks according to the *type of information processing* that has taken place. The sequential nature of the tasks becomes apparent and is depicted in a set of flow diagrams and a narrative overview. This overview and the diagrams are then reviewed by the interviewees for their accuracy, clarity, and completeness, and are revised as appropriate.

Once the description revision process is completed, the analytic stage begins. First, it focuses on the identification and specification of opportunities for improving the workflow's current configuration, i.e., how the information tasks can be sequenced more efficiently. While TAM does provide some general guidelines for this process (e.g., looking for redundancies), the process remains highly judgmental.

TAM and its subsequent development (Sasso, Olson, and Merten, 1986) additionally prescribe which tasks can be made more efficient through automation and support. Using knowledge about which information processing tasks are easy and difficult for humans to perform, TAM annotates the revised workflow diagram, coding each task as one which,

1. *must* be done by humans and is unlikely to benefit from computer support (e.g., the creation of information);
2. *must* be done by humans but has potential for meaningful computer support (e.g., analysis of data, in which the human recognizes the patterns by the computer facilitates the comparison of alternative representations); or
3. may be completely automated (e.g., routine calculations, transportation of data from one location to another).

Comparing the Methodologies. Table 1 relates each of these methodologies' steps to the five-step general office analysis process.

The methodologies are similar in three aspects:

1. Each uses a closely corresponding unit of work, the *task*⁴ as the basic unit of analysis.
2. In each procedure, we observe a scheme for identifying and classifying these tasks.
3. In each case, individual units of work are identifiable subsets of some larger aggregation of units of work.

Interestingly enough, this third similarity provides the basis for a rather important distinction between them. While each relates the particular task to some larger assemblage of

⁴In OAM/OADM, the step/event/state is the equivalent construct.

tasks, these aggregations are done in dramatically different ways. Waterloo OAM and CTM focus on the activities of particular classes of *workers*, managers and researchers, respectively. MIT's OAM and OADM generally describe the activities performed in a particular *organizational unit*, as defined by the organization chart. TAM focuses on the activities carried out in the execution of a particular *function* or *workflow*, such as payroll or estimating. In other words, while these procedures all partition office work, they bound their studies in three rather different fashions. These boundaries may in turn affect the kinds of suggestions that an analyst provides and, perhaps, the ultimate productivity change brought about by automation or support.

Terms used in describing the tasks also differ. Work can be described in terms of its physical components (such as writing) or its more logical components (such as composition). More accurately, we can characterize the most extreme physical description (e.g., a detailed description of physiological processes) and the most extreme logical description (i.e., an abstraction of the cognitive processes underlying composition) as end points of a spectrum. The terms used by various office analysis methodologies lie somewhere on this spectrum. The Waterloo OAM procedure falls in two distinct categories, sometimes describing very physical tasks (e.g., "listen") and sometimes using more abstract terms (e.g. "persuade"). The descriptions used by OAM/OADM tend toward the logical end of the spectrum, as do those of TAM. Though CTM does not provide a generic set of task-descriptors, those developed in the study of researchers appear to tend toward the logical end.

Key Issues in Office Analysis

The resolution of the following key issues is of major importance if office analysis is to be of any use to practitioners. Its failure to address and overcome these issues precludes the wide-scale adoption of office analysis. In order of decreasing importance, these problems can be characterized as:

1. The inability of office analysis to generate enlightening, practical recommendations for office automation.
2. Our failure to perform systematic, comparative evaluation of the different

- analysis procedures available.
3. Our failure to investigate the practical implications of major conceptual distinctions between existing methodologies.

First among these concerns is the general inability of the set of office analysis techniques reviewed to *prescribe* actionable recommendations, noted by Higgins and Safayeni (1985). The summary in Table 1 emphasizes this glaring weakness; only CTM provides any significant linkage between office activities and commercially available office automation products, and only TAM provides any guidance as to which information processing tasks would benefit from support or automation. We need the ability to specify both *which tasks* can be supported and the *nature* of their appropriate support, whether in terms of requirements for commercially available software or functional requirements for in-house development of software. These specifications should then feed directly into either the standard Systems Analysis and Design process (for systems developed in-house) or the Product Development Life Cycle (for creation of commercially marketed software packages).

The second key issue is that with one exception, these office analysis methodologies have not been tested.⁵ Research is needed to provide an impartial basis for the evaluation of these methods. Currently, organizations have no basis for the selection of an office analysis procedure, they all claim to provide clues about where to employ office automation. Performing an office analysis diverts scarce resources from the productive activity of the firm; rarely if ever will the firm have sufficient resources available to do a study over if the first attempt is unsuccessful.⁶ Through comparative evaluation of the techniques, involving experimental as well as conceptual studies, we can identify the relative strengths and weaknesses of different methodologies, helping practitioners to select the proper procedure for their context.

⁵The one exception is the comparative study in TAM's development, in which subjects were taught one of two methods, the two differing only on whether the office was described as a departmental unit (as in OAM) or as a function that cuts across unit boundaries. Resultant descriptions and suggestions were then evaluated by office personnel for their value and practicality. See Sasso, 1985.

⁶It is unsuccessful if the descriptions are considered inaccurate or its prescriptions unenlightening.

When we consider evaluating office analysis methodologies, however, several associated issues emerge. The first concerns the criteria by which to judge the techniques, while the second concerns the evaluation procedure itself. Obviously, these issues are related: once we have identified an appropriate set of evaluative criteria, we can design a set of evaluative processes which will provide data for those the criteria. At present, however, we lack a well-articulated set of evaluation criteria.

The third key issue concerns evaluation, not of the techniques themselves, but rather of the implications of the several major differences underlying concepts which we observed in the previous comparison. We noted, for example, that the four techniques use three distinct concepts of the "office" itself: Waterloo OAM and CTM see it as a class of employees; OAM/OADM focuses on the organizational unit; and TAM concentrates on the workflow. Alternatively, we have noted distinctions in the descriptors of work used by the different methodologies, with Waterloo using a more physically oriented set of descriptors, while the rest use more logically oriented descriptors. The implications of these conceptual differences might be important, but until a set of evaluative criteria has been established, we can do little to investigate their impacts.

Resolving These Issues

Recent research has begun to address these issues. The CTM framework (Harris, 1985) and the Helander (1985) scheme are seeds of linkages between office analysis and office automation. While CTM's framework was developed in a single context, it may prove to have sufficient generality that it can be applied in other organizational contexts as well. Alternatively, Harris and Brightman might create frameworks specific to other areas of work besides academic research. Similarly, Helander's framework, while not currently embedded in an actual office analysis procedure, may prove to be valuable in bridging the gap between analysis and action.

Evaluative criteria have not been directly addressed in the literature, but several points in this paper provide a reasonable starting point for such a development. For example, one clear

gauge of a procedure's value is its *utility*, i.e., the degree to which it can help the office analyst suggest efficient and profitable alterations to office work. We would clearly prefer to apply an office analysis technique with greater utility over one of lesser utility.

A second important criterion for evaluation concerns the *validity* of the office description. If the office personnel do not perceive the description and its recommendations as valid, i.e., as accurately reflecting the true nature of the work performed, then difficulties are likely to arise in the implementation of the resulting recommendations.

The office analysis technique must be *reliable*. Different office analysts should describe a given activity in a similar fashion and generate similar recommendations concerning the application of information technology in its support. Reliability is also important to researchers, who must have reliable cases on which to base generalizations about the nature of office work and organizations (cf. Simon, 1984).

Under the assumption that utility, validity, and reliability form a core set of evaluative criteria⁷, we now sketch several evaluative procedures which may prove useful. One possibility is the "transcript experiment," described in Sasso (1985), in which subjects were trained in the use of an office analysis methodology (TAM) and then performed an analysis using transcripts of interviews conducted in actual organizations. Having transcripts to work from alleviates the problem in repeated interviews of the same people in an organization, in that the interviewees might change or shorten their reports as time progressed. Once a set of office descriptions have been produced, we can evaluate their reliability and validity, and use the comparisons of descriptions and prescriptions from different techniques to evaluate the efficacy of office analysis methodologies.

Summary

⁷Clearly, other criteria such as ease of learning, ease of use, and cost effectiveness may apply. These factors are significant only after the first three criteria are met.

Office analysis proceeds in five steps involving acquisition of information, formation of an office description, and suggesting reorganization, automation, and support for activities in the office. Four office analysis methodologies elaborate different aspects of these stages, providing more complete descriptions and less complete prescriptions. Comparison of these techniques has pointed out that the area needs better elaboration of the prescriptive phase of analysis, and to reach consensus regarding evaluative criteria for "good" office analysis techniques. This in turn will enable the construction of good testing procedures for the techniques in their development stage.

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	WATERLOO OAM	CTM	OAM/OADM	TAM
1.	TARGET THE OFFICE Managerial Center	Groups of Actors	Organizational Unit	Workflow
2.	ACQUIRE DESCRIPTIVE INFORMATION	Group Sessions: Forms, Communications Logs, Structured Interviews	Interviews, Forms	Interviews
3.	ASSEMBLE DESCRIPTION	Journal Article	Context-specific Descriptors	Narrative, Office Specification Language
4.	CIRCULATE AND REVISE AS REQUIRED	-----	Validate with Original sub-sample	Validate with original participants
5.	ANALYZE TO GENERATE RECOMMENDATIONS	-----	Identify bottlenecks in context specific framework	Critical Success Factors point to opportunities. No general rules.

Table 1. Comparison of Office Analysis Techniques