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ABSTRACT

Office analysis is a technique for supporting the first stage in modern systems analysis and design, the invention phase. The process involves first describing the activities that take place in a given office, focusing not on who is doing what with an object, but rather on the high level information processing activities that change or move the object's information content. After having described the activities, office analysis prescribes modifications of the existing system, by identifying both potential reconfigurations of work and additional technological support. These prescriptions are based primarily on theory from cognitive psychology about the strengths and weaknesses of humans as information processors (e.g., they are fast and powerful in creating information, but slow and error prone in transporting information from place to place).

This paper describes how office analysis works and what makes it hard to do, including the facts that office work is intangible, seems to lack focus, and often involves intermingled and parallel streams of activity. There are, however, major advantages to successful analysis: requirements for new information systems are founded on careful scrutiny of the work done in the office, assigning those activities better done by computers to automation and those by people to people. We argue that the application of office analysis techniques will make more efficient use of an organization's resources, including human resources, to accomplish its information processing activities.

1. What is Office Analysis?

Office analysis is an office modelling process which describes some of an organization's information processing activities in order to:

- Identify activities or groups of activities that can be automated or supported with computer-based tools.

- Suggest how the configuration of these activities can be improved or streamlined without additional computer support.

Office analysis provides important tools for the first stage, the invention phase, in the systems analysis and design process. In the first stage, the invention stage, the analyst generates ideas about how and where to incorporate information system technology to improve the handling of corporate information. In this paper, we describe and illustrate the process by:

- Defining clearly the different objects, actions, and processes involved in office analysis;

- Identifying the obstacles which interfere with the seemingly straightforward task of analyzing an office;

- Proposing tactics for overcoming these obstacles;

- Describing how to conduct an office analysis;

- Delineating the distinct advantages of doing office analysis in the detail proposed.

By clarifying what is involved in office analysis and explicitly teaching how to do to it, we hope to encourage the widespread application of office analysis techniques and stimulate their further development.

Office analysis takes time and people resources. For example, we estimate that a careful analysis of the payroll process in a moderately large corporation could take one person one month. What can be gained? With major advances in computer and communication technology occurring practically continuously, opportunities for improving the efficiency and effectiveness of information processing abound in most organizations. Managers are pressured to adopt new technologies without having clear bases on which to make purchase or development decisions. Furthermore, most managers do not have the tools with which to identify their needs in order to seek new technologies both to cut internal costs and to provide favorable new positions in a

competitive market (Porter and Millar, 1985; and Ives and Learmonth, 1984). Office analysis provides tools that help identify new information needs and that can provide a basis for making decisions to adopt new technologies. The investment of time and people in office analysis could prevent investment in the wrong technology or missed opportunities.

More specifically, office analysis provides a description of the office work which in turn allows the analyst to identify opportunities for:

1. Elimination of unnecessary work;

2. Automation of work;

3. Profitable combination of work;

4. Computer-based support of work;

5. Improvements in the set of reports or presentations of information (here called information products) produced; and

6. Production of new information products to meet identified needs.

Unnecessary work may consist of either the production of unused reports or the execution of redundant work. For example, suppose that several years ago a sales manager requested a special report breaking out sales in an unusual manner, such as by the customer's standard industrial classification codes, for a particular, one-time analysis. After that purpose had been served, the report was no longer needed. But, because a mechanism had been created to produce and deliver the report, it continued to be produced each month. The work associated with the production, delivery, and disposal of this report is unnecessary. It can be profitably eliminated.

An opportunity for the automation of work occurs when an algorithm that transforms input into output can be defined and there exists a device that can perform that algorithm. An automated teller machine, for example, successfully automates some parts of the human bank teller's job.

Work can be combined when either a source of information or the same information processing device is used at several different stages in the course of processing a single information entity, such as a sales order or credit card application. For example, we might access the files at a local credit bureau at one stage in approving an application for credit to verify that the applicant does, in fact, possess the credit cards which he claims to hold. Later, we might access the same files to review his record of payment. Where a charge and/or time delay is

associated with accessing these files, the combination of these two activities might be desirable.

Computerized support for work entails automating some portion of a complex task with a computer-based tool. Examples are word processing systems that support the production of documents, electronic messaging systems that facilitate communication, and decision support systems that enhance the ability to evaluate the outcomes associated with alternative courses of action.

Information products, such as reports, can be improved or new ones created as a result of assessing the needs of the user. If, for example, managers use only two or three figures from a large report, the report could be condensed or tailored to their requirements.

Office descriptions can also allow us to identify similar or identical work activities or groups of work activities. This is valuable information for indicating what single support device could serve two separate tasks. Furthermore, if an individual performs the same kind of task on different information in different contexts, he or she is likely to be either very slow or make errors unless the user interfaces to these systems are highly similar. An internal auditor, for example, may be responsible for the verification of travel expense vouchers and physical inventory write-offs. While the two contexts, travel expense and inventory control, are quite different, the operations the auditor performs are similar. Presenting the auditor with similar interfaces for the verification tasks will make the tasks move more quickly and have fewer errors.

2. The Complexities of Office Analysis

Given these benefits, it may come as a surprise that office analysis has not already been developed and adopted widely. However, offices form complex environments, making office analysis difficult. Techniques for doing office analysis, therefore, are still under development and not part of the general systems analysis and design process. Most systems analysis and design processes begin with a quickly conceived notion about the new system's functionality and continue with a detailed design and plans for implementation (e.g., Cougar, Colter, and Knapp, 1982; Hartman, Matthes, and Proeme, 1968). Office analysis begins with unidentified needs and ends with a clear statement of the new system's functionality.

There are six major difficulties in doing office analysis:

1. Office work is largely intangible.

2. Office activities appear to have a lack of focus.

3. Most office workers routinely process exceptions.

4. Most office workers rely on the actions of people or machines outside their control.

5. Many office tasks are concurrent or parallel.

6. Activities often involve the intermingling of different kinds of information in search of particular relationships between pieces of information.

Each of these difficulties is described below, along with suggestions about how to overcome them.

The intangibility of office work reflects our inability to observe directly the logical operations we wish to describe. If we look at office work, we see actions such as writing, telephone conversation, typing, and reading. These are the physical activities in which office work is manifest; they can be observed, counted, and tabulated. The fundamental nature of office work, however, is the processing of information; it is an essentially logical operation. There is no one-to-one mapping between the logical operations and the physical actions.

To overcome this problem, office analysis should focus on the result of work, not on its physical manifestation. Once a task has been executed, some information object in the office will have changed. The type of change can be determined, allowing us to infer the logical operation that was performed.

Offices often have an apparent lack of focus. If we examine the chronological sequence of activities performed by a secretary or manager, there is little if any logical interconnection between one action and the next. Activities which are logically unrelated are frequently temporally and spatially intermingled.

Again, a focus on information objects assists in overcoming this problem. Office analysis ignores the chronological sequence of the worker's day and describes instead the chronological sequence of operations performed on the same information. Rather than asking the secretary, "What do you do next?" we ask, "What's the next thing that happens to this information object?"

A third complication is that exceptions will frequently occur. Things are never as simple as they "should be." Requisitions are incompletely filled out; labor account codes are incorrect; approval or authorization is missing. Most of these cases, however, are handled without difficulty. The problem is not that we don't know what to do if these exceptions occur; the problem is that detailing each of these in the office description is very tedious.

This difficulty is overcome by limiting our detail in an office description to the activities that occur after the successful completion of the previous activities. Routines for error handling are not included here; they appear, however, in the detailed system requirements, later when the solutions for more efficient reorganization or support are discovered.

Office work often depends on the results of work done outside the control of the office worker. Accounting, for example, is unable to process timecards until this week's Employee Status Change Report is received from Personnel. Restricting our view to the office bounded by walls or a box on the organization chart may cause us to miss a number of important links or flows of information through the organization that may be automated or reorganized to great benefit.

The solution is fairly simple. The "office" which we describe consists of an information processing function, not an office bounded by walls or organizational boundaries. We follow the timecard through its route through the company; we do not just focus on what happens in the Accounting Department.

The fact that a great deal of office work seems to occur in parallel presents no difficulty to office analysis if we describe the office in terms of the information objects and their routes through processing. It is entirely feasible to annotate the processes in parallel streams. In some cases, the information object will be routed to two different subsequent processes. For example, a student's application to a university will be processed both by the Financial Aid office and the housing office, each looking at different subsets of the information in the application. The important fact to note in the office description is that both these subsequent processes are triggered by the arrival of the single student application.

The last major difficulty is that in some kinds of tasks, a single information object is the focus, while in others groups of similar information objects are the focus, and in still others groups of dissimilar objects are processed. For example, the process of examining a supplier's invoice to assure correct totals focuses on a single object. After processing an invoice, the invoice may be batched with other paid invoices prior to being filed; here the focus of a process is a group of similar information objects. Earlier in the process, someone may have verified that the price quoted on the invoice matches the current price for its item, comparing across two different kinds of information objects, the invoice and the price list.

These classes of information objects have different implications for system design or office reorganization. Therefore, any office description language must differentiate these types, distinguishing between single or multiple objects (e.g., an invoice versus an invoice file) and similar or

dissimilar information objects (e.g., an invoice or a price list).

In summary, because the office is a complicated place to describe, the office analysis technique should focus on the logical operations that occur on the information objects to support a function, not bounded by walls or organizational boundaries of the office. Exception processing is ignored until the detailed systems requirements are formed. Describing office work in terms of flows of changes in information objects allows easy description of parallel and intermingled processes; careful annotation should be made to distinguish single instances of an information object, groups of similar objects, and the collating or relating of different kinds of information objects. An office analysis technique that satisfies these criteria is not guaranteed to be easy or quick; it is, however, assured of avoiding known difficulties and complexities while building a description that can serve as the basis for potential improvements.

3. The Practice of Office Analysis

The office analysis described here is based primarily on the Task Analysis Methodology (Sasso, 1984), with additions to the analytical phase, where suggestions for improvements are made, from Olson (1985). Other methods have been developed for analyzing offices. A review of these can be found in Sasso, Olson, and Merten, (1986), and Sasso, (1985).

Office analysts proceed through six basic steps. They:

1. Target the particular "office," identifying a particular information object (or set of associated objects) to be tracked, regardless of physical or organizational boundaries.

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, concentrating on the information object and the transformations it undergoes.

4. Circulate the description to the office personnel for comments and suggestions and revise the description accordingly.

5. Analyze the description for possible reordering and combinations of the processes, and annotate the transformations for those information processes that are best done by humans and those best done by current information technology.

6. Generate specific recommendations of reorganization and support, to feed into standard systems analysis and design processes for considerations of feasibility and cost.

3.1. The Descriptive Phase. The first four steps above constitute the descriptive phase of office analysis, where details about the information that enters, is transformed, and leaves the office are recorded. The analyst acquires the necessary information about the office procedures by interviewing office personnel and collecting any artifacts that explain the processes (such as training manuals, job descriptions, and input and output forms).

Once the analyst has acquired all this information, he or she is faced with the formidable task of organizing it in a useful fashion. Any procedure for office analysis provides some guidelines for this -- TAM, for example, suggests "chunking" the specific activities identified into bodies of work recognized (and often named) by the personnel responsible for their execution and coding these activities according to a standard set of terms for process description (e.g., calculation, revision, inspection, etc.). These descriptions are then circulated among the office personnel for their review. The "chunked" groups of activities can then be identified using the popular terms by which the office personnel are accustomed to referring to them. Feedback from the personnel is then used to produce an accurate description of the current workflow, one that satisfies all major participants in the office analysis process.

In Figure 1, we depict an outline form of an office description of one chunk of a payroll procedure, the portion concerned with vacation pay eligibility calculations. The description provides information about five aspects of what is happening in the workflow:

Initiating Conditions
: What invokes or causes the execution of this "chunk" of processing.

Information-Objects
: Which body of information is processed through this chunk of processing, and what other types of information are used in its processing.

Agents
: Which processors are responsible for performing each of these processing steps.

Process-Types
: What class or category of processing activity is performed at each step in the

Vacation Pay Eligibility
Task Group

Initiation: Employee has requested vacation pay on timecard.

Payroll Clerk	Returns vacation pay record to vacation pay file.
	Transfers date and vacation pay request to vacation pay record.
	Calculates vacation pay eligibility
	Transfers tentative vacation pay eligibility to timecard.
	Transfers vacation pay request to vacation pay report.

Termination: Return to Basic Payroll Processing

Figure 1. TAM Verbal Description.

chunk.

Terminations

Which actions cause the chunk as a whole to be considered "complete."

These same major components are highlighted in the simple type of diagram shown in Figure 2, called a Level-1 Workflow Diagram. These representations, although they provide somewhat less detailed information, are useful both when the personnel review and revise the description for accuracy and later, as a basis for several types of analysis.

3.2. The Analysis Phase. The descriptive phase produces an abstraction of the information transformation as it exists, complete with inefficiencies and unsupported activities. In the analysis phase, the analysts do two things:

1. They reorganize processes to rid them of redundancies and inefficiencies.

2. They analyze the remaining tasks to determine those best performed by human or computer.

Suggesting reorganizations of processes cannot typically be done without constraint. Information and processors exist in particular locations and information appears at particular times; these constraints often cannot be changed without massive cost. They form the limits within which the analyst works in looking for redundancies and inefficiencies.

In beginning the analysis phase, the analyst constructs a level-2 workflow diagram. Figure 3 represents a level-2 diagram for a somewhat larger portion of the payroll function. In studying the diagram, the analyst notes that vacation pay requests and approvals seem to be handled an excessive number of times. This, in turn, suggests that this portion of the workflow may be a likely candidate for reorganization such as that shown in Figure 4.

Before proposing such a reorganization, however, the analyst should take into consideration the fact that no workflow exists in a social and political void. In this particular instance, a wary analyst might ask, "Why is all this (apparently redundant) vacation pay processing being done?" It could be, for example, that several years ago, the firm's highly cost-conscious president became aware of an isolated but embarrassing incident in which upon termination, an employee received several weeks' vacation pay to which he was not entitled. He had requested and received the vacation pay earlier in the year, but the payment had not been recorded in the appropriate records. The president insisted that "steps be taken to prevent this from ever happening again." The rather cumbersome vacation pay approval procedure

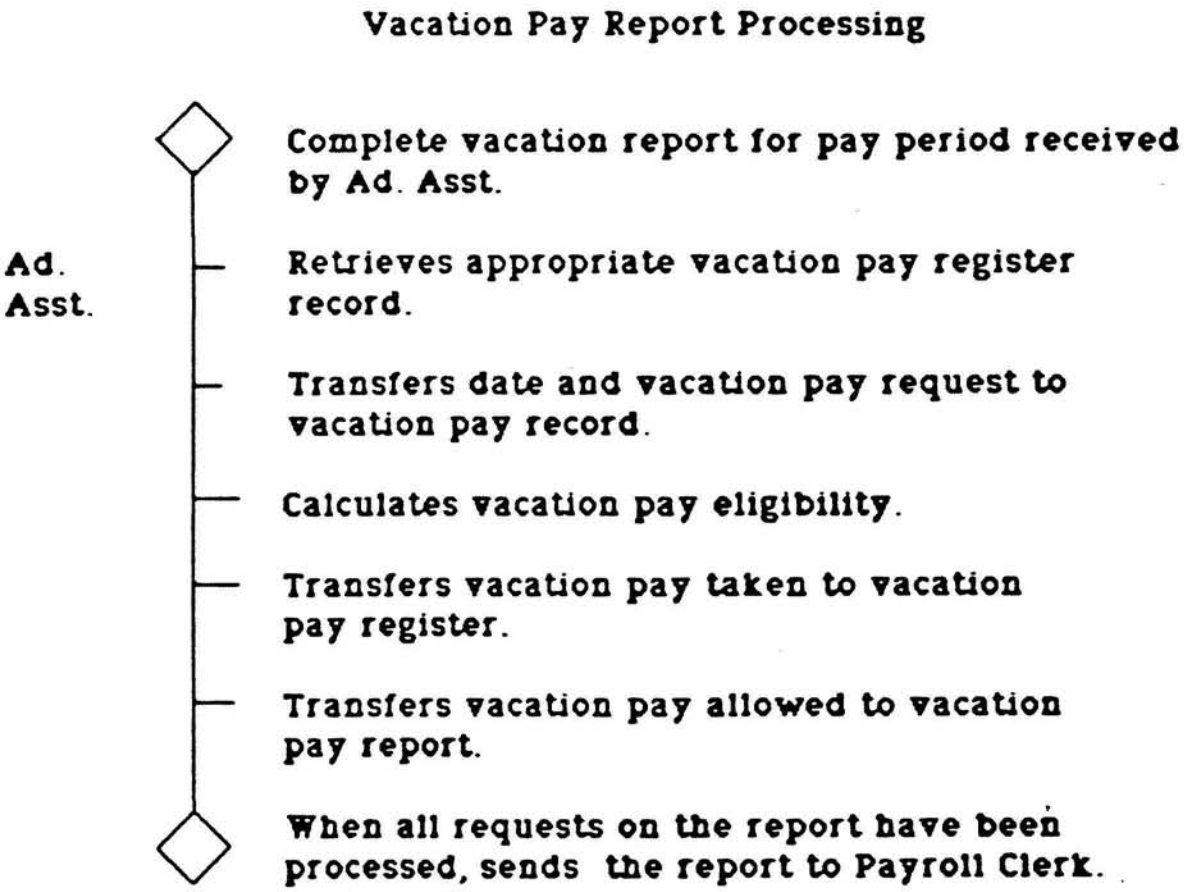


Figure 2. TAM Level-1 Workflow Diagram.

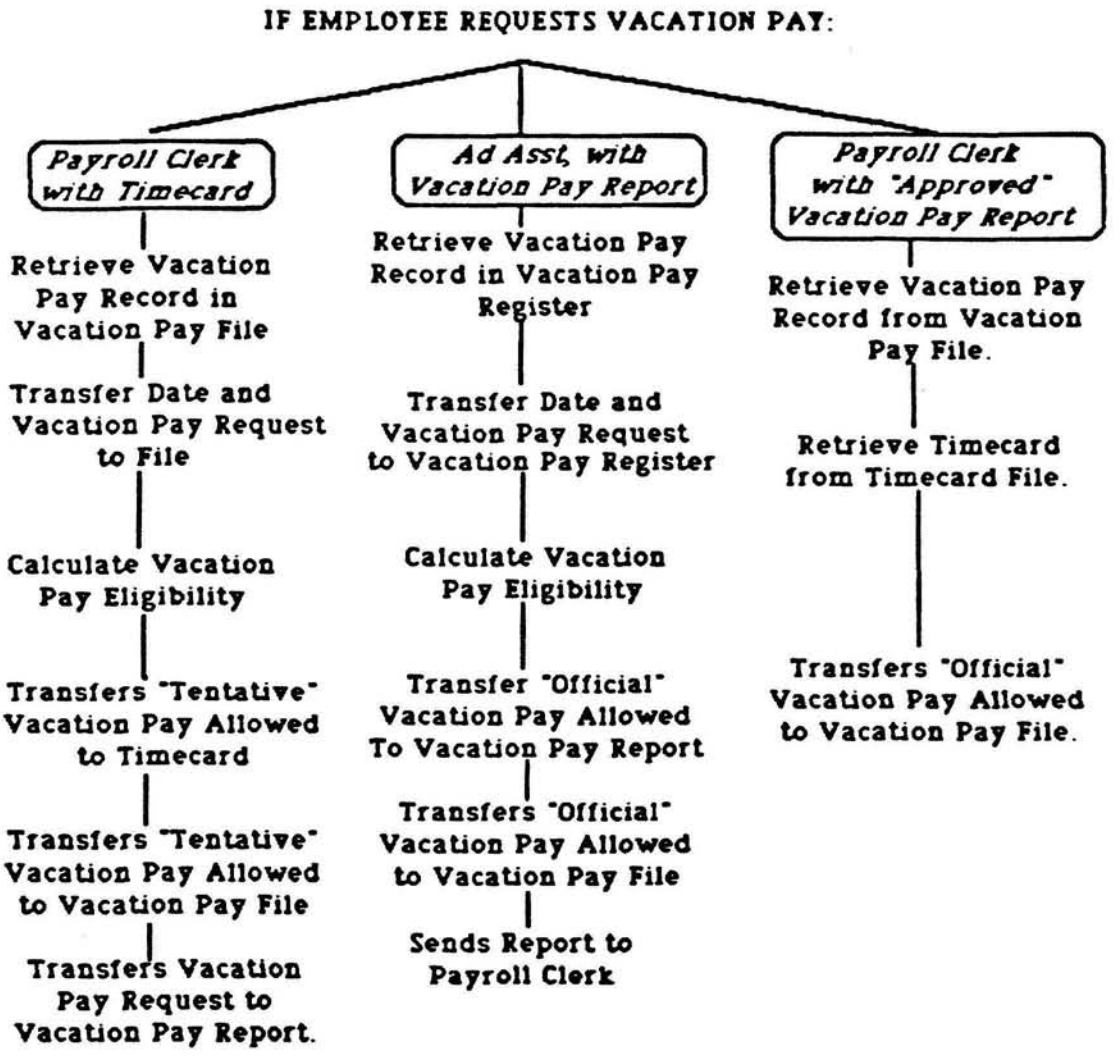


Figure 3. TAM Level-2 Workflow Diagram.

depicted in Figure 3 was thus developed.

The president's dictate should not prevent us recommending a reorganization, but it suggests that the reliability of the reorganized system should be at least as good as that of the current system. In addition, it recommends an inquiry into the causes of the original system's failure.

In this case, inquiry could have revealed that the failure occurred because the vacation pay eligibility algorithm was complex and the forms on which the information was to be recorded were awkward for the clerks to use. The complexity of the algorithm overloaded the cognitive capacity of the clerk, resulting in unreliable performance. The current system handles this by introducing redundancy, but the presence of the algorithm suggests that the eligibility calculation might be done by a computer. Thus, in this case, automation could not only increase system reliability but reduce the clerk's stress and eliminate redundant information processing.

After a reorganization, if one is called for, the analyst codes the remaining tasks as those that are best performed by information system technology and those best performed by humans. In the past, guidance for this stage came from rules-of-thumb about where automation can take place, gleaned from experience in designing information systems. These rules state that tasks with the following characteristics are good candidates for automation:

1. High processing volumes.

2. Complex algorithms or formulas.

3. High accuracy requirements.

4. Repetitive processes.

5. Quick reaction time requirements.

These guidelines appear to be vaguely based on relative strengths and weaknesses of humans and computers, noting that people have processing limits and inaccuracies. However, theory in Cognitive Psychology specifies more concretely and completely the known strengths and limits in human information processing. Applied to office analysis, this theory provides the theoretical base from which we can specify where in an office computer-based support or automation is called for. When the information processing is of the type that is difficult for humans to do, support or automation is indicated. Humans ought to perform only those tasks which they do well.

What do humans do well? Table 1 lists human information processing strengths and weaknesses. In brief, people have

IF EMPLOYEE REQUESTS VACATION PAY:

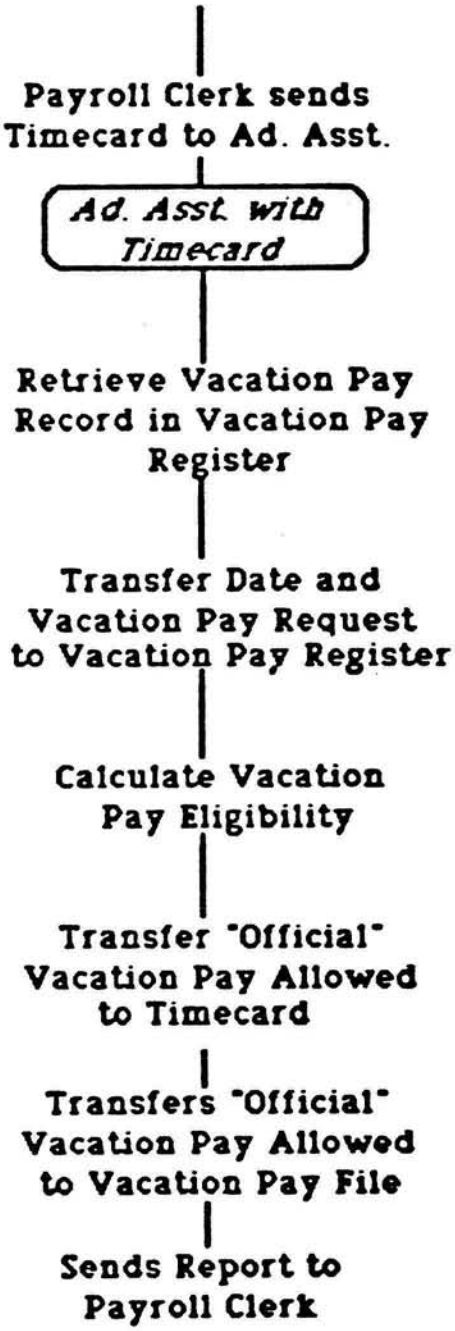


Figure 4. TAM Level-2 Workflow Diagram, Revised

Table 1. Human Information Processing Strengths and Weaknesses.

STRENGTHS	WEAKNESSES
PERCEPTION:	
Can process visual information rapidly, coordinate multiple sources, and perceive patterns in time and space.	Limited precision for detail.
SHORT-TERM MEMORY:	
Rapid storage of information.	Limited capacity, numerous errors (confusing the sounds of things remembered, reversing the order of things)
LONG-TERM MEMORY:	
Able to associate new information with items already learned, can see similarities between things, notice concepts, patterns, coordinated streams of information	Slow to retrieve, confusions among similar items.
PHYSICAL MOVEMENT:	
Able to coordinate actions.	Slow and inaccurate.
COMPUTATIONAL ABILITIES:	
Creative	Slow and inaccurate on algorithmic computations

severe limits in memory, calculating, physical motion speed and accuracy, and patience for repetition or delay. They have strengths in visual scanning (coordinating parallel inputs), in integrating patterns in time and space, and learning highly integrated, complex material. (See Fitts, 1951, for the original excellent summary, and Olson, 1986, for a more specific review in the domain of information technology.)

At this point in analyzing the office, we have merely described the tasks in the terms the personnel use, opting for accuracy of content rather than standardization of form. In order to identify the tasks to be automated or supported, we first need to categorize the information processes identified in the task into a standard set of terms. Our set of standard information processing terms follows:

Transport Information
The movement of information from one physical location to the next. The location of the information changes, but the form does not.

Transform Information
Change information storage medium. The form of the information changes, but the location does not.

Algorithmically Process
Sort information according to prespecified, stable, explicit rules.

Judgmental Process
Sort information according to multiple, complexly related dimensions.

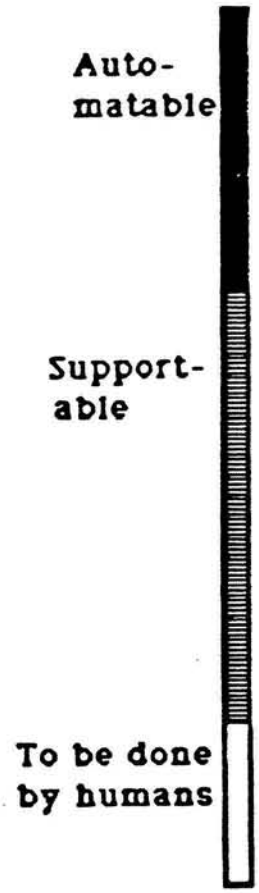
Correlate Information
Retrieve information from several sources and merge aspects of each into a new record. Several inputs merge to a single output.

Analyze Information
Look for patterns in retrieved information.

Negotiate
Persuade, teach, learn. This typically involves judgement, and interpersonal or interactive communication.

Create Information
Organize, synthesize, add new information. There are no explicit inputs or processing rules.

Table 2. Categories of information processes and their more detailed, common English terms. On the left are notes about which task is best done by human or computer.



TRANSPORTING:	Sending
TRANSFORMING:	Transfer, Prepare, Log, Destroy
ALGORITHMIC PROCESSING:	Calculate, Code, Distribute, Inspect, Retrieve, Select, Separate, Sort
JUDGEMENT PROCESSING:	Acquire, Assign, Determine, Review
CORRELATE:	Assemble, File, Merge, Verify
ANALYZE:	Reconcile
CREATE:	Compose

These categories are collections of lower-level common-language processes as shown in Table 2.

This set of information processing terms is an adaptation of the information processing categories of Machlup (1962), incorporating more recent, computer-based schemes of Lieberman, Selig, and Walsh (1983), Komatsubara and Yokomizo (1982), and Helander (1985).

These information processing terms are purposely ordered to reflect what we consider to be increasingly intellectual endeavors, and those that are less likely to be automated. Those best done by information systems are the first three: Transporting Information, Transforming Information, and Algorithmically Processing. These are done rapidly and accurately by computers, but are often slowly and inaccurately performed by humans, and frequently test human patience for repetition.

At the other end of the scale, processing that requires Negotiating and Creating information are almost uniquely human activities. Forays of artificial intelligence into creating and negotiating are sorely inadequate.

The tasks in the middle of the list, those involving Judgment, Correlating Information, and Analyzing Information, require mixtures of human and computer skills: they require the retrieval of masses of information (for which the human is particularly inept) and the extraction of patterns in time or space or the abilities to make multi-attribute decisions (for which the human is particularly ept). These processes call for computer-based support. Table 2 summarizes the mapping between information processing required in the office and the agent best suited for its conduct.

In Figure 5, we show a Level-3 Workflow Diagram for our vacation pay calculation example. In addition to the proposed reorganization of tasks, two new elements of information have been included in the diagram. First, we have coded each task into one of the eight categories of information-processing activities, and, second, we have identified candidate tasks for automation by shading their boxes. This example does not illustrate the marking of tasks that are appropriate for solely for humans or for computer-support. Their markings, however, follow similar fashion, those for support in another shading, those assigned to humans left unmarked.

The final stage in an office analysis involves summarizing the discovered opportunities and reorganizations. This summary can take on one of several levels of detail, depending on whether the next stage is mere decision making by an authority whether to proceed with the innovations or not, or whether the next step is

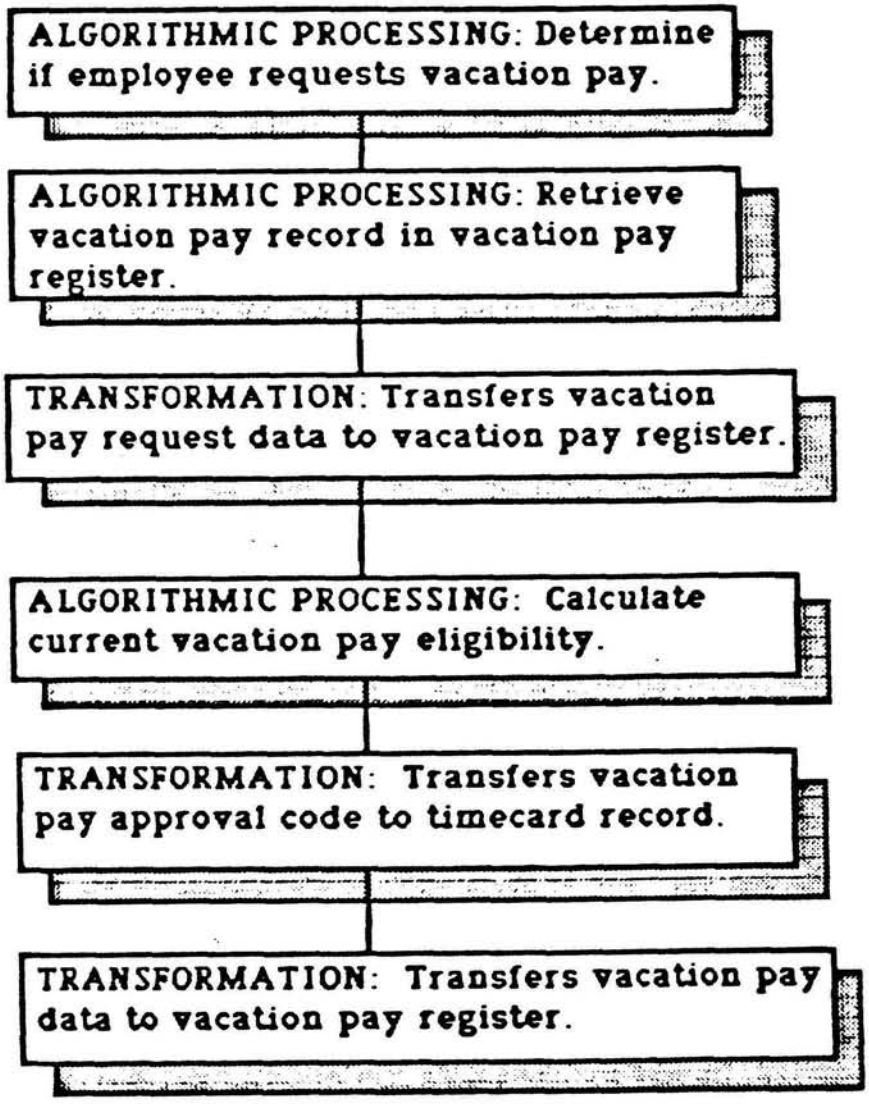


Figure 5. TAM Level-3 Workflow Diagram.

a fully specified system design for direct implementation. The former relies on the Workflow Diagram form, the latter on the more detailed Verbal Task Descriptions, such as those in Figure 2, for the newly designed system.

4. The Opportunities Office Analysis Creates

Over the long run, further development and use of office analysis will present managers with an exciting set of opportunities. These include implications for:

1. The design of new office information technology.

2. More successful adoption of new information technology, by involving the users in a meaningful way during system design.

4.1. Implication for the Design of New Information Technology. We have found that fairly complex office procedures consist of a relatively small number of task-operations (processing of information), arranged in different sequences and hierarchical relationships. Some of these task-operations are algorithmic in nature, and hence are candidates for automation, while other tasks clearly require human intervention for consistent, intelligent, and successful execution. On the one hand, there exist Office Information System packages that handle certain classes of these task operations quite well. On the other, some tasks are performed by humans, even when the task is routine, recurrent, and requires little intelligence. We need to design office systems with capabilities corresponding to as many of the elemental, supportable task-operations as is possible, to be used and combined as needed in the particular office. Certain packages, furthermore, could be offered for those task-sequences that occur often in many offices.

Office analysis divides the complex operations in an office into a small set of information handling processes. Some of these occur in common with each other, certain "molecules" of these elements form and serve common functions in a variety of settings. Vendors need to identify these elemental operations and relationships between operations in order to create powerful packages with applicability to a wide variety of office contexts. Often with the right underlying structure, a single package can be altered in wording of the objects and actions in the user-interface to look like a customized package for a particular market segment, when indeed with other wording and interface presentations, it is applicable to another of similarly structured office. Purchasers of systems can also benefit from this knowledge when they compare their needs with the support available from several commercially available packages.

4.2. Implications for Increased Adoption of Designed Systems. Research has shown repeatedly that involving users in the system

development process increases the likelihood that the end product will be adopted, both because more of the user's actual needs are incorporated and because the users often perceive that they have an investment in the product and are more inclined to feel favorable about using it (Lucas, 1977). Unfortunately, relatively few of the technically oriented tasks in the conventional design of systems are the kind that end users can do. However, the office analysis method described here involves users at many points in the descriptive phase. No one knows what office personnel do better than they know themselves. The expertise required to build an office description resides in the office workers, the ultimate users of the newly designed system. Users could also be involved in the prescriptive phase, when innovations are generated for reorganization and support. Users know intimately which tasks use their intelligence and which do not.

4.3. Where is the "state of the art" of office analysis? Our perception is that significant progress has been made, especially in terms of descriptive techniques. We can describe office activity, particularly structured office activity, with far more precision than we could ten years ago. Our abilities in the prescriptive realm remain generally inadequate, although Harris and Brightman (1985) have successfully overcome this problem in a particular context, that of support for scientific research. More generally, Sasso and Kim (1986) have recently proposed a framework for mapping between office work and office technology. Overall, however, our descriptive capabilities far overshadow our prescriptive ones.

This may, in part, result from an unfortunate tendency, fairly common among systems professionals and researchers, to take technology as a given. For example, one often hears statements such as "Office automation means word processing plus spreadsheets plus a data base management system." Because the technology exists in fairly discrete packages, it becomes very easy to slip into a mind-set which perceives reality in terms of these technological packages. Perhaps a still more subtle effect is seen in our general failure to differentiate the functional capabilities of generic software classes (such as spreadsheets or word processors) in any standard, abstract fashion.

Humans as agents or processors of the office have received different amounts of study. At the micro-level, some of the best research done in the office modelling area has studied the interaction processes of humans and computers. Research is also beginning to study the effects of computerization on group work processes, though this area is just beginning to be defined. The popularity of the Conference on Computer Support for Cooperative Work, held in Austin last November, suggests that this area will be receiving a great deal more attention in the near future.

What critical research questions do those working in the office modelling area face? We face a spectrum, ranging from concerns such as the scientific reliability of our office modelling techniques themselves, through the extension of their prescriptive capabilities and the empirical validation of those prescriptions, to the collection and structuring of data into large-scale data bases, portraying in detail how organizations and offices process information to accomplish meaningful results. Once our modelling techniques have been refined, we can begin this data collection process in a cross-sectional fashion, and extend it with longitudinal studies. These will allow us to see how individual activities, configurations of activities, and their performance and technological support change over time.

Another set of key research questions address our ability to model the capabilities of software. Ideally, this would involve using or adapting existing techniques for modelling office activity to describe the capabilities of commerically available software. Once this has been done, a large-scale data collection program, analogous to that sketched for office information processing, can be carried out for commerically available software. Once these two data bases are available, mappings between office work and office technology should be a much more scientific process.

5. Summary and Conclusions.

We have introduced the reader to the practice of office analysis, to the opportunities it offers, and to the difficulties that can arise in its conduct. The process includes description of the existing office followed by prescription of new arrangements and computer-based support of some of its activities. These improvements may eliminate unnecessary work, create more effective information products, or apply support or automation to expedite activities. Obstacles to the easy performance of office analysis were presented and each was overcome in the particular office analysis method described.

The crux of the first phase of the office analysis method presented here is the description of the information and the transformations it undergoes, independent of the location or organizational boundary in which these acts take place. Prescriptions of new arrangements come from inspecting this description for redundancies; prescriptions for support or automation come from annotating those identified information processing tasks as being appropriate to human or computer processing, depending on known strengths and limits of the human information processor.

Office analysis benefits several groups of people. Developers of information systems can use it to discover general market needs, places where sets of information processes that can be automated co-occur. Purchasers can discover and document their

own information system requirements to use in making decisions about commercial office information system packages. If no existing package suffices, the analysis can serve as the basis for inhouse design. Furthermore, when an office undergoes reorganization or installation of computer-based support, having the users involved, as they are in office analysis, can make the implementation much more successful.

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