# MEASURING OFFICE COMPLEXITY

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## ABSTRACT

An "office" can be described in terms of at least four different (but related) sets of descriptors: the physical, the social, the organizational, and the work-related. This paper focuses on work-related aspects of offices, and presents two measures of complexity in office work. The first measure, operational complexity, gauges the average difficulty, in terms of the cognitive resources required, to perform a "chunk" of office work. Independent of this, sequential complexity measures the potential number of task sequences which could be used to accomplish a given chunk of work. Sequential complexity increases as does the number of "special cases," "special cases of special cases," etc. for which the chunk of office work need be performed. In other words, it focuses on the complexity of interrelationships between individual office tasks, while operational complexity is concerned with the complexity of the individual tasks themselves. We then combine these measures into a an aggregate measure of overall complexity, combined complexity. The application of these measures is illustrated, using descriptions of order entry processes, for two hypothetical firms, employing job shop and assembly-line technologies, respectively. While these three measures hardly comprise an exhaustive catalogue of complexity in the "office" (or even in office work), we believe they provide a useful basis for both practical application and further theoretical extension.

Even after years of serious study by conscientious researchers, experienced consultants, and perceptive practitioners, consensus on the nature of office work still seems to elude us. As a case in point, consider the apparently straight-forward question, "Is the office a complex entity?" and the range of comments it has engendered. From the Office Automation Group at MIT, we find such assertions as "Offices are complex and sensitive organizaitons" [Sirbu 83] and "Offices are complex systems, with infinite variations along many dimensions." [Sutherland 83] Similarly, Suchman of XEROX's Palo Alto Research Center has reported extremely complex exception-handling processes, which clearly require the use of inductive reasoning and human judgment for their successful resolution [Suchman 83] [Suchman 84].

On the other hand, groups such as the National Organization of Women and 9 to 5 voice ever-increasing concerns regarding the routinization or deskilling of office work. These assertions seem to fly in the face of those made in the previous paragraph. Evidently, we are transforming the office worker into a mindless automaton, at the same time somehow capable of dealing successfully with "infinite variations along many dimensions."

This paper addresses the general issue of complexity in the office, and the specific one of complexity in office work. Its objective is to present a set of measures which can be used to quantify the complexity of one dimension of the office, namely the work there performed. We will begin our discussion by detailing our conceptions of the "office" and of "complexity." Next, we will briefly introduce a procedure for the systematic description of office work, the Task Analysis Methodology (TAM). TAM descriptions suggest three types (or "flavors") of complexity in office work: the complexity present within a particular task (operational complexity), the complexity inherent in relationships between tasks performed together (sequence complexity), and combined complexity, integrating both of the previous types. Measures for each of these will be formally defined, and examples of their application will be presented. The paper will close with a discussion of the implications of this work for other research topics, most notably that of office productivity.

What Is the "Office?"

Let us step back for a moment and consider the misleadingly simple term "office." Upon reflection, we begin to perceive a variety of heterogeneous elements connoted, denoted, imputed, and implied by this common, six-letter word. Thus, it becomes far less surprising that there is little consensus on the question "Is the office complex?" Perhaps the best reply is another question, "Which office are we talking about?" or, better still, "Which dimension(s) of which office are we talking about?"

The term "office" can be (and unfortunately is!) applied almost interchangeably in common English usage to denote any of at least four relatively distinct meanings. First, of course, an office may be a room, a location, a physical subset of a building. Secondly, the term is often used as a formal organizational unit designator, in governmental bodies such as the Congressional Budget Office or universities' Financial Aid Offices. Thirdly, the office often denotes a social grouping, a set of people with a particular "group dynamic," subtly reinforced and reformulated every work day through common experiences. Finally, we can note that an office is almost always responsible for work, and hence we can regard it as an apparatus which enacts certain processes to carry out its corresponding responsibilities. While aspects of the physical, organizational, and social dimensions of the office certainly exhibit characteristics of complexity and have been shown to affect human performance, our focus here will be on the office as "responsibility - fulfilling agent." Thus, we will examine office complexity in terms of the components and structural relationships present in workflows whose enactment fulfills these responsibilities.

What is "Complexity"

The concept of complexity is opposed to that of simplicity. That which is simple is easily understood and mastered, while the complex entity requires "... considerable study, knowledge, or experience ... for [its] comprehension or operation." [Gove 61] Moreover, at least part of this extra effort can be explained by the fact that complex entities have "... many varied, interelated parts, patterns, or elements and [are] consequently hard to understand fully." [Gove 61]

If we differentiate parts and elements from patterns (i.e., recurrent combinations of parts or elements), and note that variation and interelation can occur at both of these levels, we can begin to appreciate the nature of complexity. Furthermore, if we assert that patterns may themselves serve as elements in higher-level patterns, we move from a two-tiered concept of complexity to one with an indefinite number of levels. Like Simon [Simon 69], we see hierarchical structure as the essence of complexity. For our purposes, then, these characteristics of variation and interrelation at multiple levels in an office system comprise office complexity -- they are the characteristics we wish to measure.

Specifically, we will apply measures of these characteristics with respect to the work processes executed in a given office, rather than its physical dimensions, formed organizational structure and reporting channels, or social groupings and dynamics. This choice is predicated, of course, on the objectives of the paper and its audience. Office technology is generally applied to get work done -- not to alter social dynamics, rearrange organiztional structures, or reallocate physical space (although such results have been observed). We believe, therefore, that by presenting a procedure which measures the complexity of office work as embodied in existing procedures, this paper will both provide a more meaningful basis for evaluating office systems and increase the likelihood that office technology will be applied in an appropriate fashion.

In order to measure the complexity of office work, we must begin with systematic descriptions of the work itself. Therefore, we present a brief explanation of a procedure capable of creating such descriptions, the Task Analysis Methodology.

## The Task Analysis Methodology

The Task Analysis Methodology (TAM) allows for the systematic description of office activities and facilitates their evaluation and possible enhancement. This paper will use TAM descriptions as a basis for measuring office complexity, and this section will introduce the reader to the basic concepts of TAM and its products, called office descriptions. For a more complete treatment of TAM, see Sasso [Sasso 85] or Sasso, Olson, and Merten [Sasso et al 86].

The methodology takes an essentially "structuralist" approach to office work. There are five types of fundamental elements in TAM's perspective on the office:

1. Conditions -- which involve or cause a "chunk" of activity to occur;
2. Information-Objects -- which contain and store the information processed, and/or other information used in its processing;
3. Agents -- which are responsible for the actual performance of these processing steps;
4. Operations -- which are different types of information-processing activities to be performed; and
5. Terminations -- which cause some organizationally recognized "chunk" of work to be considered complete.

The TAM operations are of special interest to us, because it is the operations which can be supported or automated through application of information technology. TAM not only identifies a set of distinct task-operations, but also provides a classification of these operations into physical, procedural, discretionary, and complex activity-classes. This classification is shown in Table 1.[1] The operations in the physical and procedural classes are prime candidates for automation, while those in the discretionary class are far more difficult to automate, though computer-based support for them is often quite valuable. Activities in the complex class are not susceptible to automation; human judgment is essential for their successful performance.

Using these five basic element-types, TAM forms three types of higher-level structures; tasks, task structures, and task groups. A task is a unit of work indivisible from the organization's perspective. That is, a partially completed task is of little or no value to the organization, in much the same fashion as a partially delivered presentation conveys little information to its audience. A task

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[1] All tables and figures will be found at the end of the paper, following the References.

consists minimally of an agent, an operation, and an information-object. The agent executes the operation on the information-object: e.g., "Foreman approves sick pay request." Secondary objects, such as standards for verification operations, or secondary agents, such as recipients of communication-operations, are sometimes present in a task. Finally, a task may include a condition, which governs or controls its execution. As an example of a conditionally-controlled task, consider "If employee has been sick, he/she transfers description of sickness to sick pay request."

Just as conditions, agents, information-objects, and operations are the components of tasks; tasks are themselves the components of task structures and task groups. A <u>task structure</u> is defined as an organizationally-recognized body of work, i.e., a "chunk" of work readily perceived (and often named) by the office personnel responsible for its performance. A task structure includes: (1) an <u>initiating condition</u>, which upon fulfillment invokes execution of the entire chunk of work; (2) a <u>task sequence</u>, or set of individual tasks which fire in a "stimulus/response" fashion, once the initiating condition is true; and (3) a <u>termination</u>, essentially the last task in the structure, whose completion should fulfill the initiating conditions of the subsequent task structure in the overall workflow.

The task group is defined at the same structural level as the task structure, and their components are identical. The <u>task group</u> is a "chunk" of work applied to special cases, i.e., task groups are additional processing required when legitimate, but somewhat unusual conditons apply. For example, we may receive an order from a new customer. In all but the simplest of order entry task structures, we will have the "extra-ordinary" tasks of creating the customer records for this new customer. Since not every order is from a new customer, "create customer records" would form a task group within the "order entry" task structure.

As a basis for illustrating the measures of office complexity described in the following sections, we will now present TAM descriptions of two (hypothetical) order entry task structures. One of these, "Jobco," wil be for a job-shop manufacturer, and the other, "Lineco," for an assembly-line manufacturer of standard major household goods, e.g., refrigerators. In Table 2, we present a fairly complete set of order entry task structure options, and indicate their respective presence or absence in the Jobco and Lineco order entry task structures. Figure 1 depicts a more complete specification of the Jobco order entry task structure, while Figure 2 shows the correpsonding Lineco task structure.

Figures 1 and 2 should be interpreted as follows. Along the left hand side of the Figure is shown the task structure's basic task sequence, the activities which are invariably performed on any order. The ovals to the right depict (optional) task groups, which perform processing required by only <u>some</u> orders. Above the line connecting each oval to the basic task sequence is the condition which, when true, invokes the task group's execution.

As should be clear from a comparison of Figures 1 and 2, the more complex job shop environment is reflected in Jobco's more complicated order entry procedure. In another sense, however, it should be clear that these processes are quite comparable, in that they play the same role for their organizations. Both task structures receive an order-contact from a customer, and perform the required processing such that the order can subsequently be successfully filled and the customer charged for the goods. Nonetheless, in spite of this comparability, we question the propriety of using Lineco's order entry throughput rate as standard for Jobco (or vice versa!). The measures of office complexity presented in the next section will provide a quantitative basis for this position.

## Measures of Office Complexity

Earlier, we stated that complexity is based on the variation and interrelation of parts and patterns evident in an entity upon its investigation. In TAM's terminology, the basic unit of analysis (i.e., part or element) of office work is the <u>task</u>, while patterns of tasks occur as either <u>task structures</u> or <u>task groups</u>. Our focus will be on the measurement of variation and interrelation at the level of the task structure and, to a lesser extent, the task group. Before commencing that discussion however, let us note why we ignore variation and interrelation at the level of the task itself.

Every task, by definition, has at least three basic components: an agent, an operation, and an information-object. Thus, by definition, any two tasks vary from each other unless exactly the same agent performs exactly the same operation on exactly the same object. Even in the most antiquated and inefficient organization, this occurs relatively rarely, for the excellent reason that people see little point in repeating their actions verbatim. Thus, at the level of the individual task, variation is almost endemic, and the utility of measuring such variation is highly questionable. With respect to the interrelationships of tasks, we note that TAM organizes this information not as a component of the task itself, but rather as implicit in the task's superordinate task structure or task group. By measuring the appropriate characteristics of task structures and groups, we obtain information about the relevant interrelationships of the individual tasks.

For the task structure, or task group, we will define and measure two types of complexity: operational complexity and sequential complexity. A third measure combined complexity, meant to serve as a combination of these, will then be proposed.

## Operational Complexity

Operational complexity, as its name implies, is based on the complexity of the task-operations comprising the task structure under study. As we have seen in Table 1, the degree of "procedurality" or "structure" in a given task varies in relation to its task-operation. The amount of intelligence needed for successful execution of tasks increases steadily as we move from (1) physical through (2) procedural, (3) discretionary, and into (4) complex operations. The boundary between procedural activities and discretionary ones is probably the most important demarcation, however, as it separates "structured" activities from those which require an element of judgment or intuition. Thus operational complexity will measure the relative proportion of more complex task-operations present in the task structure under investigation as shown in formula 1.

$$C_o(i) = \text{semi}(i)/\text{tasks}(i) \quad (1)$$

where $C_o(i)$ = Operational complexity of task structure i

semi(i) = number of semi-structured or unstructured tasks present in task structure i; and

tasks(i) = the total number of tasks in task structure i.

In this formulation, both semi(i) and tasks(i) are integer-valued functions, with tasks(i) having a range from 1 to infinity (at least in theory), and semi(i) having a range from 0 to tasks(i). In practice, it is extremely rare to find a task structure without at least one structured task, and few task structures contain more than one hundred tasks. Thus, we expect to find values for $C_o$ ranging from 0 to 1, with zero indicating a task structure composed entirely of structured or algorithmic tasks, while a value of 1 would indicate a task structure in which every task operation is an unstructured or semi-structured one. Thus, operational complexity measures relative variation in the nature of task operations present in a task structure.

To calculate the operational complexity of the Jobco Order Entry System ("Jobco-OE" for short), we need to specify values for semi(Jobco-OE) and tasks(Jobco-OE). From Figure 1, we see that we see that semi(Jobco-OE) = 21. While no value for tasks(Jobco-OE) is explicitly presented, we note that tasks(Jobco-OE) = semi(Jobco-OE) + struc(Jobco-OE). As the value of the latter is 42, tasks(Jobco-OE) = 63. Thus, the operational complexity of Jobco's order entry process is $C_o$(Lineco-OE) = 21/63 = .33. In similar fashion, $C_o$(Lineco-OE) = 0/49 = 0.0. This difference in values reflects such factors as:

1. Jobco accepts orders over the telephone, thus implying a more complex information acquisition process, while Lineco insists on receiving hard-copy orders, and simply returns those which are incomplete or incorrect.

2. Jobco's estimation, production scheduling, and delivery planning activities include judgmental tasks; these activities are not present in the Lineco task structure.

3. Jobco negotiates prices and payment terms; Lineco does not.

4. Lineco has a smaller, but far more stable customer base. New customers are solicited by salespeople, and their credit reference verification and record creation is handled outside

the order entry process entirely.

Sequential Complexity

Sequential complexity measures the complexity of the interrelationships binding the task structure together. The simplest type of relationship is the strict stimulus/response relationship, where the completion of one task acts as an automatic stimulus for the subsequent task. The only other option is for the stimulus to be mediated by a condition. The number of conditions present in other "bindings" of a task structure then permit a measure of the complexity of the sequence's interrelationships, as follows.

$$C_s(i) = \text{cond}(i)/\text{tasks}(i) \qquad (2)$$

where $C_s(i)$ = sequential complexity of task structure i,

cond(i) = number of conditions present in i, and

tasks(i)= number of tasks present in i.

In this formulation, both cond(i) and tasks(i) are integer-valued functions, with tasks(i) ranging in value from 1 (since every task structure has at least one task) to infinity and cond(i) ranges from 0 to tasks(i). Thus $C_s$ can also range from 0 to 1, with a value of 0 indicating the complete absence of conditional interrelationships between tasks in the task structure. In other words, a sequential complexity of 0 indicates that the task structure's component tasks are bound together entirely by the simple "stimulus/response" binding. Such a task structure is "simple" in the sense that once the task structure's execution has been initiated, the execution of each of its components tasks in a unique predictable sequence is assured. Alternatively, a sequential complexity of 1, the maximum value possible, indicates a task structure in which the execution of each task is governed by a condition. Such a task structure is highly "complex" in the sense that, even given the initiation of the task structure, we are unable to predict which of its component tasks will be executed without determining truth-state of each condition. Moreover, the task structure is also "complex" in the sense that there are multiple execution sequences of tasks possible, as opposed to the one possible execution sequence present in a task structure whose sequential complexity is 0.

To calculate the sequential complexity of our two example order entry systems, we need to know the number of tasks and conditions that each includes. Using the notation established in the previous section, we see that cond(Jobco-OE) = 10 and cond(Lineco-OE) = 2. Thus $C_s$(Jobco-OE) = .159 and $C_s$(Lineco-OE) = .04. Even after correcting for the differences in size (n of tasks) in the two task structures, we note that the number of conditions present in the Jobco-OE task structure is approximately four times as large as their presence in the corresponding Lineco process.

## Combined Complexity

Since operational and sequential complexity represent distinct dimensions of the complexity of office work, their combination into a single measure appears advantageous in that it would allow the direct comparison of the overall complexity of different task structures. Because the interaction of different aspects of complexity begets further complexity, we feel strongly that the product of operational and sequential complexity measures should be part of an overall or combined measure. However, the product by itself is insufficient, as consideration of our Lineco values clearly demonstrates. When a task structure has either operational or sequential complexity valued at 0, its product with any other value is also 0, which is appropriate for a measure of interaction effect alone.[2] It is not, however, appropriate as an overall, aggregate measure, for it asserts that because one aspect of complexity is not present, no aspects of complexity are present. The measure we propose for Combined Complexity, then, includes both the sum of individual complexity measures, in order to reflect their individual presences, and their product, to account for their anticipated interactions. Thus, we define combined complexity, $C_c$, as follows.

$$C_c(i) = C_o(i) + C_s(i) + (C_o(i)*C_s(i)) \qquad (3)$$

where all terms are as defined earlier.

[2]That is, there should be no interaction effect if one of the interacting factors is not present.

Under this formulation, combined complexity varies from 0 to 3 for any task structure. A value of 0 indicates a task structure with (1) no semi-structured or unstructured tasks present ($C_o = 0$); (2) no conditions present ($C_s = 0$); and, obviously, (3) no interaction between operational and sequential complexity. A value of 3, on the other hand, indicates a highly complex task structure. The task structure would be composed entirely of semi-structured and unstructured tasks ($C_o = 1$), and the execution of each task present would be governed by a condition ($C_s = 1$). Thus, there would also be complete interaction between the two types of complexity ($C_o * C_s = 1$). Not only would the performance of each task involve human judgment, but the maximum number of task-execution sequences would also be seen.

In practice, a task structure with a combined complexity value of 3 would never occur. Such structured activities as the filing, retrieval, and sending of information-objects are performed quite frequently, even by such august and eccentric personages as chief executive officers, strategic planners, and secret agents. A one to one correspondence between the number of structured tasks and semi- or unstructured ones (generating $C_o = .5$) is quite high, as would be a sequential complexity value of .5, indicating the presence of half as many conditions as tasks in the task structure. These two values would produce a combined complexity of $C_c = 1.25$. Only occasionally would we expect to encounter such a value in measuring the complexity of "real world" task structures.

The application of our combined complexity measures to our example order entry processes is straightforward. $C_c$(Jobco-OE) $= .33 + .159 + (.33 * .159) = .54$. $C_c$(Lineco-0E) $= 0.0 + .04 + (0*.04) = .04$. The combined complexity value for Lineco remains extremely small, while that for Jobco's order entry function is much higher.

## Discussion and Summary

This section will discuss the implications of these office complexity measures for the measurement of white-collar productivity, and identify and elaborate some of the limitations which currently attach to our measures. Some of these limitations, in turn, will be seen to suggest promising avenues for further research of both empirical and theoretical flavors. A brief summary will then conclude the paper.

### Implications

The applications of the measures we have proposed above has strong implications for the organization, staffing, automation, and evaluation of existing task structures as well as for the design of new ones. In terms of re-organizing office work or designing new workflows, the calculation of combined complexity values for the existing and proposed task structures provides a simple yet meaningful basis for their comparison. Ceteris paribus, a proposed task structure should have a lower combined complexity value than that of the structure it will replace.

Operational complexity also can be used as a basis for staffing, in terms of differentiating positions, in terms of grade and salary, based on the complexity of the work the position entails. The greater the job's operational complexity, the higher the grade and salary appropriate to it. For a purpose such as this, we would use a job-oriented task aggregation (e.g., a job description) rather than the workflow-oriented TAM task structure.

Operational complexity also forms a relatively easily-devised predictor of the susceptibility of a given task structure to automation or computer-based support. The lower the structure's operational complexity value, the larger is the degree to which structured, easily-automated task-operations predominate over unstructured (and un-automatable) ones. Sequential complexity is a less serious consideration here, because computer-based systems generally handle the evaluation of explicitly-stated conditions quite well. Thus the Lineco order entry system would be an excellent candidate for automation, while that of Jobco might prove a much "thornier" problem.

The last major implication we wish to elaborate concerns the evaluation of office processes, especially in terms of "productivity." As the examples above have illustrated, a similar "function" may exist in extremely different forms in different organizations, in spite of the fact that it receives equivalent inputs and produces similar outputs. For this reason, we suggest that measures of complexity such as those we have presented should be used to "calibrate" productivity measures when they are applied to compare operations in different firms or even in the same firm at different points in time.

Beyond this, however, we wish to suggest an additional thesis. Where a large variance in throughput rates is observed, we anticipate an increased value for sequential complexity. In other words, in a system where there are many types of "special cases" (leading to a high value for $C_s$), we expect to see a large variance in throughput rates. We contend that, by discriminating case-types more finely, and defining unique task structures for each "special case," we can both lower sequential complexity values and, more importantly, improve our precision in measuring office productivity.

## Limitations and Possible Extensions

Not surprisingly, the measures presented in this paper have many limitations, several of which are apparent to its author. The latter stem from: (1) our lack of empirical corroboration of the measures; (2) their reliance on TAM Office descriptions; (3) the strong possibility that other dimensions of office work complexity deserve inclusion; (4) the lack of any objective standards, such as national average values, against which a particular task structure's complexity can be meaningfully compared; and (5) the failure of these measures to consider the frequency of a task's execution or a conditions's evaluation in calculating its parent task structure's complexity. Each of these limitations is elaborated below.

Currently, we have no empirical corroboration of the office complexity measures presented here. As an example of such corroboration, we might administer a simple survey questionnaire to order entry employees at Jobco and Lineco, asking them to agree/disagree with statements such as "Every order has something special it needs" (sequential complexity) and "When I tell people what I do, it always sounds easy; but when I have to train a replacement, it's a real challenge" (operational complexity). If questions like these were answered more strongly in the affirmative by Jobco employee than by Lineco employees, we would have greater confidence in our measures.

As we have presented the measures, they are applied to TAM office descriptions. This is problematic for at least two reasons -- first, few people are familiar with TAM, and, secondly, its reliability as a data collection instrument has yet to be established. The calculation of operational complexity values, in particular, is quite sensitive to TAM coding of task-operations, and this sensitivity increases as the number of tasks in the task structure decreases. For this reason, reliability studies of TAM coding are a particularly important topic for research.

We may also surmise that there exist further dimensions of complexity in office work, beyond the two with which we have dealt in this paper. Two possibilities which may deserve consideration include the complexity of the information-object being processed and the complexity of the conditions themselves. We have not considered the complexity of objects because we feel it is, to a significant degree, reflected in the complexity of the processing applied to the object. Thus, considering the object's complexity in addition to the processing complexity would result in "double-counting." This, however, is little more than "informed conjecture," and could prove an interesting subject for research. Evaluating the complexity of individual conditions and expanding our definition of combined complexity to include "conditional complexity" could also be a worthwhile subject.

Measures of office complexity calculated as we have proposed above are all <u>absolute</u> measures. This is problematic because we have no standard against which to compare them. Thus, we do not know, for example, whether the Jobco order entry function's operational complexity value of .33 is "high," "low," or "typical." We do not know how it <u>compares</u> to the corresponding value for analogous order entry functions. Calculations of <u>relative</u> complexity (or simplicity) derived from the variance between a particular function's complexity and an average complexity calculated from a large sample of comparable functions, might be far more valuable and informative. Indeed, longitudinal comparisons of such average complexity values would enable us to estimate the impact of information technology on office complexity. However, the calculation of such averages presupposes the collection, organization, and analysis of large amounts of empirical data, over a period of at least several years.

Finally, we note that each of the three measures we have formulated could be improved by weighting its component factors to reflect their actual frequency of occurrence. We will elaborate this point via an example. Suppose we know that 28% of the orders Jobco receives require preparation of a bid or estimate. In that case, rather than counting the Bid Preparation task group's components as (6,1,1) as in Figure 1 above, we could apply a weighting factor of .28 and value the components at (1.68, .28, .28). Where such information is available, it can be applied to generate more representative valuations of office complexity -- more representative in the sense that they reflect the average set of activities performed, rather than the most complex one possible, as do our measures.

## Summary

This paper has presented two direct measures of office complexity, operational complexity and sequential complexity. The former is concerned with the difficulty of mastering and successfully performing a particular task, while the latter measures the complexity of relationships (or possible sequences) between different tasks. These two are aggregated into an overall measure of complexity, combined complexity, which reflects their individual presence and expected interaction. Values for each of these measures have been calculated for, and used for comparison of, two hypothetical order entry processes. Descriptions of the processes, prepared using the Task Analysis Methodology, provide the basis for application of our measures.

Measures such as these have important implications for the evaluation of existing and/or proposed office systems, for staffing decisions, and for the study of productivity across different office workflows. Possible extensions and elaborations of these meaasures have been identified, including their empirical corroboration, the inclusion of additional dimensions of complexity in the office, their refinement via the application of weighting factors, and the collection and analysis of appropriate data to allow the derivation of standards for meaningful comparison.

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## References


[Gove 61] Gove, P. B, ed.
*Webster's Third New International Dictionary.*
G. & C. Merriam Co., Springfield, MA, 1961.

[Sasso 85] Sasso, William C.
*A Comparison of Two Potential Bases For Office Analysis: Function and Organizational Unit.*
PhD thesis, The University of Michigan, 1985.

[Sasso et al 86] Sasso, William C., Judith Reitman Olson, and Alan G. Merten.
The Practice of Office Analysis: Objectives, Obstacles, and Opportunities.
1986.
In Preparation.

[Simon 69] Simon, Herbert A.
*The Sciences of the Artificial.*
MIT Press, Cambridge, MA, 1969.

[Sirbu 83] Sirbu, M. A., Jr., S. R. Schoichet, J. S., J. S. Kunin, M. M. Hammer, J. B. Sutherland, and C. L. Zarmer.
*Office Analysis: Methodology and Cases.*
Technical Report, MIT/LCS/TR-289, March, 1983.

[Suchman 83] Suchman, Lucy A.
Office Procedure as Practical Action: Models of Work and System Design.
*ACM Transactions on Office Information Systems* 1(4):320-328, October, 1983.

[Suchman 84] Suchman, Lucy A.
Procedures and Problems in the Office.
*Office: Technology and People* 2(2):133-154, January, 1984.

[Sutherland 83] Sutherland, J.
*An Office Analysis and Diagnosis Methodology.*
Technical Report, MIT/LCS/TR-290, March, 1983.

Table 1.

**The TAM Information-Processing Hierarchy**

| TAM Activity-Class | General Description | TAM task-operations |
| --- | --- | --- |
| Physical | Transformation of Medium | Destruction<br>Preparation<br>Transfer |
| | Communication to new location | Sending |
| Procedural | Algorithmic (1 to 1)* | Calculation, Coding<br>Sorting, Inspection |
| | Disjunctive (1 to many) | Distribution<br>Retrieval<br>Selection<br>Separation |
| | Correlational(many to 1) | Filing<br>Assembly<br>Merger<br>Verification |
| Discretionary | Judgemental (1 to 1) | Acquisition<br>Review<br>Determination |
| | Analysis (1 to many) | Reconcilation |
| | Synthesis (many to 1) | Synthesize |
| Complex | Negotiation<br>Creation | Negotiate<br>Create |

* denoted as 1 input to 1 output

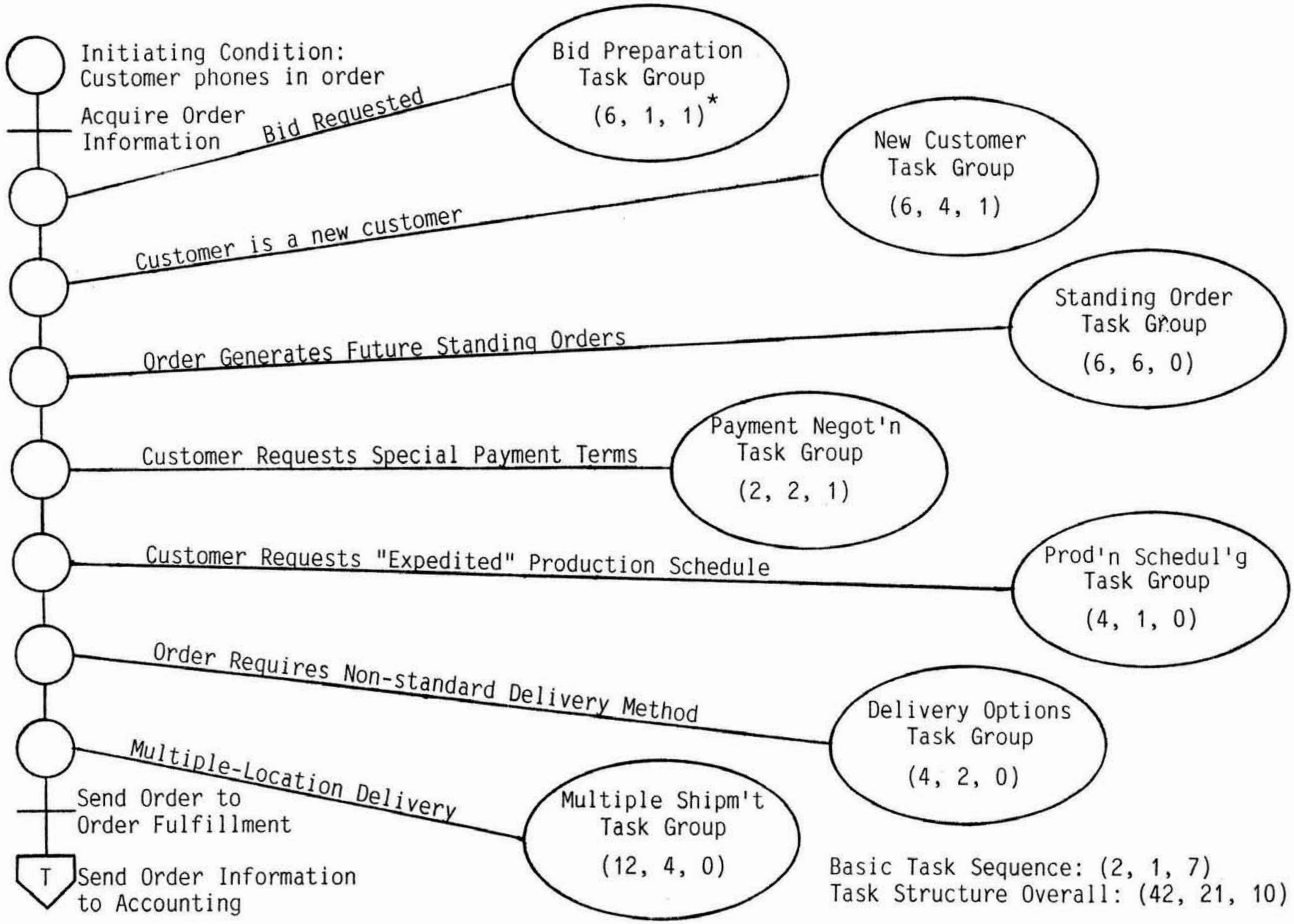
Table 2

Order Entry Components: Jobco and Lineco

| | Presence or Absence at Jobco | Presence or Absence at Lineco |
|---|---|---|
| **Basic Task Sequence** | | |
| Enter Order description | Present | Present |
| Transmit order to Order Fulfillment | Present | Present |
| Transmit order to Accounting | Present | Present |
| **Possible Processing Options** | | |
| Check Credit References | Present | Absent |
| Create New Customer Records | Present | Absent |
| Bid/Estimate Preparation | Present | Absent |
| Standing Order Handling | Present | Present |
| Payment Term Negotiation | Present | Absent |
| Production Scheduling | Present | Absent |
| Special Delivery Scheduling | Present | Absent |
| Multiple-Location Delivery | Present | Present |

Figure 1

Jobco Order Entry Task Structure




*The numbers in parentheses denote the number of (1) physical and procedural tasks, (2) discretionary and complex tasks, and (3) conditions present in the task sequence, group, or structure.

Figure 2

Lineco Order Entry Task Structure