WORKFLOW AND ORGANIZATIONAL UNIT:
AN EMPIRICAL COMPARISON OF ANALYSIS PERSPECTIVES

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ABSTRACT

Many processes, techniques, tools, methodologies, and approaches claim to facilitate the process of information systems development, but little empirical validation in support of these claims has been publicly reported. This research addresses this shortcoming in two ways. First, it develops and applies a promising experimental design for the comparison of systems analysis techniques. The design's objective was to external validity of experimental findings while maintaining high degrees of control and comparability. Secondly, our design, the "transcript experiment," was used to evaluate two versions of an analysis procedure. This paper both presents and evaluates the transcript experiment as a research design and reports the results of an actual experiment.

The study we report investigated the impact of a particular factor in the systems analysis process, which we term analysis perspective. After elaborating a (partial) theory of systems analysis enabling us to predict the impact of different analysis perspectives on (1) the analysis process, (2) the content of reports it produces, and (3) the utility of the analysts' recommendations, we compared the influences of two particular perspectives, the workflow perspective and the organizational unit perspective. We observed significant differences in subject behavior in acquiring information during the analysis process, but the data were inconclusive with respect to our predictions concerning the content of reports and the utility of subjects' recommendations. Finally, we noted a strong negative correlation between the number of recommendations produced by a subject and the degree to which he documented the current system. We term this correlation the descriptive/prescriptive tradeoff, and feel it deserves further study, as it may invalidate a number of widely-held assumptions concerning the systems design process.

Many procedures, techniques, tools, methodologies, and approaches claim to facilitate the process of information systems development, but little empirical validation of any of these has been publicly reported. Vitalari, for instance, notes the "... proliferation of untested methodologies for systems analysis" [18]. Turner states that " ... we don't know what system design consists of, we don't know how it is done, and we don't know how to teach it" [17]. Given such ignorance, the advantages of the systematic evaluation of these methodologies are clearly important. They include:

1. enhancement of our ability to identify and apply superior techniques for systems analysis and design;

2. identification of the critical parameters of an analysis and design context, which may mediate our selection of the most appropriate technique or tool;

3. specification of gaps in the "coverage" of development process activites provided by the set of techniques currently available, where either

    a. no technique supporting a particular activity currently exists; or

    b. the existing techniques can be proven to support that activity in an inadequate fashion; and

4. delineation of charactersistics which contribute to the superiority of one procedure over another, i.e., the ability to say not only <u>that</u> one procedure is superior, but <u>why</u> it is superior.

Counterbalanced against these advantages, however, there exist some very serious difficulties in performing such an evaluation. First, there is the problem of achieving controlled, experimental conditions (thus allowing the meaningful comparison of experimental results), in situations which provide some basis for the generalization of those results. In other words, it is quite reasonable to question whether findings produced in a "sanitized" experimental context bear any semblance to those which would be observed in the complex arena of "real-world" systems development.

On the other hand, research done at individual field sites (e.g., case studies) offers

little meaningful basis for the comparative evaluation of "equivalent"[1] techniques supporting the systems development process. Such evaluation, when based on case study data, requires acceptance of a highly unrealistic set of assumptions, especially concerning the degree to which different sites provide equivalent bases for application of a particular tool. Even in overtly similar contexts, such as commercial lending departments at different banks, or admissions offices at different universities, it would appear naive to expect truly comparable conditions to be realized. At least one of a number of potentially critical dimensions[2] of the analysis context is highly likely to vary. Thus, using an experimental approach, we achieve comparability of results by sacrificing our ability to generalize from them, while the case study approach seems to preclude any real basis for comparing results produced through the application of different techniques for systems analysis and design.

The research reported here has developed and applied a promising experimental design for comparison of systems analysis techniques. The design's objective was to increase the generalizability of results while maintaining high degrees of control and comparability. Our design, the "transcript experiment," was used to evaluate two versions of an analysis procedure. This paper will both present and evaluate the transcript experiment as a research design and report the results of the comparison performed.

The capabilities the transcript experiment gives us may be of particular value at the present time, due to the growing realization the "often management has to change work flow in order to realize the benefits of automation" [1]. After literally millions of computers have

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[1]Throughout this paper, we will term different methodologies "equivalent" if they use similar inputs and produce similar outputs, i.e., if they support the same component activity (or set of component activities) in the systems development process.

[2]Dimensions likely to vary could easily include, for example, the degree of cooperation received by the analyst, the articulativeness of the interviewers and the accuracy of their conceptualizations of systems in use, the nature of the systems in use, and the fundamental responsibilities of the units and their structures used to carry those responsibilities out.

been installed in America's offices, few gains in overall productivity have been observed [14, 16, 1]. This shortcoming has not gone unnoticed by top management -- in a recent survey of chief executive officers, the two issues of great concern most commonly cited were cost containment and productivity [7].

Office analysis addresses these concerns be helping describe information-processing activities in order to (1) identify activities or groups of activities which can be automated or supported with computer-based tools, and (2) suggest how the configuration of these activities can be improved or streamlined without additional computer support. More specifically, office analysis helps the analyst 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 currently produced; and
6. Creation of new information-processing capabilities.

Office analysis, then, is a preliminary stage of the systems development process, involving the description of current information-handling practices and the identification of potential improvements in those practices[3].

1. Towards a Theory of Systems Analysis

Since office analysis has only recently become a topic of interest, the literature on it remains rather sparse. Nonetheless, some promising inquiries have begun to identify and analyze critical components and differentiating factors in existing office analysis procedures.

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[3]For a more complete discussion of office analysis per se, see [11].

Bracchi and Pernici, for example, discriminate and compare data-based, process-based, agent-based, and mixed models of office systems [2]. Higgins and Safayeni discuss the presence of office task taxonomies as a common element in many office analysis procedures [5]. Further, as Sasso, Olson, and Merten [12] have noted, existing methodologies for office analysis can be meaningfully differentiated along at least two distinct dimensions: (1) domain of analysis and (2) characteristics of work described.

The domain of analysis of an office description is that region of the organization whose information-handling activities it describes and analyzes. That is to say, while a series of office descriptions might attempt to describe the entire set of information-handling activities in the organization, each individual description restricts itself to a subset of these activities [10]. This subset of activities described in a particular office description forms the description's domain of analysis.

With respect to the characteristics of work described, Sasso [10] notes that most component activities of office work may be described in several alternative sets of terms, ranging from descriptions of physical activities to inferences concerning cognitive operations. These different descriptions of physical activities may be thought of points on a spectrum of work descriptions, ranging from the purely concrete physical description of work activity to the abstract or logical description of work. Thus, a particular activity might be described in physical terms as "arm and hand movement," while in abstract or logical terms it might be referred to as "ordering supplies."

These two dimensions of office analysis deserve further discussion. First, we note that these dimensions apply to many descriptions of work activities, not simply those produced using office analysis methodologies. For example, Mintzberg's classic study, The Nature of Managerial Work, applies a mid-range set of descriptive terms to study a sample of individuals drawn from a domain of analysis consisting of a set of people working at the same organizational level, top management, across different firms [8]. Similarly, descriptive

techniques such as the Data Flow Diagram representation[4] clearly focus on the workflow as a domain of analysis and attempt to describe its component activities with fairly abstract descriptions. Secondly, these two dimensions appear to be independent; they do not always vary together. Descriptions produced using MIT's Office Analysis Methodology [13, 15] and The University of Michigan's Task Analysis Methodology (TAM) [9] have different domains of analysis, but generally equivalent work descriptions. This suggests that in mastering an office analysis methodology, one acquires two distinct types of knowledge. The first type, we will refer to as analysis technique. In learning a methodology's technique, one becomes adept at identifying, measuring, and reporting that set of descriptive characteristics of information processing work considered relevant by the methodology. Technique often involves a fairly complex set of descriptors and formats, but it is generally treated explicitly in any presentation of the methodology. Within a particular domain of analysis, a competent application of the technique should produce an office description identifying, measuring, and reporting certain factors of the situation, in a specific and predefined manner. Thus, we attribute the variation in work descriptors produced through the application of different analysis methodologies to the distinct analysis techniques present in these methodologies.

But one must not only learn to apply an analysis technique competently -- one must also learn to identify the domain within which its application is appropriate. This is a second type of knowledge, which we will term analysis perspective. Analysis perspective guides the analyst in delineating the boundaries of the analysis situation itself. Unfortunately, to the extent that analysis perspective is treated at all in formal presentations of methodologies, it is generally dealt with implicitly, emerging only in examples of the application of analysis technique.

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[4]See, for example, [3] or [19].

Figure 1 about here

Figure 1[5] depicts our model of the analysis process. In the course of learning to use a methodology, one learns its technique and perspective. These two factors, in turn, shape the analysis process and thus indirectly determine the general structure, content, and domain of analysis of the resulting office description.

We make two assertions in this model. First, we contend that it can explain the systematic differences between office descriptions produced through application of different office analysis methodologies, as noted by Sasso et al [12]. Second, we suggest that, in the context of systems development, the utility of an office description is correlated with its domain of analysis (when analysis technique is held constant). Now we will elaborate this model into a comparative model as a basis for testing a particular case of each of these assertions.

Consider the possibility of having groups of analysts trained in two versions of an analysis methodology, where the versions share a common set of techniques but differ in the analysis perspectives they embody. We would expect the office descriptions they produced to differ in terms of their domains of analysis due to the different analysis perspectives. The work descriptors they employed, on the other hand, should be quite similar. This comparative theory is depicted in Figure 2.

Figure 2 about here

In this research, we have replaced the "generic" factors "analysis perspective 1" and

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[5]All figures and tables follow the text of the paper, beginning on page 26.

"analysis perspective 2" with specific perspectives which have been articulated and embodied in office analysis methodologies. The first perspective is the organizational unit perspective. Most notable of the office analysis methodologies which embody this perspective is MIT's OAM/OADM. The second perspective is the workflow one, most clearly embodied in TAM.

Why were these two particular perspectives chosen for comparison? First of all, we feel that analysis perspective should relate to a dimension of the office over which management has some control. This suggests that the "office as social group" perspective is not a desirable alternative. Secondly, because the benefit of computer-based systems will not be fully realized if we focus on physical work locations, we feel the physical (or geographical) perspective is a fairly weak candidate.[6] Third, because we wish to provide support not only for individual tasks but also for their recurrent aggregations, in the forms of routines or procedures, we rule out the hierarchical level perspective of Waterloo's Office Activity Methodology. Furthermore, the unit perspective and the workflow perspective have both been embodied in office analysis methodologies which appear to use generally comparable and equivalent analysis techniques.

When these analysis perspectives are combined with the comparative model depicted in Figure 2, we derive the following hypotheses, which are tested in this research.

The search pattern hypothesis predicts the behavior of the subject as he searches for information, and has two components. The order of search sub-hypothesis states that subjects using the workflow perspective ("workflow subjects") will give higher priority to acquiring transcripts of interviews with employees outside the original unit[7] than will the unit

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[6]For example, much of the computer-based support applicable at a particular branch office of a bank will apply at all branch offices of the bank, regardless of the fact that they are geographically disparate.

[7]The experimental design starts all employees with transcripts of the same interview. The employee interviewed is the manager of the "original unit."

subjects. The extent of search sub-hypothesis asserts that workflow subjects will spend more time studying transcripts from outside the original unit than will unit subjects.

The domain of analysis hypothesis predicts the content of the descriptive portion of the reports prepared by subjects. The focal unit sub-hypothesis states that the unit subjects will more completely describe activities performed in the original unit but outside the original workflow. In Figure 3 below, assuming that our original unit was the Accounting department, these "extra-workflow" activities would include the Payroll and Accounts Payable processes, neither of which is as directly related to the Advertising workflow as directly and intimately as is the Accounts Receivable process. Analogously, the focal workflow sub-hypothesis states that workflow subjects will devote a greater proportion of their description to activities in the original workflow which occur outside of the original unit. In Figure 3, these "extra-unit" activities would include Ad Definition, Ad Scheduling, Ad Preparation, Ad Proofing, and Ad Placement. We expect subjects trained with the workflow perspective to describe these parts of the workflow in more detail than those trained with the unit perspective.

Figure 3 about here

The utility hypothesis focuses on the prescriptive recommendations generated by the subject. We feel that the study of an entire workflow better enables the analyst to identify areas of redundant processing and storage of information, as well as operations which may be profitably combined. Moreover, we believe a general familiarity with the sources, transformations, and ultimate uses of information can help uncover more subtle strengths and weaknesses of the current process, as well as opportunities for creative, new applications of information already available or easily generated. Therefore, this hypothesis asserts that the recommendations generated by workflow subjects will be judged more useful by management personnel than will those generated by the unit subjects.

We now turn to a general introduction of the transcript experiment, and a specific discussion of its application to test these hypotheses.

2. Experimental Design and Data Collection

One way to test these hypotheses would be to train two groups of subjects and send them into an organization with instructions to perform an office analysis, with each "subject analyst" starting from the same point. There are, unfortunately, serious drawbacks to such an approach. First, for even a minimal number of subject analysts, the time demands on the organization and its employees would probably be excessive. Second, being interviewed repeatedly by different subject analysts on the same topics would be likely to contaminate the interviewees rather rapidly. Third, possible variation in the interviewing skills of the subject analysts might confound the experimental design, as could the presence of other factors discussed earlier (See footnote 2 above). In the transcript experiment, we avoid these difficulties by interviewing each employee once, tape-recording these interviews, and preparing interview transcripts from these tapes. We use these transcripts as a basis for experimental subjects to conduct systems analyses. A standard set of transcripts (and supporting displays) is available to each subject, thus creating the standard and comparable analysis context not present when analysts work at different field sites. The use of a standard set of transcripts minimizes the impact of such factors as the variation in subjects' interpersonal skills and in the degrees of cooperation they receive from interviewees.

The transcript experiment thus generally involves a four-step process. First, interviews are conducted (and tape-recorded) with personnel at field site organizations. Display materials, such as forms and documents mentioned in the interviews, are collected. Second, transcripts of the interviews are prepared. This includes the transcription process itself, indexing display materials so they can be found when mentioned in the interview, and an editing process intended to improve the intelligibility of the transcripts. The third step involves the selection and training of experimental subjects, and the fourth is the actual

experiment itself. In the discussion below of our transcript experiment, we will elaborate on each of these stages.

Field Site Interviews

The purpose of this process was to tape-record descriptions of office information-handling procedures, as related by the people responsible for their execution, to serve as a standard body of information available to experimental subjects. The transcripts, then, served as "intermediate" data. They did not allow us to test the experimental hypotheses, but rather enabled us to conduct an experiment which would generate data for that purpose.

Thirty interviews were conducted in two organizations, a newspaper and a book manufacturer. Given the nature of our research topic, interviewees were selected with regard to providing adequate coverage of a particular organization unit and a particular workflow. Moreover, there had to be a significant intersection between the workflow and the unit, in other words, some segment of the workflow had to be a significant part of the unit's responsibilities, in order to provide subjects with a common starting point in the experiment. Perhaps more subtly, but equally important, there had to be areas of non-overlap between the unit and the workflow. The unit had to have other responsibilities and the workflow needed segments performed by other organizational units, in order for us to expect to observe any impact of the different analysis perspectives.

The interview procedure used may be described as "goal-oriented" interviewing. The goal was an intelligible description of the information-handling work performed by the interviewer at a level of detail susceptible to TAM's analytical technique. Prior to taping any interview, the interviewer requested and received the interviewee's consent for the recording of the interview. To insure that the interviewer had an accurate understanding of the office processes described in the interviews, he prepared specifications of them and circulated each specification to at least two of the interviewed personnel familiar with the

process.[8]

Preparation of Transcripts and Materials

The tape recordings of the field site interviews were transcribed, edited, and typed in a consistent format. Transcription, though tedious, was a fairly straightforward process, but the original transcript in most cases then required significant editing. The editing process, for example, excised passages detailing: (1) interruptions by third parties clearly not relevant to the research (e.g., plans for lunch); (2) explanations of the purpose of the interview and/or research project; and (3) other digressions and small talk clearly not germane to the research project. Further, much of the dialogue was revised to improve its intelligibility. This frequently involved the segmentation of run-on sentences into proper sentences, the deletion of inital phrases or incomplete sentences which were later corrected or restated by their speaker, and the substitution of intended antecedent nouns for ambiguous pronouns. Furthermore, the names used to refer to organizational units and technological processes were standardized across the set of transcripts for each organization. Finally, to guarantee the anonymity of the individual interviewees, their actual names were replaced with fictitious ones in all materials associated with the experiment.

The display materials included forms and reports referred to in the interveiws. Copies were obtained, assigned index numbers, and mounted in manila file folders to facilitate their retrieval and protect them. When a transcript discussed a particular display item, its index number was inserted at the appropriate point in the passage, in order to help the subject locate the appropriate item.

The final type of material used in the experiment was the initation packet. A packet

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[8]Feedback about the interviewer's appreciation of these processes becomes important because he will be required to edit transcripts and to index materials and transcripts in the next stage.

was prepared for each of the two field sites. It contained a fictitious but plausible "statement of management concern," attributed to the organizations's president. This one-page statement was used to direct the attention of each subject to a common starting point for his analysis. The packet also contained a listing of all organizational personnel for whom interview transcripts were available, and a simplified organization chart indicating the "organizational location" of each employee interviewed.

The Selection and Training of Subjects

The eight subjects[9] participating in this experiment were full-time, first-term students in a Master of Business Administration program. They were drawn randomly from a pool of volunteers,[10] after the volunteers were restricted by eliminating those with either (1) significant academic training and/or work experience in the analysis of procedural systems, or (2) significant knowledge of the industry of in which either of the field site companies operated. Subjects were then randomly assigned to analysis perspectives and to the order in which they analyzed the two field site "cases." These orders were counterbalanced within the two experimental groups; half of each group analyzed the The Daily Miracle (the newspaper) first, while the other half studied Glatfelter (the book manufacturer) first.

Each subject attended two three-hour training sessions, and received a set of training materials. At the end of the second training session, subjects demonstrated their mastery of the analysis methodology by using a short sample transcript to prepare an office description. These descriptions were evaluated by the researcher, and two subjects whose mastery

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[9]This relatively small sample size was used for two reasons. First, this experimental technique is very time-intensive, with each subject spending over 20 hours in the training process and the experiment itself. Second, given the "unprovenness" of the experimental design, we were reluctant to commit the resources necessary to run a larger sample until the design had been successfully executed with a sample of eight.

[10]Subjects were compensated for participation in the experiment; they are described as "volunteers" in the sense that they received no external pressure to participate.

appeared questionable received tutorial assistance from the researcher and were re-tested. Upon passing either the intial test or the re-test, subjects were considered eligible to begin the experiment.

The Experimental Process

During the experiment, the subjects used interview transcripts to produce office descriptions, which could then be analyzed to generate data enabling us to evaluate the domain of analysis and utility hypotheses presented in the previous section. Moreover, during the experiment itself, the researcher collected data on the information search patterns used by subjects in the course of their analyses, enabling us to evaluate the search pattern hypotheses.

The subject's role in the experiment corresponded to that of a consultant brought in from outside the organization. By studying a set of transcripts, he was expected to acquire the information required to prepare an office description. The subject had the active role in the experiment; he was required to take the initiative in terms of selecting the relevant interview transcripts, identifying relevant information, and preparing the office description. This was done in order to parallel as closely as possible the actual analysis situation, in which the analyst receives only that information which he attempts to obtain.

The researcher's role in the experiment corresponded to that of a fairly senior member of the organization, acting as sponsor of the office analysis project. This role was fundamentally re-active, and focused on responding to the requests of the subject. The researcher "arranged" interviews by providing transcripts, and explained organizational or technical jargon present in the transcripts in response to specific questions from the subject. Moreover, in response to direct requests from the subject, the researcher would attempt to

clarify references or descriptions present in the transcripts.[11]

Over the course of the experiment, the researcher also maintained a log, recording the time and nature of each significant event. These included, for example, question/answer interactions between the subject and researcher, comments made by the subject, the timing of short breaks taken by the subject, and that of the subject's acquisition and return of transcripts.

Each subject completed two eight-hour experiments, divided into four major activity phases as shown in Table 1, Time Structure of the Experimental Sessions. Below, we will discuss each phase in more detail, and sketch out the philosophy used to apply this schedule during the experiment.

Table 1 about here

After a fifteen minute review of the appropriate version of the Task Analysis Methodology, the subject was given the initiation packet, commencing the session's first phase, transcript study. After a few minutes, the subject would indicate that he was ready to see the first transcript, which was the same for each subject. The initial transcript for the Miracle was from the retail display ad sales manager, and that for Glatfelter on the interview with the customer service manager. After finishing with the initial interview, each subject was allowed access to (up to) five additional transcripts of his own selection. While

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[11]This was necessary for several reasons. First, subjects often studied the transcripts in an order which differed from that in which the interviews were originally conducted. This meant that concepts which had previously been explained to the researcher at the time of the original interview were often new to the subject upon receipt of the interview. The explanation of these concepts or processes was necessary for the subject to comprehend the information presented in the interview, which was, after all, the experiment's intention. Moreover, in some cases, the descriptions in the interviews relied heavily on visual demonstrations, and thus were very difficult to follow in a two-dimensional narrative form.

subjects were restricted to possession of a single transcript at a time, they were allowed to see a given transcript any number of times. During the four-hour transcript study period, subjects were expected to identify and bound the processes which they planned to include in their office descriptions, and to prepare notes containing the required information. Again, these conditions represent our intention to duplicate as closely as possible the actual situation an analyst faces. He cannot, for example, conduct two independent interviews at once, but can call a previous interviewee for elaboration of points mentioned in the earlier interview.

After the subject and researcher had refreshed themselves over a one-hour break period, the session resumed. During phases two and three of the session, the subject was expected to prepare final versions of his office description's overview and task structure diagrams. For the first hour after returning, he was allowed access to those transcripts which he had already studied. After that first hour back from the break had ended, however, the subject was required to turn in any transcript currently in his possession, and no further access to any of the transcripts was allowed. At the end of the third phase, seven hours into the session, the subject was required to turn in all his notes and rough drafts, retaining only the final version of his office description's overview and task structure diagrams.[12] Here, our intention was to focus the subject on the generation of recommendations, which we needed in order to evaluate the utility hypothesis stated above. Experiences with pilot subjects suggested that, unless a fair amount of time was "dedicated" to this part of the process, it would be left to the very last minute and performed in an unsatisfactory manner.

During the last hour of the session, the subject was intended to review the final version of the task structure diagrams in order to prepare the final element of office description, the opportunities section. After turning in the entire office description, including

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[12]Subjects were also allowed to retain notes they had taken which specifically concerned office opportunities encountered in the course of studying the transcripts.

the overview, task structure diagrams, and opportunities, the subject had completed the session.

This four-phase time structure was originally developed to help the subjects complete the session, rather than to truncate their ongoing cognitive processes at certain arbitrary points in time. Accordingly, these time constraints were generally applied as guidelines rather than as inflexible, compulsory mandates for subject behavior.[13] The subjects conformed to them quite closely.

3. Data Analysis and Evaluation of Hypotheses

This section will evaluate the search pattern, domain of analysis, and utility hypotheses in turn, and then elaborate an unexpected and interesting finding of the research.

The Search Pattern Hypothesis

This hypothesis states that subjects using different analysis perspectives should exhibit different information acquisition behavior. We expect subjects behavior to differ along two dimensions: the order in which they acquire optional interview transcripts, and the amount of time they devote to the study of extra-unit transcripts. The model suggests that subjects using the workflow perspective will accord a higher priority to acquisiton of extra-unit interviews than will subjects using an organizational unit perspective. Similarly, we expect the former to spend more time than the latter in analyzing extra-unit transcripts.

In Table 2 we summarize measures of the amount of time each subject spent with extra-unit transcripts and the priority he accorded to their acquisition. The order of search values increase with the priority accorded acquisition of extra-unit transcripts, while the

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[13]The rules concerning the limit on the number of transcripts to which each subject had access and the return of the current transcript at 6:15 into the session were rigorously applied.

extent of search values increase with the proportion of time spent studying extra-unit transcripts. Each value is a mean of a set of four percentages, and thus can range from 0 to 100, computed as shown in the Appendix, which follows the Figures and Tables at the end of the paper.

Table 2 about here

Using the analysis of variance, our order of search data values reduce to an F-statistic of 9.052, for 7 degrees of freedom significant at alpha=.024. The extent of search data reduce to F=4.049, for 7 degrees of freedom significant at alpha=.091. Thus, we find strong support for the order of search sub-hypothesis, and less strong, but still statistically significant, support for the extent of search sub-hypothesis.[14] Thus, we conclude that analysis perspective does influence information acquisition behavior during the analysis process.

The Domain of Analysis Hypothesis

This hypothesis suggests that office descriptions produced by analysts trained in a workflow perspective should include more complete descriptions of workflow segments performed outside the focal unit, while those prepared by analysts trained to use a unit prospective will provide greater coverage of those activities not related to the focal workflow performed by members of the focal unit. In Table 3 we summarize measures of the relative degree to which each office description discussed (1) extra workflow activities performed by members of the focal unit (focal unit data), and (2) focal workflow activities executed by members of other units. Again, these are group averages of percentages, such that the larger

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[14]These hypotheses measure different dimensions of the same overall phenomenon. They are not independent hypotheses; indeed, the data used to evaluate them are correlated, with r=.80, which is significant at alpha=.007 for eight cases.

the value, the greater the degree to which these types of tasks comprised the office descriptions produced by members of the group, computed as shown in the Appendix.

Table 3 about here

Using the analysis of variance, we derive from the focal unit data an F value of 1.537, while that of the focal workflow data is 2.410. For 7 degrees of freedom, neither of these values approaches statistical significance. On the basis of this research, we are unable to demonstrate that training in an analysis perspective will influence the context of the office description that an analyst produces.

The Utility Hypothesis

This, the central hypothesis of this research, asserts that office descriptions prepared by subjects trained in the workflow perspective should be of greater value in the information systems development process than those prepared by subjects trained in the unit perspective. This is because we believe the former will be able to identify more redundant activities within a given workflow as well as greater opportunities for the combination and integration of these activities. By having managers at each field site score each recommendation made by subjects as to its feasibility and value, and using the product of these two scores as a measure of utility, we derive the values summarized in Table 4. These values are computed as shown in the Appendix.

Table 4 about here

Again applying the analysis of variance[15] , we generate a total utility F-statistic of

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[15]Application of the analysis of variance technique on this data requires a willingness to treat these values as interval data. This assumption appears reasonable, given the nature of the data, as discussed in the Appendix.

0.191, and one of 1.807 for average utility. With 7 degrees of freedom, neither of these approaches statistical significance. Thus, we are unable to verify our model's predictions with respect to either the total utility or average utility scores. This research has been unable to verify the predicted impact of analysis perspective on the utility of an analysts' recommendations.

The Descriptive/Prescriptive Tradeoff

In attempting to identify factors which do influence these total utility scores, we noted an interesting correlation which we term the "descriptive/prescriptive tradeoff." This is a strong inverse correlation between the total utility score of an office description and the number of tasks specified in the description. The total utility value of a description is obviously related to the number of opportunities it identifies (Pearson correlation coefficient r=.902, for n=8, Alpha=.001). Also evident from the data presented in Table 5, and perhaps more intriguing, is the inverse relationship between the number of tasks specified and the number of opportunities identified. These values correlate at r=-.743, which for eight cases is statistically significant at level alpha=.017. Since the number of tasks described and the number of recommendations made exhibit a strong negative correlation, it is hardly surprising that the number of tasks specified and the total utility scores have a correlation coefficient of r=-.734, for eight cases statistically significant at level alpha=.018.

Table 5 about here

These data suggest a possible negative interaction between the two major activities in the office analysis process. That is, they suggest that the more completely and accurately we describe an office's activities, the less useful will our recommendations be! We had implicitly assumed that a more complete specification of the current system would help the analyst generate recommendations for its enhancement. In these data, however, we observe an interference between these factors. It is possible, of course, that this may represent little

more than the impact of the experiment's time constraints. On the other hand, it may be possible that as we build more formal, detailed descriptions of current systems, we reduce our innate ability to conceive of alternative systems. Finally, it may be that this result can be attributed to the tendency of structured work to pre-empt less structured work. The technique employed does provide more structured procedures for the description of existing systems than it does for the generation of recommendations.

We feel the descriptive/prescriptive tradeoff clearly deserves further investigation. Some proposals for its examination will be presented in the next section.

4. Discussion and Summary

This research has identified a particular factor in the systems analysis process, i.e., analysis perspective. Further, it has developed a (partial) theory of systems analysis enabling us to investigate the impact of variation in the analysis perspective on (1) the analysis process, (2) the content of system descriptions it produces, and (3) the utility of these descriptions. We have used this model to compare the impacts of two particular analysis perspectives, the workflow perspective and the organizational unit perspective, and have observed statistically significant differences between them in terms of the observed subject behavior in acquiring information during the analysis process. The data were inconclusive with respect to our predictions concerning the content of descriptions and the utility of the analyst's recommendations. Finally, we noted a strong inverse correlation between the number of recommendations produced by an analyst and the degree to which he documented the current system. We term this correlation the descriptive/prescriptive tradeoff.

The main methodological contribution of this research is its development and application of the transcript experiment. Research on the practice of systems analysis has been hampered by our inability to study the process under conditions which are both

comparable, i.e., standard for all subjects, and at the same time sufficiently complex that they resemble real-world analysis situations. As it is elaborated further and refined, the transcript experiment is likely to prove valuable in research studying the systems analysis process.

These contributions have important implications for research on the topic of systems analysis. They involve the extension and investigation of the systems analysis model we have proposed, the evaluation and refinement of the transcript experiment as a data collection technique, and further study of the specification effect.

The results of this research provide empirical support for important components of our office analysis model, but for some relationships proposed (e.g., the relationship between analysis perspective and office description utility), our data are inconclusive, implying the desirability of further investigation. Moreover, certain relationships suggested by the model, such as the possibility of interaction effects between analysis perspective and analysis technique, or the interaction of elements of technique itself, have not been treated here. The extension of the perspective/technique dichotomy to later stages of the systems analysis process may prove quite informative. Systems analysis is fairly rich in its set of analysis technique elements, such as data dictionaries, data flow diagrams, pseudo-code, HIPO charts, and program and system flowcharts, but the compilation of some or all of these elements into an integrated analysis technique appears to be guided primarily by the common sense of the methodology's developers rather than by any theory of systems analysis as a process. By determining whether the elements of a methodology's analysis technique are congruent, complementary, or orthogonal, to each other, we may be able to improve the design of methodologies and the execution of systems development projects.

Similarly, we need to refine the transcript experiment procedure, reducing its susceptibility to the personal bias of the researcher, and identifying the most appropriate types of materials, duration, and time structure for these experiments. The replication, via

other research procedures, of the results achieved by this study's use of these procedures will mark a step forward for information systems research methodology.

This replication might be done, for example, by conducting similar studies in actual organizations (rather than working from transcripts). Subject analysts would maintain logs of the analysis process, recording such information as the duration of interviews, the amount of time spent studying notes from each interview, the order in which interviews were conducted, and their opinions as to the "ideal" next interview after concluding each one. These data would then be used as a surrogate for our experimental log. The office descriptions themselves could be analyzed in much the same manner as was used in this study.

Finally, we feel that the descriptive/prescriptive tradeoff which we have observed forms a strong argument in favor or the development of specific analysis technique components for the identification of office opportunities. Since our experiment was not designed to investigate this phenomenon, we remain uncertain as to whether this is a "real" finding or merely an artifact of our research design. Nonetheless, human beings exhibit a general propensity for doing that which they know how to do; if a methodology's technique focuses primarily on the documentation of current activities, so will the office descriptions produced through its application. While this opportunity identification process will probably never be reduced to an algorithmic level, we can certainly develop more structured procedures than the intuitive ones currently suggested.[16]

Moreover, the current wisdom on this topic seems to contradict the effect we have observed. Kunin, a central figure in MIT's Office Automation Group, states that "An analyst must first construct a description of the system as it is currently configured and use

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[16]See, for instance OADM's discussion of problems, causes, and opportunities [[15], pages 22-23]. Note that the inclusion of these concepts at all was a step forward from the original OAM, which did not attempt to generate suggest improvements at all.

that as a basis for developing specifications of a new and improved system." [[6], p. 25]. This belief seems to pervade systems analysis methodologies as well. Dickinson [4], for example, comments that

> Many of my clients find their most difficult problem to be identifying, confirming, and fitting future needs to an existing environment; yet once a readable logical model of the current environment has been developed, they are suddenly able to suggest a number of improvements. [p. 7]

This apparent paradox underlines the need for further research on this topic.

Summary

The substantive contributions of this research include identification of the analysis perspective concept and demonstration of its impact on the analysis process through the experimental comparison of two perspectives, organizational unit and workflow. We have also reported evidence suggesting the existence of a descriptive/prescriptive tradeoff, i.e., a strong negative correlation between the degree to which an office description documents the current system and the total utility of its recommendations. This research has also made a methodological contribution through its articulation of the transcript experiment as a data collection tool.

We have suggested a number of promising directions for further research. First, we need to evaluate, extend, and refine the transcript experiment as a research technique. Secondly, we feel the descriptive/prescriptive tradeoff we observed strongly merits further study. In conclusion, we suggest that the investigation of additional relationships suggested by the systems analysis theory and this theory's extension and elaboration represent avenues along which understanding of this process may advance.

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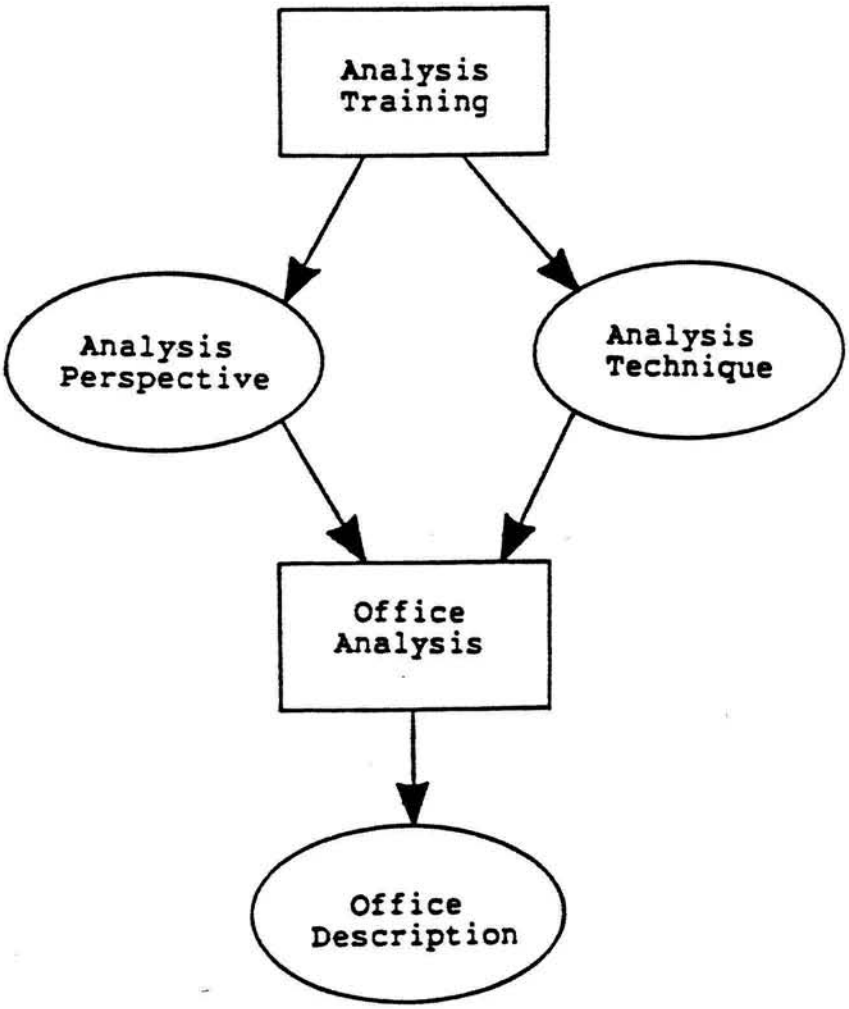

Figure 1

The Office Analysis Theory

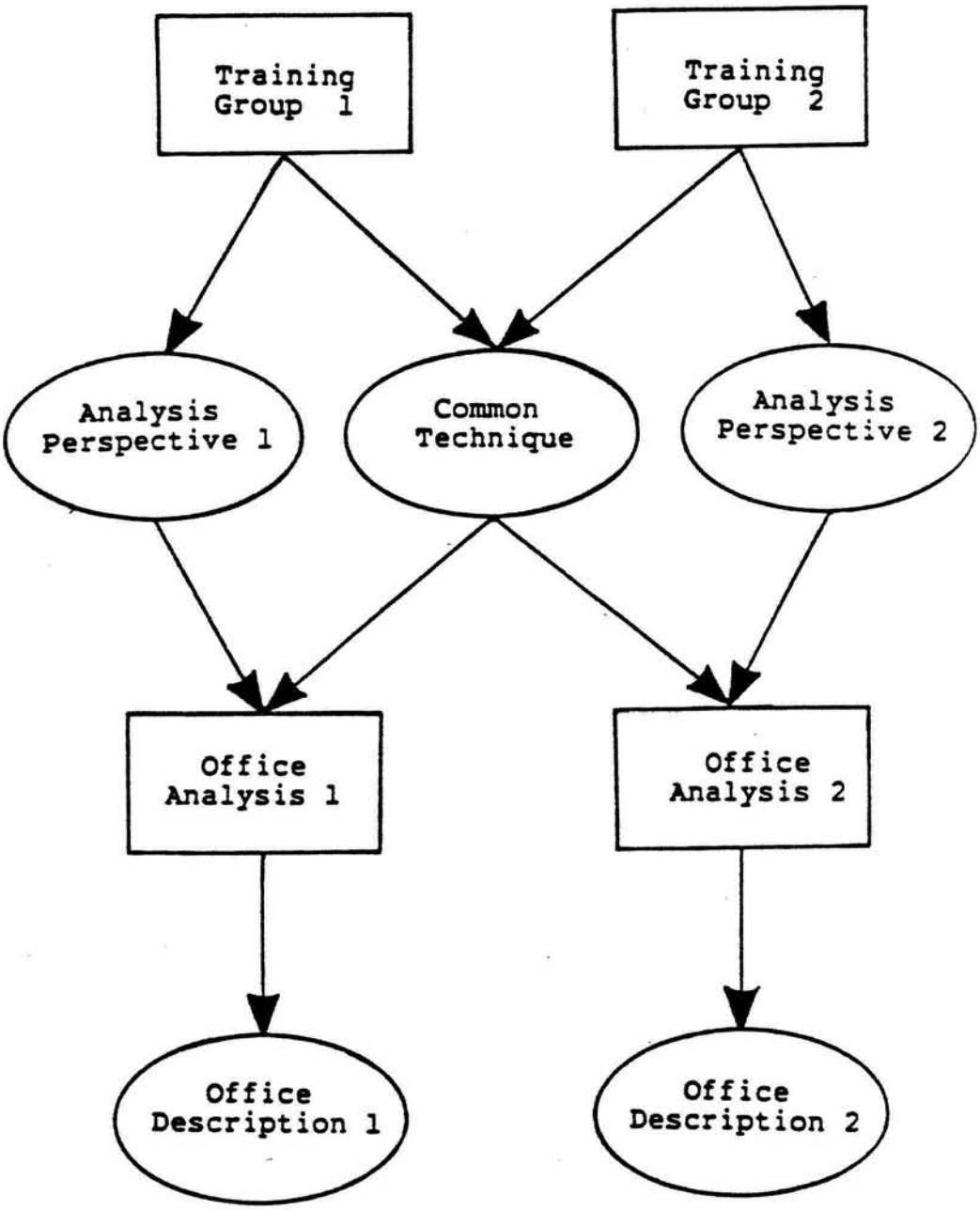

Figure 2

The Comparative Office Analysis Theory

Figure 3

Units, Workflows, and Activities

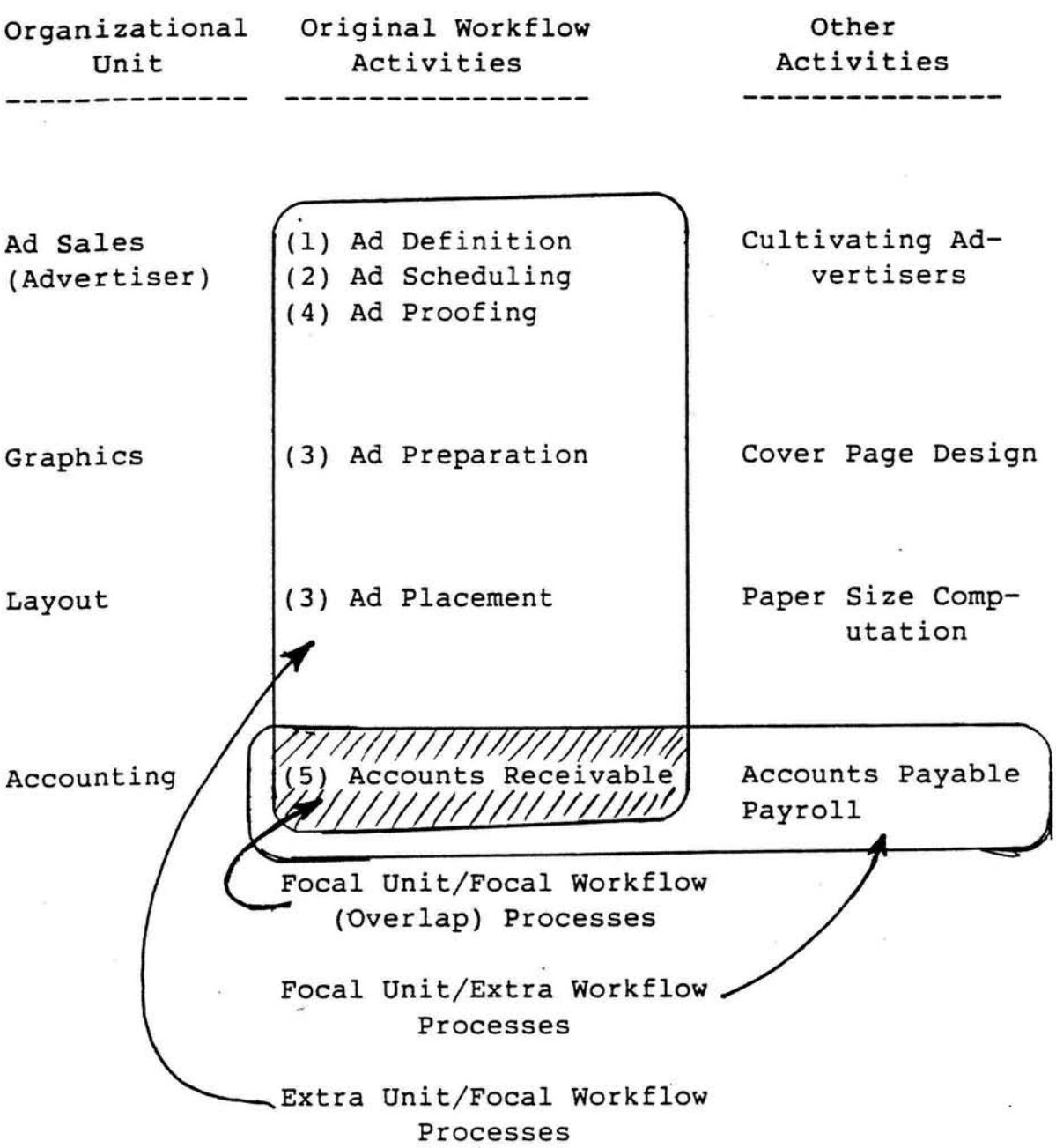

TABLE 1

Time Structure of the Experimental Session

Time Into Session	Session Phase	Experimental Activity Intended of Subject
0:00		TAM/TAM* Review
0:15	1	Transcript Study
4:15		Major Break
5:15	2	Preparation of Office Description (Access to transcripts allowed)
6:15	3	Preparation of Office Description (No access to transcripts)
7:00	4	Opportunity Identification
8:00		Completion of Session All materials turned in

TABLE 2

Group Mean Percentages:
The Search Pattern Data

Treatment Group	Order of Search	Extent of Search
Function	86.475	55.750
Unit	60.500	32.225

TABLE 3

Group Mean Percentages:
The Domain of Analysis Data

Treatment Group	Focal Unit	Focal Function
Function	1.200	64.775
Unit	3.975	48.500

TABLE 4

Group Means: The Utility Data

Treatment Group	Total Utility	Average Utility
Function	84.01	7.98
Unit	92.63	7.03

Table 5

Tasks, Recommendations, & Total Utility

Workflow Group	Tasks	Number of Recommendations	Total Utility
Subject 1	125	9	66.42
2	116	7	63.44
3	77	17	124.96
4	159	10	81.22
Unit Group			
Subject 5	97	15	124.82
6	89	13	99.99
7	93	14	86.41
8	151	10	59.29

Appendix: Procedures for Computing Data Values

Procedure 1: The Order of Search Data Computation

1. For each case,

   a. Determine from the experimental log how many optional transcripts were acquired, their order of acquisition, and which of them were extra-unit transcripts.

   b. Assign each transcript acquired a weighting factor, beginning with 5 for the first transcript acquired, and ending with 1 for the last one acquired.

   c. Sum these weighting factors for all the optional transcripts acquired (S1).

   d. Sum these weighting factors for the extra-unit transcripts acquired (S2).

2. Over both cases for each subject,

   a. Sum the S1's (SS1).

   b. Sum the S2's (SS2).

   c. Normalize the SS2 sum by dividing it by the SS1 sum (P1).

3. Over all the subjects in a treatment group, sum the P1's and divide by the number of subjects in the group (4), thus calculating the order of search group mean percentages presented in the first column of Table 2.

Procedure 2: Computing the Extent of Search Data

1. For each case,

   a. Compute, from the experimental log, the total number of minutes the subject spent working with transcripts (T1).

   b. Compute the number of minutes the subject spent working with extra-unit transcripts (T2).

2. Over both cases for each subject,

   a. Sum the T1's (TT1).

b. Sum the T2's (TT2).

c. Normalize, by dividing TT2 by TT1 (P2).

3. Over all subjects in each treatment group, sum the P2's and divide by the number of subjects (4), thus computing the extent of search group mean percentages presented in column 2 of Table 2.

Procedure 3: Computing the Domain of Analysis Data Values

1. For each case,

a. Compute the total number of specified tasks included in the subject's office description (C1).

b. Code each task as one of:

i. focal unit/focal workflow

ii. focal unit/other workflow

iii. other unit/focal workflow

iv. other unit/other workflow

c. Compute the number of tasks in focal unit/other workflow (C2) and other unit/focal workflow (C3) categories.

2. Over both cases for each subject,

a. Sum the C1's (CC1).

b. Sum the C2's (CC2).

c. Sum the C3's (CC3).

d. Normalize by dividing CC2 by CC1 (P3).

e. Normalize by dividing CC3 by CC1 (P4).

3. Over all subjects in each treatment group, sum the P3's and divide by 4, thus computing the focal unit group mean percentage presented in column one of Table 3.

4. Over all subjects in each treatment group,, sum the P4's and divide by 4, thus computing the focal workflow group mean percentage presented in column two of Table 4.

Procedure 4: Computing the Utility Data Values

1. For each recommendation presented,

    a. Each manager at the evaluation meeting assigned scores for feasibility and value, ranging from 0 (no feasibility/value) to 4 (extreme feasibility/value), according to his or her perception of the recommendation.

    b. These scores were averaged over the number of raters present.

    c. The product of these two scores was then assigned as the recommendation's utility value.

2. Over the set of recommendations made by the subject,

    a. The utility values were summed, generating the total utility values presented in Table 5.

    b. These, in turn, were averaged over the number of recommendations the subject made, generating the average utility scores presented in Table 5.

3. Over all subjects in a treatment group,

    a. The total utility scores were averaged, thus deriving the total utility group means presented in column one of Table 4.

    b. The average utility scores were averaged, thus deriving the average utility group means presented in column two of Table 4.

For a more elaborate discussion of the procedures used to compute these values and their underlying rationales, see Appendix D in [10].

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