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Why Systems Analysts Ignore Socio-Organizational Concerns During Systems Analysis?

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I. INTRODUCTION

It is our contention that the major reason most information systems have failed is that we have ignored organizational behavior problems in the design and operation of computer-based information systems. (Lucas, 1975, p. 6)

It is generally accepted that the high incidence of information systems failures may be rooted in a lack of attention to socio-organizational issues. However, in systems development practice, technical and economic issues continue to dominate the consideration of social, organizational, and behavioral issues (Bostrom & Heinen, 1977; Drummond, 1996; Hirschheim, 1985; Hirschheim, Klein, & Newman, 1991; Hirschheim & Newman, 1991; Lucas, 1975; Kling, 1980; Kumar & Welke, 1984;

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Kumar & Bjorn-Anderson, 1990; Iivari et al., 1998). A number of researchers (Bostrom and Heinen, 1977; Dagwell and Weber, 1983; Hedberg and Mumford, 1974; Kumar and Welke, 1984; and Kumar and Bjorn-Anderson, 1990; Wastell, 1999) suggest that this imbalance between the consideration of technical and social issues may have its origins in the limited frames of reference held by the systems analysts. These authors suggest that most analysts by training, education, and background are technology-oriented and thus tend to ignore the potential social implications of the information system for the users and the organization:

> The current social system/behavioral problems associated with an MIS originate in the lack of awareness of available design alternatives and change strategies and faulty decisions concerning perceived options. Both problems stem from the current frames of reference of system designers. (Bostrom and Heinen, 1977, p. 19)

However, such arguments are usually made at the theoretical level only. Beyond demonstrating that the current generation of systems analysts possess a primarily techno-economic perspective, these studies do not present any empirical evidence to support the assumption that this limited viewpoint is responsible for the analysts disregard for socio-organizational issues.

The objective of this research is to empirically investigate the effect of the analyst's frame of reference on the systems analysis process. Specifically, this research examines the relationship between the analysts frame of reference and the types of problems identified by the analyst during the systems analysis process.

The experiment reported in this article addresses this research objective. It compares the social problem identification performance of analysts with primarily technical frames of reference to analysts with social and socio-technical frames of reference. The remaining article is structured as follows. The next section reviews the literature which provides the conceptual basis of the research. Based upon this theory, research hypotheses are established and concepts of frames of reference and problem identification are defined and operationalized. Finally, the experiment, its results, and the implications of these results for further theory development and practice are described.

II. THEORETICAL BACKGROUND and RESEARCH HYPOTHESIS

Conceptually, we approach the issue of problem identification from two complementary perspectives. First, from a problem solving perspective, we take systems analysis and design to be a problem solving process in which the systems analyst gathers information from the real world to identify and structure problems, and to devise solutions for these problems (Davis, 1982; Vitalari and Dickson, 1983; Vitalari, 1985). In doing so, he or she forms simplified abstractions of the real world problem situation. Central to the concept of problem solving is the notion of problem space, i.e., an abstract world, which is a simplified model of the task environment or the real world (Newell and Simon, 1972; Payne, 1980; Simon, 1978; Walsh 1988). All problem identification, diagnosis, and problem solving takes place in the problem space.

It is commonly accepted that the problem space perceived by systems analysts (problem solvers) can differ between individual analysts. An analysts problem space depends on the particular mental filters the analyst brings to the perception process (Fiske and Taylor, 1984; Walsh, 1988). The mental filter, which is a product of the analysts individual background, culture, and work environment, guides the analysts cognitive processes and constrains his or her problem perception and identification process. It thus plays a central role in information processing by filtering out information considered as irrelevant and selectively rendering the perceived information (Dearborn and Simon, 1958). These filters have been variously called as implicit theories (Brief and Downey, 1983), cognitive maps (Weick and Bougon, 1986), frames of reference (Shrivastava and Mitroff, 1983), and belief structures (Walsh, 1988).

The concept of a mental filter is also recognized in information systems literature. Bostrom and Hienen (1977), use the term frames of reference instead of mental filters, while Welke (1980) calls it the analysts context. Hiercshheim (1985) renames the term context as perception schema or schema. Checkland (1981), on the other hand, uses the word *weltanschuuang* to describe the concept. These contexts or frames of reference act to accept those aspects of the object that are considered relevant to the problem solving process while rejecting the others as irrelevant.

A number of empirical studies (Dagwell and Weber, 1983; Hedberg and Mumford, 1974; Kumar and Welke, 1984; and Kumar and Bjorn-Anderson,1990) report that most information systems analysts have a strong technical value orientation and they find socio-organizational values much less relevant to information systems development. Thus, following the above line of reasoning, these authors argue that these technically oriented analysts would focus primarily on techno-economic concerns to the detriment of socio-economic issues.

The second theoretical perspective is provided by Hogarth's concept of judgmental biases (Hogarth, 1980; Hogarth and Makridakis, 1981). Judgmental biases are described as influences that distort the decision process and therefore result in less than ideal decisions. Hogarth (1980) provides a comprehensive list of biases that may be introduced during the various phases of a judgmental process. During the information acquisition phase, these biases hinder the acquisition process of information from the problem environment, thereby biasing the abstraction results.

These biases could be internal to the decision-maker (i.e., could be due to the decision makers internal cognitive structure) or induced by external factors such as the availability, recency, primacy, and frequency of information cues arising from the problem environment or the mode in which data or information is presented to the decision-maker. Hogarth suggested that problem identification takes place during the information acquisition phase. During this phase the decision-makers selective perception bias may act to limit the information cues perceived by the analyst/decision-maker from the problem environment, thereby biasing the problem identification process.

Hogarth (1980) further subdivided the selective perception bias into experience bias and view consistency bias. Experience bias suggests that information is selectively perceived or acquired based on the decision maker's past personal experiences. For instance, the same business problem may be perceived as a marketing problem by a marketing manager and as a financial problem by a finance manager. Therefore, a technically oriented systems analyst is more likely to perceive IS development situations as technical problem situations dealing with the diagnosis, identification, and solution of technical problem aspects such as data transformation processes, data flows, data entities, software, hardware, and files. For such an analyst, socio-economic problems hardly exist.

The second selection bias influencing problem identification is the view consistency bias. People have a strong tendency to seek or search for information that is consistent with their own views or hypotheses, and to disregard information that could cause them to reject their views. Thus, a systems analyst who considers information systems development to be a rational and objective techno-economic process will tend to disregard any non-rational and subjective political and organizational issues arising during development. The problems identified by these analysts will tend to be primarily in the areas of technical efficiency, reliability, capacity, and cost effectiveness and they may fail to perceive the more subjective organizational concerns.

Thus, taken together, the problem-solving view of systems analysis and Hogarths concept of judgmental biases tend to support the commonly hypothesized relationship between the analysts frames of reference and the types of problems identified. Thus we establish the overall research hypothesis:

H: The analysts frame of reference influences the types of IS development problems identified by the systems analysts.

Fiske and Taylor (1984) define *frame of reference* as a "cognitive structure that represents organized knowledge about a given concept or type of stimulus" (p. 140). It acts as a perceptual filter through which one perceives the world and provides guides for actions. Thus, a systems analyst's frame of reference serves as a basis for understanding design problems and creating and assessing design alternatives. A biased frame of reference would result in an incomplete perception of the problem situation, a failure to examine organizational design alternatives, and in sub-optimal design choices.

The frame of reference of systems analysts can be classified as primarily technical, primarily social, or socio-technical. The primarily technical analyst provides a technical (e.g., computer science) perspective on systems development. Thus, a technical frame of reference characterizes a cognitive structure which emphasizes and places a high value on the technical and rational issues in information systems. The analyst with a primarily technical frame of reference is more likely to be concerned with the technical problem aspects, such as system reliability, accuracy of the output information, data integrity, and hardware capacity, rather than with social issues.

On the other hand, the primarily social analyst represents the organizational development perspective on system development. He views IS as a form of social interaction and focuses primarily on the human, social, and organizational issues in information system development and implementation, while giving little attention to technology. Thus, he gives more attention to such social issues as user resistance, top management support for IS, organizational impacts of IS, and authority and power structures within the organization.

Finally, the analyst with a socio-technical frame of reference provides a balanced emphasis on and recognition of social and organizational, as well as on technical issues of IS development and implementation. This type of analyst, by linking the technical and social sides of information systems, represents a balanced socio-technical view of organizations (DeMaio, 1980; Fok, Kumar, & Wood-Harper, 1987; Mumford, 1983). The procedure for classifying individual analysts according to their frames of reference is described in the next section.

Previous researchers (Bostrom and Hienen, 1977; Dagwell and Weber, 1983; Hedberg and Mumford, 1974; and Kumar and Bjorn-Andersen, 1990) have attributed the analysts limited problem perception to their primarily technical frames of reference. They recommend that, in order to be more effective, analysts frames of reference should be modified through education and training in order to make them more sensitive to socio-organization concerns. However, this recommendation is based upon theoretical argument only. Thus, this research empirically compares the social problem identification performance of primarily technical systems analysts with analysts having primarily social and socio-technical frames of reference.

As we are particularly interested in examining the effects of frames of reference on the lack of attention to socio-organizaional problems, problem identification performance is defined by a *social problem identification score*. In a typical problem situation, initially the analyst may receive both technical and social problem cues from the task environment. However, depending upon his/her frame of reference, the analyst may attach different levels of importance and priority to the various problem cues. The social problem identification score measures the relative importance attached by the analyst to socio-organizational problems as compared to technical problems. The operationalization and measurement of this score is described in the next section.

Using these definitions of frame of reference and social problem identification score, we state our detailed specific hypotheses as follows:

H1: Systems analysts with primarily social frame of reference are likely to have higher social problem identification scores than systems analysts with primarily technical frame of reference.

H2: Systems analysts with socio-technical frame of reference are likely to have higher social problem identification scores than systems analysts with primarily technical frame of reference.

III. RESEARCH DESIGN

3.1 Experimental Task

The experimental task consisted of the identification and prioritization (ranking) of problems perceived in an information systems development context. The problem situation was a description of a sales management information system (SMIS) for a large chemical corporation. This case was designed to embody an ill-structured IS implementation situation and included equal number of technical and socio-organizational problem cues having equal levels of saliency. The balance between the number and importance of technical and social cues and their saliency was pre-tested using two doctoral students and six MIS students. Based upon suggestions from the pre-tests, the case was modified until the testers were in agreement about this balance in the case.

Lab experiments, such as the one reported in this research, while providing a high level of internal validity, have been criticized on account of low external validity of the results. A number of strategies were used to increase the realism of the analysis task with the objective of increasing the external validity of the results. First, in a typical systems development situation, problem identification and analysis usually takes place under time and budget constraints. Davis and Olson (1985, p.237) suggest that the stress of making decisions under time pressure causes the filtering due to frames of reference to increase, thereby further reducing the amount of information to be processed by the systems analyst. The time pressure would presumably have the analysts focus on the problem aspects they perceived to be most important while ignoring or filtering out details considered less important (Cantor & Mischel, 1977; Walsh 1988). Finally, the use of a time limit would also increase the realism of the situation as systems analysts usually have limited time and a deadline for collecting requirements information in the real world.

In order to simulate the time pressure, a time constraint was established for the information acquisition phase. The case was tested with twelve additional subjects to establish the average time required to read the case and to test the methodology for administering the experiment. In order to further heighten the sense of resource limitation, the subjects were limited to identifying and ranking the five most important problems only. The time deadline was especially important because the pilot tests showed that given unlimited time to study the case and the freedom to formulate unlimited number of problem descriptions, the subjects were able to identify most of the problems embedded in the case. It was therefore important to limit the time available to study the problem situation and to limit the number of problems identified to only top five problems.

Next, typically, as a step to understanding the systems analysis situation, analysts develop a model or representation of the system. To increase the realism of the exercise, the subjects were asked to produce a model (data flow diagram) of the system before they identified and ranked the perceived problems. The choice of data flow diagrams was influenced by two factors. First, data flow diagrams are currently the most commonly used system modeling tools in practice and therefore their use increases the realism and thus the external validity of the exercise. Second, they are also the most commonly taught technique and thus it was easier to recruit subjects for the experiment who possessed prior knowledge of this analysis technique.

To remove experimenter bias and to provide consistency in administering repeated experiments, a software program for administering the experiment was developed using a multi-media authoring software. The program also provided greater control of the experimental procedure than was possible with human administration of the procedure. The subjects had to follow a pre-defined sequence of tasks enforced by the program. They could proceed to the next task only after they had completed all parts of the previous task. The program informed the subject about time limits imposed on various experimental tasks, provided them with a running estimate of the remaining tasks, and enforced the time budgets. The interactive program, through diverse animation, sound effects, and the use of color also kept the subjects attention through out a demanding cognitive exercise. Finally, the program automatically collected experimental session data and stored the subjects responses thereby reducing the possibility of errors during data collection.

3.2 Research Variables

This study employs one independent variable - the frame of reference of the analyst - and one dependent variable - the social problem identification score achieved by the analyst in the problem identification task:

3.2.1 Frame of Reference

The individual analyst's frame of reference is an attribute variable which is a characteristic of the individual analyst. Being an attribute variable it raises some issues in the experimental design. First, the frames of reference cannot be directly manipulated as in typical experiment situations. Therefore, as Kiess and Bloomquist (1985) suggest, there should be more caution in interpreting the cause-effects relations when the independent variable is an attribute variable. To address this problem, Emory (1985) suggests that information about potentially confounding factors should be gathered to make cross comparisons to confirm the causal relations between the frames of reference and problem identification. Possible confounding variables are the analysts work experience, age, and educational background. However, these variables are also antecedents of the frame of reference and can be taken to influence the dependent variable through this variable.

Second, a balanced research design, in which each treatment consists of the same number of subjects, is not possible because the distribution of the participants' frames of reference can not be controlled a priori. However, there was an attempt in this research to balance the number of subjects with the same frame of reference by employing the similar numbers of computer science and MIS/CIS students. Kumar and Bjorn-Anderson (1990) suggest that the frames of reference are affected by educational backgrounds. The use of computer science and MIS/CIS students was believed to lead to a more balanced distribution of technical and social frames of reference and thus lead to a more balanced design of the experiment than otherwise might have been possible.

Because the frame of reference is an attribute variable, we could only measure and classify, not actively manipulate, each subjects frame of reference. To classify each individual subjects frame of reference, a sorting method suggested by Rosenberg (1982) and Walsh (1988) was employed.

3.2.2 Social Problem Identification Score

Previous research dealing with problem identification (e.g., Dearborn & Simon, 1958; Walsh, 1988) usually measured only the number of problems corresponding to a particular type of problem identified by the subject. For instance, simple counts of marketing, accounting, and financial problems were employed as the dependent variable to represent the types of problems identified. However, in practice, problem identification is usually accompanied by some type of prioritization of the problems identified. As all problems are not likely to be of the same level of importance, the use of a simple count for each problem type may not be an adequate representation of an individual's problem identification performance. Thus, in addition to the number of problems identified, the importance attached to each problem identified was also considered in defining problem identification for the purpose of this study.

Thus, we define social problem identification as the perceived importance of social problems identified. For instance, if the systems analyst finds a large number of social problems *and* recognizes them as important, his or her social problem identification score is considered as high. Each subject was asked to identify and rank order the five most important problems he or she perceived in the problem situation. The perceived importance of the problem was derived from its rank (1 through 5) assigned by the subject.

The problems identified by each subject were classified as either technical or social. As this classification may be influenced by the judgement of the person doing the classification, four raters (other than the researchers) were employed for classifying the problems. Each rater was given detailed written instructions prior to their encoding of the problems. Next, the raters were given the sets of problems identified by the subjects and, based upon the instructions, were asked to classify them as either technical or social. The final classification was decided by the majority opinion of the four raters. Any contradictions among the raters were resolved by discussion between the raters. Interrater reliability for the problem identification coding results were calculated using Pearson-product moments. The Pearson-product moment has been used as an index of the intercoder reliability by Staw, McKechnie, & Puffer (1983) and Walsh (1988). All but one of the correlations between the pairs of the raters were significant at the 0.0001 of significance level. These high correlations among the four raters demonstrated that the classification results were similar and that no systematic differences between the raters appeared to exist.

The rank assigned to each problem by the subject was taken as its perceived importance. Because the subject was asked to identify only five problems, the ranks ranged from 1 to 5. Both, the number of each type of problem (social or technical), and their importance rank were considered in calculating the problem identification score. To consider the rank-orders of the problems identified, a weight was assigned to each problem based on its rank. A weight of 5 was assigned to the most important problem, and 4 was given to the second most important problem, and so on. The problem identification score for each problem aspect was obtained by summing up these importance weights for that problem aspect. Thus, the problem identification scores for the technical and social problems aspects were determined by summing the importance weights for technical problems and social problems respectively. The technical and social problem identification scores could range from 0 to 15. If the analysts identified all the technical problems, for instance, the problem identification score for the technical problem aspect was 15. On the other hand, if they identified all the social problems, the problem identification score for the technical problem aspect was 0 while the score for the social problem aspect was 15.

Using the technical and social problem scores, a *social problem identification score* was developed to assess the problem identification performance as a single measure. This score was obtained by subtracting the technical problem identification score from the social problem identification score. Theoretically, this score could range from -15 to 15. A positive index indicated that the analysts attached more importance to social problem aspects than technical problem aspects of the problem situation, and a negative index indicated that the analysts attached more importance to technical problem aspects than social problem aspects.

3.3 Experimental Design

A between-subjects design was used to investigate the effect of the frame of reference on problem identification. The three frames of reference are: primarily technical, primarily social, and socio-technical. The experiment design employed in this study is a between-subjects design in which the subjects in a group receive only one level of an independent variable. With this type of design, differences between different groups of subjects are used to assess the effect of the independent variables on the dependent variables. As Kiess and Bloomquist (1985) point out that when the researchers interest is in an attribute variable, such as a personality variable or gender of the subjects, use of a within-subjects design is precluded and only a between-subjects design can be used.

A concern in experimental design is to maximize the systematic variations of the variables of interest while minimizing or eliminating variations due to extraneous variables. In a laboratory experiment, the researcher can employ a variety of procedures for controlling the extraneous variations (Kiess & Bloomquist, 1985). The first method is holding the extraneous variables constant. If the extraneous variables are not allowed to vary, then their influence is virtually removed. Kiess and Bloomquist point out that constancy is the most fundamental control technique because constancy removes the influence of extraneous variables on systematic and error variation. The second technique is random assignment of subjects to the treatment conditions for controlling the influence of extraneous variables which cannot be held constant.

Possible extraneous variables in this study were identified as the systems analyst's work experience, knowledge of systems analysis techniques, and the individual's diverse cognitive style. Work experience and knowledge about systems analysis techniques were controlled by attempting to "hold constant" these variables. The influence of varying work experience was removed by employing only students with little or no work experience. Variations of knowledge about systems analysis techniques was minimized by selecting subjects with approximately the same level of knowledge about the systems analysis techniques (structured analysis) used in the experiment. Further, a hypertext tutorial, developed to teach data flow diagramming (technique used in the experiment) also contributed to minimizing knowledge variations. Finally, the individuals style of processing information (cognitive style) could not be controlled. Even though it may be assumed that cognitive style is randomly distributed over the three frames of reference, the possibility of a systemic bias in with regards to specific cognitive styles being associated with particular frames of reference remains.

3.4 Administration of the Experiment

3.4.1 Subjects

Thirty-five subjects participated as volunteers in the experiment. The subjects in the study were required to have certain qualifications. First, they were to have sufficient knowledge about the system development process to understand the situation proposed in the experiment. Second, their knowledge and experience about the systems analysis technique employed in the experiment was to be similar because variations of the knowledge might create spurious differences. Third, it was desirable that the subjects had little or no work experience so that the influence of work experience could be held constant. Fourth, the use of different majors was also desirable because a homogeneous group of subjects from the same educational background was not likely to provide diverse frames of reference. Technical majors such as computer science students were expected to provide technical frames of reference while managerial majors such as MIS and CIS students were expected to provide social frames of reference. To satisfy these qualifications, undergraduate computer science students at a major engineering school enrolled in the software engineering class and MIS or CIS students at major business schools enrolled in the systems analysis and design classes were employed as subjects in this study. Table 1 summarizes the demographic information about the participants collected from their background questionnaires.

Table 1: The Subject Profiles

	Number	Percent	
Major	Computer Science	18	51%
	MIS	17	49%
Sex	Male	23	66%
	Female	12	34%

Individual course instructors of the software engineering and system analysis classes were contacted at the three universities and were asked to cooperate in contacting students needed for the study. It was explained that students could benefit from participation by learning about the hypertext software used in the experiment and gaining knowledge about information systems development methods. Participating students also received an additional three percent credit towards their grades from their instructors.

With the instructors approval, the researcher presented the nature of the study and outlined the experimental procedures to the classes. While full participation was encouraged, the voluntary nature of the project was also presented.

The use of student subjects in experiments has been controversial in IS and in other disciplines (Enis, Cox, & Stafford, 1972; Hughes & Gibson, 1991; Miller, 1966). Some critics (Dobbins, Lane, & Steiner, 1988; Hughes & Gibson, 1991) reject the soundness of using students as surrogates for industry managers or professional decision makers. However, Dickson (1989) points out that the use of students as subjects is not only acceptable but also is appropriate when studying the relationship between information, decision processes, and decision outcomes. He states that there is little reason to expect students to behave differently from any other set of subjects in such experiments. Furthermore, when the students employed in the experiment have similar education, training, and career aspirations as the professionals, they can be reasonably considered as being novice professionals and therefore reasonable surrogates for the professionals.

DeSanctis (1989) also supports the use of student subjects for IS research such as small group research. She indicates that they have the advantage of a common organizational experience and open attitudes towards experimenting with information technology. Enis, Cox, and Stafford (1972) suggest that students are appropriate subjects when internal validity is more important than external validity. Given the artificial setting of the experiments and the use of student subjects, use of laboratory experiments would lead to low external validity. However, because the primary purpose of this research was to test a theory about the effects of analysts frames of reference on problem identification, the use of students as subjects is acceptable. Furthermore, the employment of students most similar to novice professionals (i.e., junior or senior computer science or MIS students) in order to increase external validity also justifies the use of students as subjects. Thus, the research results from these students can be generalized to include novice analysts. Hence, even though student subjects were employed in this research, the threats to external validity are not large.

3.4.2 Experiment Procedures

The experiment consisted of two tasks: a sorting task to determine the subjects frame of reference and the main experiment. In an initial meeting conducted to measure the students frames of reference, the students who agreed to participate were given a deck of cards that they used to perform the sorting task. The main experiment was conducted by appointment, 1 to 3 weeks after the sorting task, depending on the availability of the individual student. The 1 to 3 week waiting period was considered adequate for minimizing retention, if any, of the cues which may have been inadvertently provided by the sorting task.

On the appointment date, each student met with the experimenter to perform the main experiment. A special hypertext program was developed to conduct the experiment. The subjects received instructions from the program and followed those instructions to complete the experiment. During the course of the experiment, the subjects had no interaction with the experimenter.

As the first step in the experiment, the program provided the subjects with a timed case to read which is shown in the Appendix. The case information was presented in a sequence of 16 computer screens. Subjects were asked to take notes while they read the case because they would not be allowed to go back and review the case when they performed tasks associated with the case. After the subjects read the case, they were asked to draw a data flow diagram representation of the system. Next, the subject was informed that the implementation of SMIS in the Chemical U.S.A. was having difficulties. The subjects were asked to assume the role of a systems consultant and to identify and to rank-order the five most critical problems. They were also asked to explain their rationale for each problem in an open-ended form. When the subjects completed the last task, the program saved their answers and completion time of each task in a PC file. Upon the completion of the experiment, the subjects were debriefed about the true purpose of the experiment.

3.5 Classification of the Analysts Frame of Reference

To analyze the data in identifying the analyst's frame of reference, a multidimensional scaling (MDS) program was employed. A modified version of multidimensional scaling, the IDSORT program [Takane, 1982], was used to analyze the result data of the sorting task. MDS generally allows the investigator to examine and evaluate the underlying dimensions or criteria that people use in formulating perceptions about the similarities among products and services.

An eight-dimensional solution best fitted the data from the result of a scree test. Such a solution is known as a group trait space, which represents a common set of dimensions along which individuals are thought to perceive stimuli. An examination of the individual weights for each of the eight dimensions in the group trait space indicates how the systems analysts differed in their views of systems development perspectives allowing assessment of Dearborn and Simons' [1958] hypothetical construct. The frame of reference of each systems analyst was classified depending on his or her weights on eight dimensions. The frame of reference of a systems analyst who gave a very high weight to social dimensions and a very low weight to other dimensions was considered as social concerns. A technical frame of reference would have a high weight on technical dimensions. And finally, a generalist with socio-technical frame of reference whose orientation to IS development is not narrow would have high weights on social as well as technical dimensions.

IV. RESULTS

As the hypotheses H1 and H2 are comparisons of two groups of subjects, and as both hypotheses were a *priori* directional, single-tail t-tests were used to test the hypotheses. Before the t-test was employed, the sample data distribution for the dependent variable was first examined for the assumption of normal distribution.

To test the normality assumption statistically, Shapiro and Wilk's (1965) W statistic was used. W ranges from zero to one and the small values of W usually lead to the rejection of the normality assumption. The result of the normality test are shown in Table 2. The null hypothesis of the test is that "the observations are normally distributed" and thus, a p-value less than 0.05 in any factor level (with the 5% significance level) indicates that the normality assumption for the corresponding measure was violated, meaning that the observations were not likely to come from the normal distribution.

Table 2: Test of the normality condition for the dependent variables

Frames of reference	*W*	*p-value*
Technical	0.9092	0.10
Socio-technical	0.9574	0.30
Social	0.9468	0.25

A test for normality of the dependent variable using the Shapiro and Wilks W statistic failed to reject (at 5% significance level) the null hypothesis that the observations were normally distributed. Furthermore, given the robustness of the t-test against the normality assumption (Kiess & Bloomquist, 1985), the use of t-tests was justified. Table 3 provides the results of the test of the hypothesis:

Table 3: t-test results for Hypotheses 1 and 2

Frames of reference	*N*	*Mean*	*s.d.*	*t*	*p-value*
H1: Primarily Technical versus Primarily Social Frames of Reference					
Technical	9	-6.78	5.61	1.98	0.0316*
Social	11	-1.64	5.90		
H2: Primarily Technical versus Socio-Technical Frames of Reference					
Technical	9	-6.78	5.61	1.35	0.0957
Socio-technical	15	-2.67	8.01		

* Indicates a significance at the 5% significance level.

As described above, an social problem identification scores above zero indicates that the analyst attached more importance to the social problem aspects than the technical aspects. Negative scores, on the other hand, indicate greater importance attached to technical aspects.

In all cases, i.e., for analysts with all types of frames of reference, the social problem identification scores were negative, thereby supporting the commonly held belief that, in general, systems analysts attach greater importance to technical problems than to socio-organizational problems. However, the scores for analysts with primarily technical frames of reference (-6.78) were significantly less (at 5% significance level) than the score for analysts with primarily social frame of reference (-1.64). Similarly scores for analysts with primarily technical frames of reference (-6.78) were also less (at 10% significance level) than the score for analysts with socio-technical frames of reference (-2.67). The scores for analysts with socio-technical frames of reference were lower than those for analysts with primarily social frames of reference, but the difference was not significant.

V. DISCUSSION and CONCLUSIONS

The objective of this research was to empirically test the often stated argument that the primarily technical orientation of information systems analysts is to blame for the lack of attention to socio-organizational issues during systems analysis (Bostrom and Heinen, 1977; Dagwell and Weber, 1983; Hedberg and Mumford, 1974; Kumar and Welke, 1984; and Kumar and Bjorn-Anderson, 1990). The results of the research suggest that analysts with social frames of reference do identify and attach greater importance to socio-organization problems than analysts with primarily technical frames of reference. Furthermore, though statistically not significant, the results indicate that analysts with socio-technical frames of reference tend to have a more social view of problems than primarily technical analysts.

Though, in past, this assertion was made by a number of researchers at the theoretical level, beyond empirically demonstrating the prevalence of the technical frames of reference, previous research had not presented any empirical evidence to support this argument. Furthermore, this assumption had led IS researchers, educators, and enlightened practitioners to devise and suggest various alternatives for influencing and modifying the overly technical frames of reference. For example, textbook authors and researchers have routinely exhorted educators to educate and sensitize budding information systems analysts to socio-organizational concerns. As recently as this year, Friedman and Kahn (1994) suggested that computer scientists should be educated to understand linkages between social and technical perspectives. They state:

> computer science education should not drive a wedge between the social and the technical, but rather link both throughout the formal and informal curriculum. (p.69)

Similarly, in an attempt to overcome the technical biases of the current generation of systems analysts, IS managers are routinely asked to institute training programs and develop reward systems which would sensitize the analyst to socio-organizational issues and thus include them in his or her analysis process.

This research, by providing empirical evidence in support of the above argument, provides a stronger basis for the above recommendations. Thus, this research has important implications for both research and practice. From the research perspective, it completes a key link in the theory explaining the continuing lack of attention to socio-organization concerns. From a practice perspective, it provides educators and IS managers with a sound basis for developing and implementing education and training programs which include and emphasize socio-organizational issues.

However, it should be recognized that the above research was conducted in a controlled laboratory environment using student subjects. Though, as outlined above, a variety of strategies were employed to increase the realism of the lab exercise to increase external validity, and the student subjects employed could be appropriately considered novice analysts, it may not be possible to generalize the results to all analysis situations. For example, this research simulates a typical development environment in which usually primarily technical analysis methods such as structured analysis are employed. Though, this is typical of the current development environment in the United States, the emerging use of socio-technical methods and soft systems methods may provide other avenues for making the socio-organizational concerns more salient. Similarly, the use of multi-perspective teams may also overcome some of the shortcomings of the analysts limited technical frames of reference. Finally, as reported in a variety of cross-cultural studies (e.g., Hofstede (1980); Kumar and Bjorn-Andersen (1990)), different societies may emphasize the socio-organizational aspects of computing differently, thereby, to some extent shaping the frames of reference of the systems analysts in these societies. Investigation of issues, such as mentioned in this paragraph, would add to the richness of explanation about the lack of (or existence thereof) attention to socio-organization concerns.

BIBLIOGRAPHY

[1] Bostrom, R. P., & Heinen, J. S., MIS Problems And Failure: A Socio-Technical Perspective, Part I: The Causes, *MIS Quarterly*, Vol. *1*, No. 3, 1983, pp. 17-32.

[2] Brief, A. P., & Downey, H. K., Cognitive And Organizational Structures: A Conceptual Analysis Of Implicit Organizing Theories, *Human Relations*, Vol. *36*, 1983, pp. 1065-1090.

[3] Cantor, N., & Mischel, W., Traits As Prototypes: Effects Of Recognition Memory, *Journal Of Personality And Social Psychology*, Vlo. *35*, 1977, pp. 38-48.

[4] Checkland, P., *Systems Thinking, Systems Practice*. Chichester: John Wiley & Sons, 1981.

[5] Dagwell, R., & Weber, R., Systems Designer's User Models: A Comparative Study And Methodological Critique, *Communications of the ACM*, Vol. *26*, No. 11, 1983, pp. 987-997.

[6] Davis, G. B., Strategies For Information Requirements Determination, *IBM Systems Journal*, Vol. *21*, No. 1, 1982, pp. 4-30.

[7] Davis, G. B., & Olson, M. H., *Management Information Systems: Conceptual Foundations, Structure, And Development*, Mcgraw-Hill, New York, 1985.

[8] Dearborn, D. C. & Simon, H. A., Selective Perception: A Note On The Department Identification Of Executives, *Sociometry*, Vol. *21*, 1958, pp. 140-144.

[9] Demaio, A., Socio-Technical Methods For Information Systems Design, In H. C. Lucas, T. J. Lincoln, & K. Supper (Eds.), *The Information Systems Environment* (pp. 105-122), North-Holland, Amsterdam, 1980.

[10] Desanctis, G., Small Group Research In Information Systems: Theory And Method, In I. Benbasat (Ed.), *The Information Systems Research Challenge: Experimental Research Methods*, (Vol. *2*, pp. 53-81), Harvard Business School, Boston, 1989.

[11] Dickson, G., A Programmatic Appeal To Information Systems Research: An ExperimentalistS View, In I. Benbasat (Ed.), *The Information Systems Research Challenge: Experimental Research Methods*, (Vol. *2*, pp. 147-170), Harvard

Business School, Boston, 1989.

[12] Dobbins, G. H., Lane, I. M., & Steiner, D. D., A Note On The Role Of Laboratory Methodologies In Applied Behavioral Research: Don't Throw Out The Baby With The Bath Water, *Journal Of Organizational Behavior*, Vol *9*, No. 3, 1988, pp. 281-286.

[13] Drummond, H. The Politics of Risk: Trials and tribulations of the Taurus project, *Journal of Information Technology*, Vol. *11*, No. 4, 1996, pp. 347-358.

[14] Emory, C. W., *Business Research Methods* (3rd Ed.), Richard Irwin, Homewood, IL, 1985.

[15] Enis, B. M., Cox, K. K., & Stafford, J. E., Students As Subjects In Consumer Behavior Experiments, *Journal Of Marketing Research*, Vol, *9*, No.1, 1972, pp. 72-74.

[16] Fiske, S., & Taylor, S., *Social Cognition*, Addison-Wesley, Reading, MA, 1984.

[17] Fok, L., Kumar, K., & Wood-Harper, T. Methodologies For Socio-Technical Systems (STS) Development: A Comparison, In J. Degross & C. Kriebel (Eds.), *Proceedings Of the International Conference On Information Systems* (pp. 319-334), Pittsburgh, PA, 1987.

[18] Friedman, B., & Kahn, P., Educating Computer Scientists: Linking The Social And The Technical, *Communications of the ACM*, Vol, *37*, No. 1, 1994, pp. 65-70.

[19] Herdberg, B., & Mumford, E., The Design Of Computer Systems, Man's Vision Of Man As An Integral Part Of The System Design Process, In E.Mumford & H. Sackman (Eds.), *Human Choice And Computers* (pp. 31-60), North-Holland, Amsterdam, 1974.

[20] Hirschheim, R., *Office Automation: A Social And Organizational Perspective*, John Wiley & Sons, New York, 1985.

[21] Hirschheim, R., & Newman, M., Symbolism And Information Systems Development: Myth, Metaphor And Magic, *Information Systems Research*, Vol. *2*, No. 1, 1991, pp. 29-62.

[22] Hirschheim, R., Klein, H. K., & Newman, M., Information Systems Development As Social Action: Theoretical Perspective And Practice, *OMEGA*, Vol. *19*, No. 6, 1991, pp. 587-608.

[23] Hofsteede, G., *Cultural Consequences: International Differences In Work Related Values*, Sage, Beverly Hills, CA, 1980.

[24] Hogarth, R. M., *Judgment And Choice*, John Wiley & Sons, Chichester, 1980.

[25] Hogarth, R. M., & Makridakis, S., Forecasting And Planning: An Evaluation, *Management Science*, Vol. *27*, No. 2, 1981, pp. 115-138.

[26] Hughes, C. T., & Gibson, M. L., Students As Surrogates For Managers In A Decision-Making Environment: An Experimental Study, *Journal Of Management Information Systems*, Vol. *8*, No. 2, 1991, pp. 153-166.

[27] Iivari, J., Hirschheim, R., and Klein, H., A Paradigmatic Analysis Contrasting Information Systems Development Approaches and Methodologies, *Information Systems Research*, Vol. *9*, No. 2, June 1998, pp. 164-193.

[28] Kiess, H., & Bloomquist, D., *Psychological Research Methods*, Allyn And Bacon, Boston, MA, 1985.

[29] Kling, R., Social Analyses Of Computing: Theoretical Perspectives In Recent Empirical Research, *ACM Computing Surveys*, Vol. *12*, No. 1, 1980, pp. 61-110.

[30] Kumar, K., & Bjorn-Anderson, N., A Cross-Cultural Comparison of IS Designer Values, *Communications of the ACM*, Vol. *33*, No. 5, 1990, pp. 528-538.

[31] Kumar, K., & Welke, R., Implementation Failure And System Developer Values: Assumptions, Truisms And Empirical Evidence, In J. Nunamaker (Ed.), *Proceedings Of The Fifth International Conference On Information Systems* (pp. 1-13), Tucson, AZ, 1984.

[32] Lucas, H. C., *Why Information Systems Fail*, Columbia University, New York, 1975.

[33] Mumford, E., *Designing Human Systems For New Technology: The ETHICS Method*, Manchester Business School, England, 1983.

[34] Newell, A., & Simon, H. A., *Human Problem Solving*, Prentice-Hall, Englewood Cliffs, NJ, 1972.

[35] Payne, J., Information Processing Theory: Some Concepts And Methods Applied To Decision Research, In T. W. Wallsten (Ed.), *Cognitive Process In Choice And Decision Behavior* (pp. 95-115), Lawrence Erlbaum Associates,

Hillsdale, NJ, 1980.

[36] Rosenthal, R., *Experimenter Effects In Behavioral Research,* Appleton-Century-Crofts, New York, 1966.

[37] Shrivastava, P., & Mitroff, I. I., Frames Of Reference Managers Use: A Study In Applied Sociology Of Knowledge And Knowledge Use, In R. Lamb (Ed.), *Advances In Strategic Management,* (Vol. *1*), JAI Press,), Greenwich, CT, 1983.

[38] Simon, H. A., Information Processing Theory Of Human Problem Solving, In W. K. Estes (Ed.), *Handbook Of Learning And Cognitive Process* (Vol. *5*), Lawrence Erlbaum Associates, Hillsdale, NJ, 1978.

[39] Staw, B., Mckechnie, P., & Puffer, S., The Justification Of Organizational Performance, *Administrative Science Quarterly*, Vol. *28*, 1983, pp. 582-600.

[40] Vitalari, N. P., Knowledge As A Basis For Expertise In Systems Analysis: An Empirical Study, *MIS Quarterly*, Vol. *9*, No. 3, 1985, pp. 221-241.

[41] Vitalari, N. P., & Dickson, G., Problem Solving For Effective Systems Analysis: An Experimental Exploration, *Communications of the ACM*, Vol. *26*, No. 11, 1983, pp. 948-956.

[42] Walsh, J., Selectivity And Selective Perception: An Investigation Of Manager's Belief: Structures And Information Processing, *Academy of Management Journal*, Vol. *31*, No. 4, 1988, pp. 873-896.

[43] Wastell, D., Learning Dysfunctions in Information Systems Development: Overcoming the Social Defenses with Transitional Objects, *MIS Quarterly*, Vol. *23*, No. 4, December 1999, pp. 581-600.

[44] Weick, K. E., & Bougon, M. G., Organizations As Cognitive Maps: Charting Ways To Success And Failure, In H. P. Sims & D. A. Gioia (Eds.), *The Thinking Organization* (pp. 102-135), Jossey-Bass,), San Francisco, 1986.

[45] Welke, R. J., A Context Approach To Information Systems Development Synthesis, (ISRAM W-8007-1.0), Mcmaster University, Hamilton, Canada, 1980.

Appendix

CHEMICAL U.S.A., INC. CASE

Introduction

Chemical U.S.A. is a distribution company which sells diverse chemical raw-materials and also produces one type of chemical product, Styrofoam, in its plant. The company sells a diverse line of over 2,000 products which includes almost all industrial chemical raw products, such as textile dyestuffs, pigment auxiliaries, general industrial chemical materials, plastics, and agricultural chemicals. The company has exclusive dealerships for two leading international chemical companies, IChem in the U.S., and Rendolf in Germany. These two companies supply most of Chemical U.S.A.'s products.

The company has 34 sales persons in the Sales Division and over 50 employees in the Styrofoam plant. The Sales Division is located in the downtown section of a large Southwestern city, while the plant is in the suburbs.

Organization of the Company

The company has three independent operating divisions: the Finance/Management division, the Marketing division, and the Styrofoam Plant. The Finance/Management division includes the departments of Finance, Personnel, General Management, and Management Information Systems (MIS). The Marketing division consists of five departments: Textile, Pigment Auxiliaries, General Chemicals, Plastics, and Agricultural Chemicals. The Styrofoam Plant division oversees the production of Styrofoam in its plant.

The sales departments have been organized by product groups. For instance, the Textile department sells textile-related chemicals such as dyestuffs. Since the products each department sells are usually separate from each other, the business of each department is independent from the other departments; thus, the customers are rarely shared by different departments.

Department heads in each department have broad authority and considerable latitude over the sales made by their departments. As a result, many decisions are usually made without obtaining approval from top executives. Chemical U.S.A. is run on an informal basis. Everyone is called by his or her first name, and there are few internal memos, letters, or other formal documents. Very little is written down in terms of policies and procedures. Most of the business is conducted orally in discussions between the sales department head and the responsible sales representative.

Customers of Chemical U.S.A. are usually chemical plants which produce chemical end products using raw materials purchased from Chemical U.S.A. or other suppliers. In each department, every sales person has his or her own customers. Because these customers are not usually shared among sales representatives, except for a few of the very large companies, information about these customers which might be useful to sales activities are not usually kept by the assigned sales representatives only.

Chemical U.S.A.'s Business

Sales representatives at Chemical U.S.A. are required to have a wide knowledge about the company's products and the relevant chemical processes. Thus, all sales persons have degrees in areas such as textile or chemical engineering. Most sales items are used to produce chemical end products at the customer's plant. If problems with these products occur, sales persons visit the customer's plant to solve them. Thus, long-term know-how and experience at and knowledge about the customer's plant sites are essential for good sales. Because this technical expertise and information are very valuable to individual sales representatives, they usually do not share such information with other sales representatives.

Sales Management Information System (SMIS)

In June 1992, the sales director, who had worked for 30 years at Chemical U.S.A., retired. After a two month search, a new sales director joined the company. The new director, Mr. Jones, had more than 20 years sales experience in the chemical industry and had previously been employed by a major U.S. chemical company.

In early 1993, Mr. Jones suggested that the company develop a new computer system to support sales activities: a sales management information system (SMIS). This system was designed to track sales activities by providing periodic sales reports, sales analysis reports, and specific information about the customers and competitor companies. This new computer-based information system also provides top management with specific and detailed information about customers, in order to aid them in the decision-making process regarding the company's future business strategy. In the past, top management had asked the sales department head or sales representatives for this information and had consulted with them whenever necessary. It took six months for the task force team of the MIS department to design and install the new sales management information system. The SMIS system runs on an IBM PC or other PC clones with at least 640K of RAM. Paradox, a DOS-based database software, was used to develop the system. It requires less efforts to make the same function than other programming languages like C, COBOL, or Pascal; however, it needs more computer resources due to the overhead of Paradox itself .

Subsystems of SMIS

The SMIS consists of the following four subsystems.

*1. **Competitor information:*** Chemical U.S.A. keeps track of ten other major chemical product distributors to maintain its competitive power and market share in the industry. The information includes competitors' sales amounts, good-selling products, major customers, etc.

*2. **Customer information:*** Detailed, sometimes private, information regarding the purchasing personnel in customer companies are stored in the databases. Examples of customer information include birthdays, hobbies, authority for purchasing decisions, family information, and any other relevant customer information.

*3. **Sales statistics:*** Sales clerks enter daily sales data when a copy of an invoice is delivered to the department. Sales reports are prepared from these input data.

*4. **Customer visit information:*** Sales representatives enter the results of their visits to customer sites. They input such information as reason for visit, discussions held with customers, and sales achieved.

Competitor and customer information was originally entered when the databases were created and are updated whenever necessary. S*ales statistics data* are entered every day when a copy of invoices arrives from the shipping department. Sales representatives key in *customer visit information* when they return from a customer visit.

Operations of SMIS

Each department stores these data in its individual PCs which run as stand-alone units. Every Friday, an IS staff person manually collects each department's data in SMIS on floppy diskettes and inputs them into the PC in the IS department in order to create a corporate SMIS database. Then, he prints the periodic (weekly and monthly) sales reports using the corporate database. It takes more than four hours to create a new central corporate database and print the periodic sales reports completely.

These sales reports are sent to the sales director and the corresponding department heads. The department head makes these reports available to the sales representatives. Because the sales report is single-spaced, the sales representatives sometimes made a mistake in matching the company name and the amount sold to the company. Also the total quantity sold and the total amount sold are not easily distinguished as they are closely located in the report, and there is no dollar signs in front of the sales amount.

When the system was proposed, each sales department head was concerned about the security of confidential sales data because the data would be stored in the PC which was easily accessible. Therefore, each PC was designed to operate as a stand-alone unit without being connected to a local area network. The PCs have been physically locked when the sales persons leave the office.

SMIS was originally initiated by the new sales director. Being new to the company, he needed a computer system to collect all the departments' sales information quickly in order to easily get a grasp of the sales division. One objective of SMIS was to centrally collect and store detailed information about the customers gathered by the sales representatives themselves. Therefore, after SMIS was used, the sales director could obtain the sales related information directly from the sales representatives. In the past, the sales department head usually filtered out its contents and then reported it to the sales director.

As the individual sales department PCs were standalone PCs, they did not have access to the centralized customer and product databases. These databases only existed in the IS department's PC with a large (1 giga byte) hard disk. As a result, when the sales clerks in individual departments entered the sales data, the input data was not verified right away. The data verification and validation was performed once per week when the data were collected and entered into the centralized database. Another reason for not validating the data at the time of data entry was that the sales clerks used PC-AT machines and thus, additional time for validation would have further slowed the data entry process.

The influence of sales representatives over system design was kept a minimum in the SMIS development process. Mr. Jones did not usually ask the sales representatives for their opinions. Most of the design decisions were made by Mr. Jones and Mary, a junior programmer in the IS department. Mary graduated from college a year ago as an MIS major. Mary developed most of the SMIS programs. The SMIS is a complex system that integrates four subsystems and thus required good programming skills to make the program logic efficient.

Sales representatives regarded storing their customer information and customer visit reports into the computer as making their sales know-how public and revealed to everyone in the company. Previously, this information remained in the sales representatives' private files. Sales representatives also thought that by sharing this information they would lose the control of their private information which might affect their job security.

The sales department sometimes was dissatisfied with the IS department because the sales department's requests for new programs or updates of the existing programs were not usually done immediately by the IS department. Although sales representatives spend time entering customer information and customer visit results into the system, the sales representatives usually did not review or inquire the information which they themselves input because they already knew the content stored in the computer.

Mary designed the data bases of SMIS and decided their data structures. The discussion content in the customer visit data base occupied 1200 bytes of disk space. Occasionally, a few sales representatives brought two pages of discussion content, which is more than 2000 bytes long. However, most sales persons used only 500 to 600 bytes on average to store their discussion content.

<초 록>

Why Systems Analysts Ignore Socio-Organizational Concerns During Systems Analysis?

김 종 욱 · 김 병 곤

오늘날 정보시스템 실패의 많은 원인이 기술적인 문제만을 중시하고 정보시스템과 관련된 조직, 또는 관리적인 요소들을 소홀히 하기 때문이라는 지적이 있다. 여러 MIS 학자들은 정보시스템 개발 시 이러한 기술적인 관점에로의 편중의 원인을 시스템 개발자들이 가진 편협된 준거체계(Frame of reference)에서 찾고 있다. 그러나 이러한 주장들은 아직까지 단순히 이론적인 단계에 그치고 있는데, 본 연구는 이러한 주장에 대한 실증적 근거를 제시하고자 한다. 그 방안으로 본 연구는 시스템 분석가의 준거체계와 시스템 개발 시 분석가가 발견하는 개발시의 문제의 유형간의 관계를 제시하고 있다.

본 연구의 결과 사회-기술적(Socio-technical)이거나 사회적인(Socio) 준거체계를 가진 분석가들이 기술적인(Technical) 준거체계를 가진 분석가들보다 더 조직적인 문제를 많이 발견하고 중시함이 나타났다. 그리고 통계적으로 유의하지는 않았지만, 사회-기술적인 시스템 분석가들이 사회적이거나 기술적인 준거체계를 가진 분석가들 보다 기술과 조직적인 문제 모두에 균형있는 관점을 유지하고 있음을 알수 있었다.

이러한 본 연구의 연구결과는 학문적이며 실무적인 시사점을 제시하고 있다. 우선 학문적 시사점을 살펴보면, 시스템 개발 현장에서 조직과 관리적인 관점의 문제가 소홀히 다루어 지는 원인을 알아 볼수 있는 이론적 배경을 제공하고 있다는 것이다. 그리고 실무적 시사점은 보다 균형 있는 시각을 가진 시스템 분석가를 만들기 위하여 학교 프로그램에서 어떤 교과과정을 만들어야 하며, 또 기업의 정보시스템 관리자들이 평소에 어떤 문제들을 보다 많이 강조하고 상기시켜야 할 필요가 있는지를 알려 준다는 것이다.