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THE PROCESS AND PRODUCT OF SYSTEM DESIGN*

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Given that user involvement is important in system design, this study addresses the as yet unexplored question of *how* a user should be involved in the system design process. Two radically different processes of interaction between a systems designer and a manager were compared in an information system design exercise.

In one interaction process, the designer conducted a traditional interview of the manager. He asked questions, analyzed data and made suggestions. In the alternative interaction process, there was an initial sharing of information and mutual suggestions, followed by a critique of each other's suggestions.

The study found that for this ill-structured problem:

1. The alternative interaction process produced higher quality designs with important implementation advantages.
2. The two interaction processes produced designs which used different types of organization control strategies.
3. These results may be due to a problem finding contingency—different processes of interaction may help to define different problems, and thereby produce different, but equally rational, solutions.

For the management of organization design, the process of interacting with users has important implications for the quality of the resulting design, the type of organization control strategy employed, and the subsequent implementation of the system.

1. Introduction

User involvement in the design process is necessary whether a policy, organization, or information system is being designed. In fact, this is one of the only consistent findings in research on implementation [18]. This study addresses the as yet unexplored question of *how* a user should be involved in the system design process. The setting for this study is the problem definition and top level design for a managerial control level [3] information system.

The study compares two radically different structures of interaction between an information system designer and a manager. The structure of their interaction is defined as the protocols or accepted patterns they follow in punctuating their exchange of messages. The designer and the manager have different skills, role perceptions and mental schemas which are combined through their protocols of interaction into a single design statement. The structure of their interaction serves as the context for the generation, interaction, and interpretation of ideas between them [6], [29]. The protocols followed are seen as a source of rationality in the design process, as they guide in bounding the problem space, drawing inferences, and defining an "appropriate" information system.

One set of protocols are drawn from the traditional approach to system analysis and design. In this approach the designer is the primary problem solver, and proceeds by observing and interviewing the manager. The designer poses both directed and open-ended questions, asks for suggestions, and pieces together a coherent image of the managers needs. Using his systems perspective as a guide, he then creates a suggested design for the manager's review. The alternative protocols are selected to explicitly engage both the designer's and the manager's mental schemas in the design process. A period of mutual teaching is followed by the early generation of suggestions from the two distinct perspectives. A mutual critique then serves as a basis for generating further data and suggestions.

2. Protocols of Interaction

2.1 *Protocols of Traditional Rationality*

"Designers are technical specialists who value their non-involvement. They enter a situation, inventory the problems and capabilities, go off and explore alternative solutions in the abstract, return with an optimal solution, and finally implement their solution. Since implementation requires changes, effective designers initiate and control changes. If the organization adopts these changes, the designers are judged successful." [21, p. 42].

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The possible interaction protocols between a designer and a manager range from the aloof technical expert described above, to the non-imposing process facilitator. Clark [14] and Havelock [20] give good overviews of the range and mix of interaction strategies available. From the systems design literature, one popular approach is selected as traditional. In it, the designer is seen as an expert at collecting and analyzing information about the manager. His analysis is centered on modeling the manager's operations and decision making activities. The model then serves as a basis for specifying an information system design [1].

A review of textbooks in the systems analysis and information system design area confirms the widespread acceptance of the model based approach [2], [7], [10], [15], [16], [17], [19], [23], [25]. All the authors emphasize the importance of involving the user in the design process, and an interview with the manager is seen as a major opportunity for doing so. In addition to obtaining the information the designer needs for his model, the interview is an occasion to dispel any fears the manager may have of the system development effort, and to give the manager a sense of ownership for the system being designed. Strategically, the designer's interaction with the manager is characterized by a logical sequence of identifying the manager's goals, the tasks required to accomplish those goals, the decisions required in performing those tasks and the information required to make those decisions.

Empirical work by Argyris on actual designer behavior [4], and a review of over twenty methodologies that have been developed to identify the information requirements of managers [27] supports an image of the designer as the primary problem solver. The traditional designer would not be rational if he jumped to conclusions about the manager's problems or information needs. In the first protocol he must learn about the manager's problems. The second protocol of data analysis may be a separate distinct activity, but more likely will overlap with data collection. Evidence of the manager's problem and information needs come in odd size chunks, which are pieced together as they are encountered. In the third protocol, suggested information system solutions are presented. The initial suggestion will seldom be sufficient, and a new round of data collection will begin. The traditionally rational designer punctuates his interaction with the manager as a series of *learning*, *analyzing* and *suggesting* protocols.

2.2 *Protocols of Alternative Rationality*

For managerial control decisions, a rationality of a higher order than the methodical collection and analysis of data by the designer will be sought. The designer and the manager will be viewed as equal members of a problem solving team and their interaction will be viewed as a whole. Both the designer and the manager have distinctive capabilities and viewpoints which must be merged to solve the problem of designing an information system. An information system is not something the designer will provide to the manager, but something they will discover together. The designer will not be the primary problem solver—holding a storehouse of knowledge, attempting to learn about the manager's problem, and presenting a solution. Instead, as a problem solving team, the designer and manager must share leadership, learn from each other, and together develop a solution.

This shifts the emphasis of rationality away from the tools of analysis used by the designer to the form and punctuation of their interaction itself. The problem solving process is then viewed as a dance, and rationality is seen to reside in the protocols of their problem solving dance.

Using the alternative rationality of team problem solving, the designer does not begin by asking questions, but by revealing information about himself and allowing the manager to do likewise. The first protocol allows each to reveal what they think the other should know about themselves related to the problem solving effort. Each then jumps to a conclusion, preparing suggested solutions in an attempt to extend the initial self revelations from their unique backgrounds and perspectives. In this second protocol (suggesting) the designer and manager perform separately, so that each can make their unique interpretation of the teaching process. These initial suggestions are then critiqued by each other as a method for generating and analyzing further evidence. The alternatively rational analyst punctuates his interaction with the manager as a series of *teaching*, *suggesting*, and *critiquing* protocols.

3. The Experimental Setting

3.1 *Participants and Task*

In order to test the two protocols in a realistic setting, it was decided to have experienced systems designers and managers engage in an initial system development interview. Registered nurses from the medical-surgical division of a large teaching hospital who had similar education and work experiences were offered twenty dollars to participate in a "job related problem-solving exercise." System designers were supplied by industrial and consulting firms with large, active information system groups. Two systems designers were supplied by each sponsoring organization as an equally competent pair based on their superiors' evaluation of their experience and ability. All designers were screened as having no hospital design experience. One designer from each pair was then assigned randomly to the traditional or alternative protocol condition, and nurses were randomly assigned to form two person nurse/designer teams.[1]

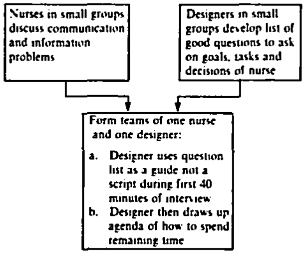

FIGURE 1. Protocols of Traditional Rationality.

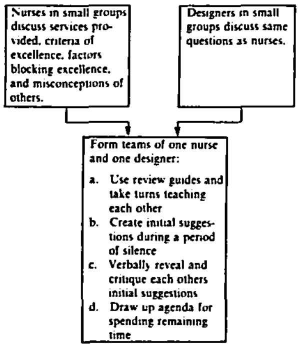

FIGURE 2. Protocols of Alternative Rationality.

The setting was a hypothetical newly constructed hospital similar in size and functioning to the hospital in which the nurses worked. A specific medical-surgical floor description was provided, giving the physical dimensions, number of patients and type of treatments that would be encountered on the floor. Nurse/designer teams were further separated into problem finding and problem solving groups. The problem finders were simply told to list the problems they identified during the interview and the solutions they envisioned for each. The problem solvers were told to investigate a particular problem, namely, assessing the needs of each patient, formulating a care plan for each patient, and evaluating the adequacy of the assessment and planning process. A pilot test of four nurse/designer teams engaged in the problem finding exercise, followed by the main experiment with eighteen nurse/designer teams divided as eight problem finders and ten problem solvers.

In order to induce the desired behaviors, an interview guidelines worksheet was prepared for each condition. For the designer using protocols of traditional rational-

[1] Designers and nurses averaged 5.4 and 2.3 years experience respectively and designers averaged 4.25 on a 6 point scale of reported frequency of actually interviewing managers (1 = not at all, 6 = to a very great extent.) There were no significant differences between groups on these dimensions. Sex roles were held constant using only male designers and female nurses.

ity, the interview guideline first gave him time to prepare a series of questions to ask the nurse. The nurse was given an equal amount of time to collect her thoughts on the information related problems of her job. The questions were grouped to inquire about goals, tasks, decision making activities and information requirements. See Figure 1 for an overview of the remaining steps in the traditional protocol condition. In the alternative protocol condition, the designer and nurse were first given time to think about services they provide to their respective users, the criteria of success in providing those services, factors which often block their success, and misconceptions they feel the other person might have about their profession. Figure 2 summarizes the remaining steps in the alternative protocol condition.

3.2 *Evaluation Procedures*

Teams in both protocol conditions were given two hours for the interview, after which the nurse and the designer separately wrote up the problems they had identified and the solutions they had proposed. A panel of seven graduate students read the designers' and nurses' write-ups and produced a listing of idea units contained in each problem finding group and a summary statement for each problem solving group.

A panel of three expert medical-surgical nurses then read and scored each idea unit from the problem finding groups separately on a scale of one to nine (with each starting at a different point in a randomized sequence of ideas). Spearman rank order correlation of interrater reliability was 0.65, 0.71, 0.65. This was deemed sufficient to use the panel avarage for idea unit scoring purposes.

After scoring the problem finders' idea units, the panel read both the nurses' and designers' write-up with a cover sheet listing the idea units or summary statements that were being attributed to that group in order to review for omissions or distortions of the ideas. Based on these readings, both the nurse expert panel and the graduate panel scored a number of learning and understanding dimensions for each team.

4. The Results

4.1 *Problem Finding Groups*

For the problem finders there was no significant difference in the number of problems identified by the designers in the traditional or alternative protocol conditions, or by the groups as a whole. The nurses, however, identified a significantly higher number of problems in the alternative protocol condition. Some of these problems were different from those identified by the designer, thereby increasing slightly the team total. In the traditional protocols, by contrast, the team total was identical to the designer total for each pair (Table 1).

Problem finding teams were credited with the total of their idea unit scores. A t-test of condition means showed a significantly higher idea quality score for the protocols of alternative rationality. This held true for the experimental only, or experimental and pilot conditions combined (Table 1). Mean group scores were also computed considering only the ideas in each team that exceeded 3.5 points in value (the distinction between average and poor ideas as reported by the panel). The consideration of only average or better ideas also showed significantly higher scores for the alternative protocols (Table 1).

It is conceivable, however, that a different evaluation panel with different managerial styles, concerns and emphasis could have rated the ideas in a different manner. Therefore, we will examine the idea units themselves, and seek a richer description of the differences between the two sets of protocols. We will first review the idea units of the problem finding nurses and designers, then we will review the solution strategies taken by the problem solving nurses and designers.

TABLE 1

Problem Finding Quantity—Designer, Nurse, and Group Number of Ideas

	Means			
	Traditional	Alternative	t-Value	Sig. (1 tail)
Designer	4.8	5.3	(d.f. = 10) 0.43	N.S.
Nurse	2.0	5.0	(d.f. = 6) 5.20	0.005
Group	4.8	6.2	(d.f. = 10) 1.26	N.S.

Problem Finding Quality—Mean Idea Unit Point Total by Condition

	Means			
Main Experimental Group	Traditional	Alternative	t-Value	Sig. (1 tail)
All Ideas	34.9	44.9	(d.f. = 6) 2.40	0.027
Ideas Rated Over 3.5	32.6	43.5	3.60	0.006
Main Experimental Group Plus Pilot Test Group				
All Ideas	29.1	41.5	(d.f. = 10) 2.39	0.019
Ideas Rated Over 3.5	27.6	40.6	2.95	0.007

Grouping the problem finding idea units by the protocol condition which generated them and the hospital activity they support provides a framework for their analysis. Three dimensions of hospital activity are used for grouping the ideas as to purpose:

1. Administrative and logistic control.
2. Nurse/doctor/patient interface.
3. Health care delivery by the nurse.

Exhibits 1, 2 and 3 summarize the idea units using this framework.

EXHIBIT 1. Problem Finding Idea Units Generated by Both Protocol Conditions.

Administrative and Logistic Control

A high speed reporting system should be installed for reporting test results that are beyond levels indicated by doctor. This would be an exception reporting system.

A pharmacy, equipment and supplies inventory system should be developed to provide better control of these resources.

A more foolproof patient to nurse communication system should be developed, along with a method of assigning priorities to patient calls.

The floor needs a method for shift to shift communication of significant changes and events that occur.

The hospital should have a system for room allotment (allocation) based on patient's need for care.

The floor should have an objective, systematic procedure for scheduling personnel.

Nurse/Doctor/Patient Interface

A computerized data base should be developed for patient history and medical/test records of current stay. The file should have a standard format for recurring information needs, and a free form section for doctor/nurse observations. Access to the patient data base would be hierarchical, and limited to authorized individuals.

Support of Nurse Health Care Delivery

The floor should have a readily accessible data base on nursing procedures (synopsis, symptoms, treatment, required nursing skills).

The floor should have a file on drugs that is more available and up to data—especially for more experimental drugs.

EXHIBIT 2. Problem Finding Idea Units Generated by Traditional Protocols Only.

Administrative and Logistic Control

The floor should have a responsibility reporting system for supplies, making the floor responsible for the cost of supplies consumed.

There should be an analysis of manual procedures in order to reduce the nurse's writing and administrative tasks.

There should be a wheelchair inventory control system.

An on-line computer system should replace the suction tube system for communication between departments.

Transcription errors by secretaries could be reduced by rotating nurses as secretaries, or automating the requisition preparation process.

The hospital needs better supervision of attendants in the X-ray department.

Computerized blood sheets are often wrong. Error correction is done verbally, and should be written down.

Nurse/Doctor/Patient Interface

The doctor/patient interviews should be tape recorded, transcribed, and made available to nurses.

The floor should have a system for informing patients more completely on the tests to be performed (why they are performed, what they do).

Support of Nurse Health Care Delivery

The nursing station should have a patient location chart on the floor, and a coding system for patient types, needs, and status in each room on the floor.

The nursing station should have a file on the particular patient care preferences of individual doctors.

There should be a file on the technical and legal forms required for each patient, and the current status of those forms.

The nursing station should have a file on important hospital policies to which the nurse is expected to conform.

EXHIBIT 3. Problem Finding Idea Units Generated by Alternative Protocols Only.

Administrative and Logistic Control

The floor should receive a short, concise history of patient instead of just diagnosis, doctor, name and age from admitting.

Each floor is too small for a computerized data base of patients on the floor. Information systems should focus on tieing hospital support services together better, reducing nurse's need to track down information from other departments.

The hospital should have a system for preparing a schedule of daily patient activities (with equipment and care requirements) made available to each nurse and each department.

Nurse/Doctor/Patient Interface

There should be a problem list on the front of the patient chart for physician-nurse informal communication of problems.

Teaching should be initiated on admission or early in patient stay.

The hospital needs a county-wide patient history information system to make patient history from other hospitals available.

Support of Nurse Health Care Delivery

Care plans should be exchanged between floors.

Care plans should be saved, recalled, and reviewed when patients are readmitted.

The nurse should prepare a short summary of interventions employed, success of interventions. and level of patient functioning at discharge. This should be added to patient record for recall at readmission.

An information summary system should be developed whereby the nurse would record data on patient at detail level, and a machine summary is prepared—especially for longer term patients.

There should be a system to help generate nurse care plans. This could be a standard plan to be modified for each patient, or a checklist to help prepare plans. The checklist could serve as a basis for group review and refinement of the care plan process, and evolve over time.

There should be a readily available file of allergies and base limitations of each patient.

There should be a system for summarizing test results and including summary results, rather than individual documents, in patient's file.

4.11 *Administrative and Logistic Control*

Looking first at the administrative and logistic control dimension, we see both conditions integrating hospital services and controlling resources with inventory, scheduling, and communication systems. The emphasis is on a solid core of systems which address the immediate logistic needs of the hospital as a whole.

Ideas found only in the traditional protocol condition add to the control features of the jointly held ideas. Increased control is sought over supplies through cost responsibility, over time through an analysis of manual procedures and increased supervision, and over errors in data collection and transmission by increased automation.

Ideas only present in the alternative protocol condition address the question of control, but it is approached as control through enabled coordination among departments rather than as control through increased efficiency, accuracy and proceduralization. Increased automation is questioned rather than called for.

The alternative protocol teams did not seem to elaborate beyond the jointly held ideas for system control to the same extent that the traditional teams did. They also approached the question of control from a different perspective. Control was not as actively created. It was either expected to follow from coordination, or was ignored altogether.

4.12 *The Nurse/Doctor/Patient Interface*

On the second dimension, both groups identified the importance of developing a patient data base. The patient history, doctor orders, nurse observations and lab results would be available in a centralized location, and accessible hierarchically to authorized personnel. While the details of how complete the data base should be varied widely among individuals, some evolutionary comprise would undoubtedly have resulted from further discussions by teams in either condition. On this second dimension, differences between the two groups are not so clear cut. Beyond the jointly held ideas, both identify similar communication gaps and suggest systems to close those gaps.

4.13 *Supporting the Nurse in Health Care Delivery*

Both groups suggested a data base on nursing procedures and a cross referenced file on drug dosages and interactions. In addition, the traditional teams have focused on the data needs of the nurse, and have suggested file systems to support those needs. The nurse must make care priority decisions (floor layout), care preference decisions and care policy decisions. The files suggested are intended to insure the information is available to make those decisions.

When viewing the nurse and her delivery of health care, the alternative teams take a more process oriented approach. They emphasize tieing the suggested system into an explicit change in the nurses behavior. She is meeting in groups, summarizing plans, and exchanging them across floors. It is interesting to note that the topic of care plans, which was not mentioned in the problem finding instructions, is discussed only by the alternative designers.

4.2 *Problem Solving Groups*

The problem solving teams in both conditions were asked to suggest a system to support the care plan generating, implementing and evaluating process. Once again, the two conditions each identify a similar core of activities. Both groups had a care plan generating system, a patient data base, scheduling support for rooms, personnel, and facilities, and a physician locating system. The core activities were elaborated differently by the traditional and alternative teams, however. This different elaboration refers to the way in which the core systems were described, as well as the additional features discussed by each condition.

For the traditional team, the computer was the center of the system and coordinated the activities of the floor and across departments. The nurses' responsibilites were reduced and control by her superiors was enhanced. For the alternative team, the nurse was the center of the system, and the computer was something she controlled and worked through to coordinate patient care. The responsibilities of the nurse were expanded, and control was enhanced through a group consultation process. It appears that the differences discussed between problem finding teams using the traditional versus the alternative rationality protocols are also evident between problem solving teams using the different protocols. This suggests that the teams in the two conditions produce solutions which are different, not only in quality as judged by a panel of experts, but in the control strategies and viewpoints they display. The symmetry of differences between traditional and alternative teams in the problem finding and problem solving conditions suggests that their solutions are different in predictable ways.

A major problem, of course, is that the solution strategies may have been misinterpreted—that the research has not only summarized but added meaning and/or emphasis to the actual write ups. To guard against this problem of data interpretation, the designers from both conditions were reconvened in a joint session. No designer reported any discrepancy between the idea unit summaries and their actual write ups. In fact, they stated strong agreement and support for the accuracy of the summarized results.

The group meeting was also used as an opportunity to ask whether the traditional protocols were, in fact, a fair representation of how the designers normally behaved during system development (especially during the problem definition phase). They agreed quite strongly that the traditional protocols did, in fact, capture the approach to systems design that they normally followed.

4.3 *Implementation*

It has been argued that the only consistent findings in the research on implementation to date has been the need for user involvement and top management support [18]. We might add to that list the need for incorporating relevant aspects of the Lewin-Schein theory of change [26], and the need for mutual understanding between the designer and the manager [13]. We will be especially concerned here with learning on the part of the manager. Learning is the central element in the unfreezing, changing and refreezing elements of the Lewin-Schein change theory. The existence of both mutual understanding and learning will be taken as indicative of a problem definition experience with a higher chance of implementation success.

The graduate student and nursing expert panels read the written summary of both the nurse and designer on each team, and the nurses were asked for a self-report on learning. The results of those judgements are as follows:[2]

A. Nurses in the alternative protocols condition had significantly better *understanding* of the problems the designer had identified and the solution strategies he was following. (The judgement of the nurse expert panel members had a spearman correlation of 0.52, 0.66, and 0.58, and showed significance at the 0.01 level. The graduate student panel rating had a spearman correlation of 0.60 with the nurse panel, and showed significance at the 0.005 level.)

B. Nurses in the alternative protocols condition had significantly better *mutual understanding*—they became something of a systems analyst themselves. (Each graduate student panel member rated this role reversal as significant, ranging from 0.03 to 0.002.)

C. Nurses in the alternative protocols condition had significantly higher *learning* in ways information could be used differently to improve task performance. (The nurse expert panel ratings had spearman correlation of 0.58, 0.70, and 0.61, and showed significance at the 0.03 level. The graduate student panel had a spearman correlation of 0.67 with the nurse panel and showed significance at the 0.001 level. The nurses' self report showed significance at the 0.045 level.)

It might be argued that these differences between the two protocols are related to the limited amount of time available for the interview. A two hour inverview may not be sufficient for the traditional protocols to generate the idea quality and mutual understanding that they are ultimately capable of. To pursue this argument, the designers were asked a simple yes/no question after the interview: "Could you have productively used more time with the nurse?" The responses revealed a significant difference between the two groups. The designers using the protocols of traditional rationality felt they could not have productively used more time, while the designers using the alternative protocols wanted to continue the interview (X^2, 3 d.f. = 8.25, significant at 0.05 level). Several traditional designers noted that it would now be appropriate to interview individuals in other departments, rather than continue working with the nurse.

Using the traditional protocols, the designer's emphasis is on collecting the information he needs from any given individual and leaving for the next collection point in his problem solving process. Perhaps because he is elaborating his solution without directly addressing required changes in the nurse's behavior, he is more free to move on. If the nurse does not understand his design, it is not critical. Understanding can come later, during "implementation," when the nurse will be taught how to use the system.

The designer following the protocols of alternative rationality, on the other hand, directly addresses changes in the nurse's behavior during task performance. The additional problems these changes entail may be why he is not as free to move on to the next data collection point in specifying a final design. The difference brought out in this short interview session may even magnify as time goes on. The traditional designer, with less understanding or learning by the nurse, and less valuable ideas, is moving on to the next step in problem solution while the alternative designer is staying to resolve issues further.

[2] Significance is based on a one-tailed test at the 0.05 level. For the details of these results, please see Boland [8]. Please note that all implementation findings are based on 19 main experiment teams. One nurse was found to be from the emergency rather than medical-surgical staff and was eliminated from all previous idea and problem oriented analysis.

5. Discussion of Results

It has been argued that information system designers have a common orientation toward their design clients, and that this orientation is 'played out' in the system design process. Hedberg and Mumford have found in Swedish and British studies that ... "systems designers use a restricted theory x type model of man when designing computer systems [22, p. 56]." Similar findings in the U.S. by the UCLA Center for Quality of Working Life are reported in Cherns [11]. Tichy [28], in a more extensive study, has identified a number of different types of change agents, and found that each type used different, but characteristic, diagnostic categories and change techniques. Let us accept that the viewpoint and implicit models held by designers will color their collection and interpretation of data about the needs of the organization they are designing for. This study suggests that understanding how the viewpoint builds a coherent design statement requires an understanding of how the designer interacts and exchanges information with his client. The interaction protocols may then be seen as mediating the process of completing the designer's 'point of view' (creating the design statement).

5.1 *Inquiry Systems and Contingency Theory*

We can propose two ways of explaining this mediation process. First, viewing the two protocols of interaction as inquiry systems [12] suggests a contingency theory of organization design. The design problem varies in difficulty from situation to situation, and the structure of inquiry should 'fit' the needs of the situation. Here, in an ill-structured design situation, interaction protocols with a dialectic (Hegelian) component proved superior to those based on concensus (Lockean) and internal consistency (Leibnizian) alone. This agrees with the different capabilities of these modes of inquiry as summarized by Mitroff and Pondy [24].

The traditional protocols rely on the input, labeling and cross referencing of raw data in the learning stage. An accurate representation of the manager will be found in the concensus of the raw data collected (Lockean). In the analysis protocol, the designer applies his own theoretical perspective to construct an internally consistent "fact net" of design (Leibnizian). The decision maker is fit with a theory of how to efficiently complete his role related decision making responsibility, and how to effectively integrate into the relevant larger organization.

For the alternative protocols, the teaching component allows a Lockean mutual consensus of important talents, needs, and perceptions of the problem situation. The suggesting protocol allows each participant to form their own Leibnizian "fact net," combining the data just generated and their individual viewpoints into an internally consistent whole. The critique which follows is the Hegelian element of the inquiry process. The two alternative world views of the designer and the manager conduct a debate on the data which they have generated in common and formed into suggestions separately. The critique protocol serves to generate new data, reanalyze existing data, and reduce any distortions caused by each individual's selective perception.

5.2 *Viewpoints and Organization Control Strategies*

The protocols may also mediate by more fully developing different points of view on the design problem. The design statement is then seen as a fully developed point of view. What is appropriate for organization control depends on the viewpoint being completed. Burns and Stalker [9] describe a continuum of organization design strategies. The polar ends of the continuum are mechanistic and organic, and their appropriateness is seen as situationally dependent. The mechanistic and organic strategies are not an either/or dichotomy, but two ends of a continuum. Keeping this in mind, we can relate the central core of systems described by designers in both protocol conditions as being in the middle of the continuum.

From this core of applications located in the center of the continuum, the two groups of designers set out in different directions. Designers who use the protocols of traditional rationality proceed to elaborate the central core application with mechanistic characteristics (policy files, responsibility accounting, manual procedure analysis, data control for superior review, assignment of tasks and reporting of task completion, establishing norms for nurse behavior, etc.). Designers who use the alternatively rational protocols, by contrast, tend to elaborate the central core in the direction of more organic characteristics (expanded responsibility to nurse, use of team coordination units, increased cross departmental communications).

It seems reasonable to portray designers using the two protocols as follows. The traditional protocols help the designer to assume a position and collect data for viewing the hospital system as a whole. Seeing how the pieces fit together is his normal mode of behavior, and seeing how to put them together efficiently with minimum error and redundancy is his problem solving posture. He assumes the role of top manager, and designs a system that helps a top manager be in control of the organization. To paraphrase Mary Parker Follet, he is designing to be in "control over" the organization. His design alternatives range from the core activities of the middle ground to the mechanistic end of the design continuum. This line of argument agrees with the top management control strategies or theories in use (Model 1) found by Argyris [5].

The designer using the alternative rationality protocols is not supported in taking an overall viewpoint. He assumes a stance and collects data that helps him view the hospital setting through the nurses' eyes. The focus is not on a system which contains nurses, but on a nurse who is trying to function within a system. The emphasis is on relationships that the nurse must establish and maintain in order to manage effectively. The design is for a nurse who is in control, rather than a nurse who is being controlled. The designer using the alternative protocols covers the applications in the center of the continuum and elaborates out toward the organic end. To paraphrase Follet, he is designing a system for "control with" the nurse.

5.3 *Limitations of the Study*

The study focused on a one to one interview situation with a complete lack of shared background between the designer and the manager, and an absence of the design criteria implicit in an organization context. It cannot, therefore, be extended directly to organizational design efforts with larger design teams, more extensively shared backgrounds and experiences, and a more fully felt set of expectations on the part of higher management or coworkers. Also, an organic process of design may not be compatible with an existing mechanistic organization. The impact of different protocols on the complete cycle of an organization design process with larger design teams remains to be explored.

5.4 *Implications*

For the management of organization design, this study raises the need to be aware of the process of design being followed. Not only the extent of user involvement, but the process of user involvement must be attended to, and not only the type of designer being used, but the viewpoint he is supported in completing must be considered. The study suggests one area for exploring the relation of process and product is in the structure of organization control systems that result from design efforts.

At a different level, and perhaps more importantly, this experiment has emphasized that problems have to be found before solutions can be designed. Different structures of interaction found different types of problems to solve. Contingency theory assumes a problem (task) exists, and that different structures are best suited for solving different types of problems.

It may ultimately prove necessary to restate the contingency framework as follows: tasks that require different types of problems to be found are best addressed by structures that find those types of problems. Differences in structural relations to problem solving may prove insignificant to the more fundamental relations to problem finding. We might, then, replace the idea of "tell me your problem and I will tell you the appropriate structure," with "tell me your structure and I will tell you the types of problems you will define for yourself."

This difference in viewpoint is not trivial ecologically, if structures that become more capable in addressing a currently identified problem become less capable of finding any other type of problem.[3]

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