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THE SOCIO-TECHNICAL APPROACH TO WORK SYSTEM DESIGN IN HOSPITALS

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For us, the human side of work is the most important aspect in any consideration of jobs and organizations. Hospital organizations, for example, are made up of people, their jobs are, of course, done by people, and the results of that work are _for_ people -- whether they be direct recipients such as patients, or whether they be the indirect recipients such as the community or the employees themselves. The dilemma is highlighted by asking, why do we so often separate the effects of work on the humans involved _in_ its production from the effects on humans as recipients of its end result? We believe that if work is consciously designed as a meaningful activity for the people involved in its production, then the chances are good that its product will also better suit its human users. That is, there is a systemic relationship between the quality of working life and the quality of the product of that work. In so saying, however, we must likewise acknowledge the importance of the technical requirements of the work -- for having meaning to the people involved is not enough. Work that is meaningfully arranged, both for the humans involved in its execution, and for its technical requirements as well, typically results in a higher quality product and, not infrequently, in greater productivity as well. In our experience, results are frequently accompanied by lowered absenteesim and turnover and greater feelings of satisfaction with the work activity (Davis and Cherns, 1975). Work system design, or socio-technical system design, is a powerful approach to this human side of work -- work that is meaningful in both that human sense, as well as the technical sense.

Socio-technical (STS) system design is a fairly recent development in the quest for jobs and work roles which are both more satisfying to their occupants and more effective in meeting organizational requirements (Emery and Trist, 1960). This new technique is used for redesigning existing work systems as well as for new site design. STS design differs from other approaches to the problem of matching work to people by attending simultaneously to the technical and production requirements of the work, and to the psychological and social aspects of individual and group requirements. It has the advantages of an operations management approach to a total work system which assumes the interdependence of diverse elements such as time constraints and control requirements; STS design takes them into account in addition to the individual job characteristics of more conventional job design programs. Unlike conventional operations management, however, which focuses on production system efficiency alone, STS does consider human and social system requirements *per se* as central aspects of work and organization design. It also recognizes the need for these human inputs and their self regulation for the achievement of system flexibility.

STS design is not, however, a cure-all or panacea for any and all organizational ills. Recognition of twin assumptions is required before this sort of work system design can be considered. First, there must be a presenting problem, a concern of a productivity or mission oriented sort. The design is intended to meet some rather specific (and specified) organizational goal or end. Second, a certain broad threshold of minimum quality in wages, working conditions and human relations concern must be in place, either in management concern in the case of a new site design, or in management actions in the case of a redesign.

We believe the STS design is a more suitable approach to improving the quality of working life and productivity than either the individual job design schemes (e.g., job enrichment (Herzberg, 1966), work simplification (Mogenson, 1963), or the more systemic or comprehensive procedures (e.g., operations management (Buffa, 1972), technical engineering (Morgan, et.al., 1963)), not because it is necessarily better than any of them, but because it demands a broader perspective. In essence, STS design, in addition to its own unique emphasis on system flexibility, becomes a vehicle for the most effective application of the design techniques embodied in these better known and more conventional approaches to work and job design.

Socio-technical work system design operates to jointly optimize the requirements of the social subsystem, as well as the technical one, by starting with the total work system rather than a piece or pieces of the technical subsystem alone. Our definition of this total work system begins with a determination of the boundaries within which the product is converted from a raw material to an end result. This constant focus on the product-in-becoming, or the primary mission of the system guarantees the joint optimization mentioned above since neither the technology nor the organization of employees is dominant over the other, or ignored for the sake of the other. Before proceeding to a description of the STS design procedure, we must acknowledge that the technology of professional service work is not as easy to understand as traditional manufacturing or assembly processes. This issue will be addressed separately later in the paper.

The STS design process undertaken is straightforward. It involves, 1) the identification of the system to be designed from the presenting problem and an analysis of technical system requirements, 2) an analysis of the social/control system requirements, together with an analysis of individual role perceptions, and 3) an examination of the interaction between the target system and its environment, both internal to a large organization and external from it.

Much energy in the initial phase is taken up in analysis of the technical system. The reasons for this are consistent with the underlying philosophy and principles. First, one of the major problems with jobs and work in today's organizations is that the relationship between the technology and the worker has been allowed to become confused. A systematic analysis of the technical system *per se* permits us to separate that technology from the social organization. Second, such an analysis allows the designer to identify the critical technical requirements in order to better understand the primary mission of the unit and to aim for the optimal technical or production results.

After the technical analysis has been completed, the focus moves to the social organization, methods and extent to which control is currently achieved for those technical requirements. Supervision, verification, and inspection are frequently found to be the mechanisms of control. Not infrequently, certain requirements or variances are not controlled adequately because they require that the persons in the work system cooperate more than they actually do. Another part of the social system analysis is to examine this coordination around technical system requirements both across the boundaries to other systems internal and external such as suppliers and users plus maintenance people. A third part of the social system analysis is to determine how people actually view their own role as it relates to the others in the system.

Initial Structure and Training

We have had our most successful experiences working with design teams of three to five persons who were inside the organization (U.C.L.A., 1974). We act, in such cases, as consultants to these internal groups by providing a model for analysis and design and by helping the groups apply their special knowledge to the general model. The composition of such groups typically includes a line manager, a staff manager from personnel department and/or systems management, and persons selected from supervision plus the non-supervisory ranks within the target department.

The process usually begins by holding an informal seminar with the design team. These seminars require approximately ten hours of class time, and about the same time in outside reading. The purpose is to familiarize the design team with several concepts. These concepts include the following:

Organizational Behavior and requirements: social structure, management climate, decision making and control, jobs, roles and role behavior, group dynamics, primary task (Kats and Kahn, 1966).

Technical Systems and requirements: input/output, product, transformation techniques and methods, unit operations, mechanization, variance control, technological determinism.

General Systems: boundaries, subsystem interdependence, application to social organizations, growth, dynamic homeostasis, reversibility, equifinality, environmental interaction (Emery, 1969).

Societal Factors: changing values, quality of working life, psychological requirements for job design (Davis and Cherns, 1975a).

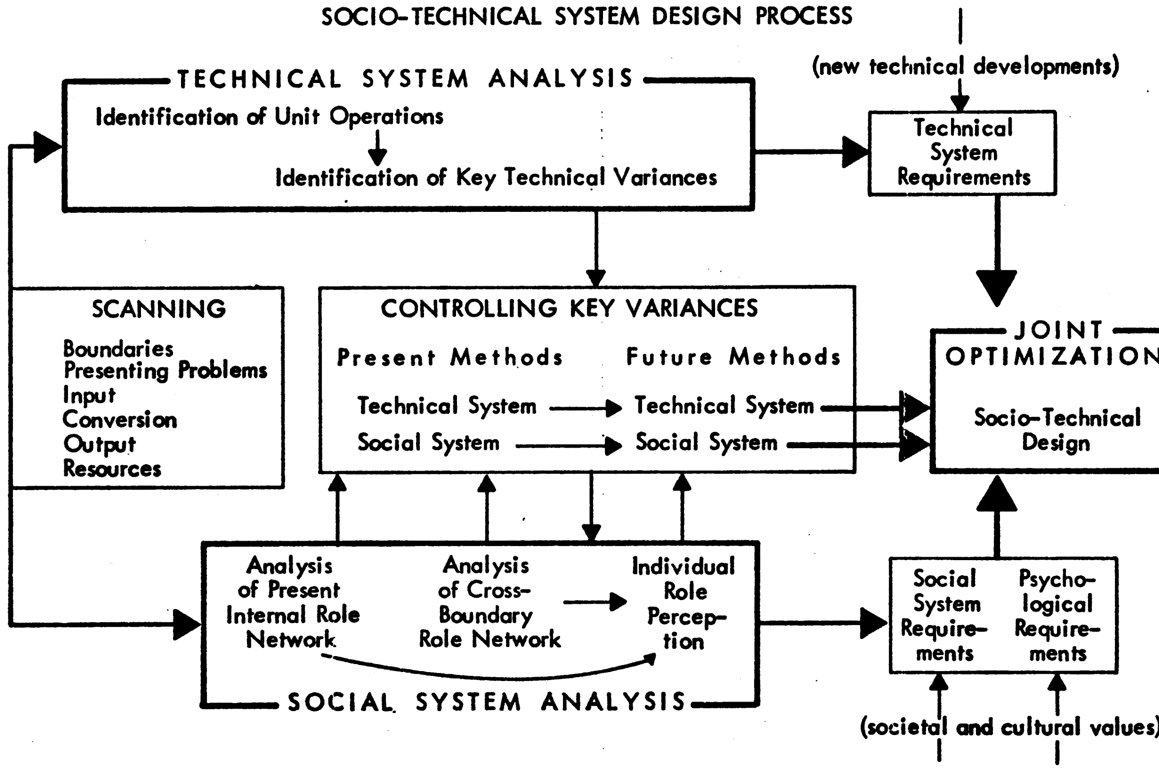
The main socio-technical design criterion is that control of key variances, and the coordinating for that control where such coordination is necessary, be placed at the lowest level at which there is both a technical subsystem (a meaningful transformation) and a social subsystem (two or more people relating to one another).

Following this emphasis on concepts, the design team embarks on the analysis of their work system by following, with consultant guidance, the process described below.

INSERT FIGURE 1 ABOUT HERE

FIGURE 1

SOCIO-TECHNICAL SYSTEM DESIGN PROCESS



1. Scanning. Scanning involves the fairly brief but extensive overview of the system to be designed, its boundaries, inputs, and products, its staff of people, its relationship to its environments, and the "presenting" or immediate problem. The scanning process allows the design team to agree on these general dimensions as well as permitting the consultant to emphasize the input or product aspects of the technology. The system as scanned is seen as a bounded region in space/time in which inputs are converted or transformed into outputs or products, a system which has certain relationships with its environment, and which has certain requirements and problems to be met. This boundary setting procedure is as important in a hospital system as it is in any other organizational setting. If, for example, one meant to design or redesign a particular ward (say general medicine, or pediatrics), then the boundaries would be drawn around all the processes and techniques used in that ward, as well as all the personnel working there, even if only part of their time. The inputs - and outputs - would be patients' conditions; the presenting problem could be anything directly related to quality of care for those patients, or the costs of that care. If we chose to redesign the Nursing Department, a very different system would be defined. The boundaries would include all nurses (LVNs, nurses aides, and orderlies), as well as nurse management; the primary product or output

would be nursing behavior, and the methods or techniques for obtaining the transformation from need for nursing to nursing behavior would be primarily managerial. The general problems of management, as well as those special or unique conditions in that nursing department in that hospital, would be defined as the issues directly relating to the quality and/or costs of nursing in that setting.

The scanning procedure is a crucial first step in the design process as it is the step in which design-system boundaries are initially but not irrevocably defined.

2. Technical Analysis

a. Identification of Unit Operations. Once the boundaries have been defined, and the primary mission or task of the system has been established by identifying the output which is expected, and which in turn has helped define the input -- then it is possible to identify the unit operations in the technical process. "Unit operation" is a concept borrowed from chemical engineering (U.S.Dept. of Labor, 1965) which refers to any one of the phases of a technology in which an identifiable state change in the input occurs. Given this definition, it follows that any technology can be analyzed by identifying all of its mutually exclusive unit operations. Furthermore, this analysis will have the advantage of defining that technology in terms of its input rather than by its processes or techniques. This focus insures that the technical system will be analyzed separately from the jobs and work of people on the one hand, and the supervisory and control system on the other. In locating these unit operations, design teams frequently find that they can establish fewer unit operations for their system than they at first thought. This is because many of the operations performed on the input are control, checking, verification or inspection activities rather than fundamental changes in that input. To say that clean laundry is ironed and folded is an identifiable state change (representing a unit operation), but to say that it is inspected or checked for wrinkles or spots is not.

b. Identification of Key Variances. Once unit operations have been determined for the system, the important task of identifying the myriad technical requirements or variances, and from among those to select the most important or "key" variances, follows. Those key variances are so called because they include not only the technical requirements which must be met in order to control their direct effects (e.g., on quality of laundry, or on quality of care), but they include the variances which, although having indirect effects themselves, are "key" to controlling those which do have direct impact on the system's primary task.

Variances are defined, not necessarily as problems to be faced (which should have been met by identifying the "presenting problem" in the scanning step) but merely as deviations around some central tendency or from some norm. These deviations represent technical system requirements to be controlled. The primary purpose of the variance analysis is to examine the manner in which those variances, or requirements for control, are met.

The actual process of identifying key variances involves first the listing of all known variances for each of the unit operations. These variances represent the possible deviations from a standard which are brought about either by the state of the input to that unit operation, or by the normal state of the technical procedures or techniques. Variations which are brought about by breakdowns in the technical process or by human error <u>are</u> <u>not</u> included in this listing. Following the listing of all variances for each and every unit operation, the key variances are identified which are most direct or important in their impact on <u>quantity</u>, <u>quality</u>, or <u>costs</u>.

The final step in further identifying key variances involves the construction of a square matrix (Engelstad, 1970:354-5) which includes all the variances, grouped within their unit operations, along both axes. Cell entries in the matrix are the relationships between each pair of variances throughout the work system. Informal rules of selection are applied which define a variance as a "key" variance if it has impact on: a) one or more of the ~~Key Variances~~ which were identified by the criteria in the preceding step, or b) if it has impact on several other variances in subsequent unit operations.

3. Table of Variance Control.

This third step actually forms a bridge between technical and social system analysis, and it is the heart of the design process. In it, key variances are examined one at a time to determine the manner in which they are currently controlled in the case of redesign, or are usually controlled in conventional sites in the case of a new design. The table actually lists the unit operations in which the key variance originates, is observed, and is controlled (Hill, 1973). In it are also listed who or what controls the key variance, what actions are used to control it, and the source of information. Finally, the table provides space for listing possible alternative control mechanisms either technical/mechanical or human/social.

Tables of variance control frequently reveal that variances are not controlled where they originate, and that much of the control is undertaken by supervision --

either in direct orders to subordinates or via coordination with other supervisors. The table of variance control permits the introduction of purely technical solutions, and begins the process of considering some social system alternatives to direct supervision or supervisory coordination.

4. Social System Analysis

The social system is comprised of the work related interactions among people. This definition includes vertical (e.g., superior-subordinate) relationships either internal to the work system or across its boundaries. The social system also includes the horizontal relationships among persons within the same class (e.g., non-supervisory, supervisory, or managerial), or more specifically among people at the same pay or status grade. As with the vertical relationships, horizontal relationships may be internal to the work system or may cross its boundaries. The particular social sub-system of the work system to be designed would be bound by the same constraints as the technical sub-system -- namely, the initial boundaries would be defined by the entry of raw material and the export of results or product.

As described, the social system is not a friendship system, but rather the coordinating and integrating buffer between the technical transformation process and the demands and constraints of a turbulent environment. The several steps in the social system analysis described below are intended to aid in better understanding of this coordinative and buffering function for the purposes of design.

a. Internal Role Network. The first step involves examination of the role relationships within the whole work system as initially defined (Kahn and Rosenthal, 1964). This activity actually includes mapping the persons who have work related interactions in the system, and the content of that interaction. This mapping could include several supervisors or managers and the groups of subordinates reporting to them. Mapping of most linear operations (e.g., laundry operations) frequently shows each employee interacting individually with a supervisor and not usually with one another. The simplicity or complexity of the roles and the number and variety of relationships with other roles in the work system should be examined.

The boundaries of unit operations are frequently found to delimit groups of employees in the organizational structure. It is also frequently found that key variances originate in one unit operation, but are controlled in another one. In such cases it is useful to carefully examine the role relationships between the point of key variance origination and its control. Is that coordination undertaken by supervisors among employees, or among employees themselves? The degree of cooperation and integration among roles and the amount desired should be assessed.

b. Cross Boundary Role Network. This step parallels the internal system network analysis described above, except that the role relationships between work system member and persons outside that system are examined. The persons outside may be within the overall organization or they may be in its environment. Before the role analysis is undertaken, however, the matrix of variance constructed in Step 2 above should be enlarged to permit the examination of relationships between the key variances identified with variances in supply or user systems or in maintenance systems, all of which are outside the boundary of the target work system. The Housekeeping Department, for example, is both supply and user systems for the Laundry, in that housekeeping provides the dirty linen and uses the newly laundered product. This continuation of the variance analysis would permit the cross boundary role analysis to go beyond the merely trivial and to open up design possibilities; for example, expanding the boundaries of the target system in order to either increase control over inputs, or to increase responsibility for the product.

c. Individual Role Analysis. This third step in the social system analysis requires that the design team actually seek out the perceptions of the role occupants in the work system in order to know their own views of those roles. Not infrequently, what appears to be an effective and efficient relationship between roles within a work system, or between a system and its environment can be experienced as extremely tense and stressful, quite apart from the personalities of the occupants themselves. More information is usually required at this time to determine the causes for this situation. Not infrequently in our experience, this tension is caused by the separation of roles or work systems on the basis of physical space or location (or perhaps purely technical constraints such as unit operations), rather than on the basis of the control of key variances through cooperation, coordination, and shared responsibility.

These three parts of the social system analysis combined with they key variances form the basis of the socio-technical system design. The first part, the coordination and control aspects internal to the system, permits additional technical solutions to be considered, and for traditional control roles to be reviewed. The second part, the coordination and control aspects on the work system's environment, permits consideration of expanded or changed system boundaries to permit greater control. The third part, the examination of the role perceptions of individuals in the system permits the evaluation of felt need and directions of social system changes which will have immediate relevance to the role occupants. Finally, this individual role analysis will also permit an examination of the set of psychological requirements the individuals bring with them to the work place. In our experience, employees at all levels are increasingly expecting greater autonomy, responsibility, variety, social support, and a meaningful career path from their jobs.

5. <u>The Socio-Technical Design</u>

Once the technical system has been separated from the social system, and the requirements of each have been teased apart, the design process proceeds by recombining the elements in such a way that the key variances are controlled by utilizing, to the full, the coordination capability of the members of the work system. If the employees themselves inspect, verify, and coordinate among themselves, then the supervisor is free to aid in coordination between the work system and its environment. We call this "controlling boundary conditions." The result is a work system with roles and jobs which not only interlock, but interact directly with one another. This sort of system better exercises the internal variance control it needs when it needs it -- the result is faster and more flexible coordination. Also, as the supervisor is released from the coordination function, he or she can better act in the managerial capacity of relating the work system at its boundaries. Our experience indicates that controlling boundaries can also be done by internal members, sometimes on a rotating basis, but that the status of the supervisor is sometimes necessary in relating to persons of similar status elsewhere in the organization.

Recent Experience with Work System Design

There are in excess of 100 known cases of work system restructuring available today (U.C.L.A., 1975). Nearly all these cases report success either in productivity dimensions, or quality of working life dimensions, or both. There are a few studies among these which have stood the test of time, and several which are so new that no output data is available. The remainder report experience with a year or two. In all, some 40 percent of the studies were begun after 1970. Most cases of work restructuring are from either the Netherlands, Sweden or the United States.

Several categories of results appeared in the studies referred to here. In order of frequency with which they were reported in those studies, those results were: increased productivity (41 percent of the studies), improved employee attitude (36 percent), improved quality (24 percent), lowered costs (11 percent), reduced employee turnover (9 percent), while drops in grievances, manpower requirements and accidents were reported in five percent of the cases each.

The success of this design procedure in attending simultaneously to both human needs and technical requirements is becoming clearly established. We need more and better documented results of the application of such designs, and we need to attempt to apply these methods in more types of organizations, such as hospitals, where turnover rates are high, the lack of career commitment on the part of professional employees has resulted in chronic endemic shortages, and where, in general, there is increasing evidence of labor force dissatisfaction.

Most reported cases of work restructuring deal with assembly operations (33 percent). Semi-skilled machine tending is the next most frequent (23 percent), while process operations account for the third largest category (21 percent). White collar work accounts only for nine percent, while the remaining 13 percent are composed of a variety of other types of work and organizations. No cases of redesign in hospitals or other health care organizations are reported, or are otherwise unknown to us. In fact, significant though this fact is, it takes on special importance when we consider that the technology of health care organizations falls into the category of non-linear processes which James Thompson (1967) calls intensive technologies, and that all the current cases referred to exemplify linear or "long linked" processes. The question we are prepared to address in the remainder of the present paper is, specifically, can socio-technical design principles be usefully applied to nursing technology and, more generally, can socio-technical design procedures be applied in cases of intensive technology?

THE TECHNOLOGIES OF NURSING

Evidence from previous studies suggests that the STS design could be readily applied to the linear operations of the laundry, housekeeping, clerical, dietary, laboratory, and pharmacy departments. In these departments, the technical system requirements can be quantified with relative ease and performance criteria, a necessary element for variance control, can be established. What is needed in these departments is an awareness on the part of the manager with a productivity or quality problem that there is a work systems design approach which is qualitatively different from traditional industrial engineering approaches or human relations techniques.

The question which has not been addressed is whether or not professional service work such as nursing can be described in terms of technical requirements, unit operations, and variances. This is important because, as indicated previously, technical analysis precedes an identification of key variances, variance control, and the optimal joint design of the technical and social systems. The remainder of this paper will focus on the technical analysis of nursing. The choice of nursing as a professional services prototype can be justified on several grounds. First, nursing turnover is taking on all the signs of a significant social problem and one that work systems design may seriously affect. Second, nurses comprise the majority of employees in most hospitals, and account for a significant proportion of the hospital payroll and the patient day expense. Finally, more unsuccessful job design approaches have been adapted in nursing departments than in other professional departments. There is a history of change and experimentation and doubtless a good many useful ideas were inappropriately applied or were ill conceived.

Nursing has established, through its professional schools and licensing examinations, that it possesses a specific area of knowledge and skills which is recognized by the recipients, physicians and employers to be of value to our society. A concise statement concerning a composition of the various nursing technologies (understood by nurses, administrators, physicians, and other policy-makers) has not, however, been developed. This inability to articulate the component technologies of the work probably explains the difficulty which has attended most efforts to rationalize the patient transformation process on hospital units. Examples of such efforts are the introduction of unit managers, attempts to institutionalize team nursing, and the functional delegation of tasks. Without a technical analysis, it is easy to address one component technology of the work without clearly understanding its impact on the entire work system design.

We present the following model of nursing technologies as a point of departure. This general model can apply to nursing in ambulatory as well as hospital settings and the care of patients with physical or emotional health problems. In a specific instance, some of the unit operations mentioned for each of the technologies may be of minor importance, while on others it may be of considerable importance. It would be the responsibility of the design team to ascertain the relative importance of each technology and each of the unit operations for that particular organization to acheive its patient care objectives in a given situation.

INSERT FIGURE 2 ABOUT HERE

The diagram in Figure 2 suggests that there are, in actuality, four separable but not independent technologies of nursing. The assisting or care function is one of these separable technologies, and is probably the most widely shared conception of the nursing function; the nurse as someone who attends personally to the perceived physical, mental, and spiritual needs of patients (Harmer and Henderson, 1939; Wood, 1972). From the nurse's point of view, since this technology has historical and cultural primacy, and since it also most clearly delineates nursing from medicine and the other helping professions, it represents a stable core value -- "the patient's needs must come first." Note that the unit operations include basic state changes: the need to breathe, to be protected, to be fed, to excrete waste, to be kept clean and dry, to move and to have the human requirements for religious and emotional experiences attended to whenever the individual is unable to achieve those states for himself because of ill health. No other occupational group challenges the nurse's supremacy within this area of nursing technology. The private duty nurse probably serves as the idealized model for this technological component.

FIGURE 2

THE FOUR SEPARABLE BUT NOT INDEPENDENT TECHNOLOGIES OF NURSING

	TECHNOLOGIES	UNIT OPERATIONS	
SUPERVISION	ASSISTING	Diversional, Environmental Maintenance Personal Hygiene, General Comfort Religious, Psychosocial Elimination Food and Fluid Safety, Comfort, Protection Mobility Oxygen Transport and Exchange	
	INTERVENING	Assessment (history & physical, observation, analysis, interpretation) Treatment and Procedures Medications Documentation	
	INFORMING	Transmission of information Translation of information Transformation of information Generation of information	Patient Family Personnel Physician Community Agencies
Staff Lead	COORDINATING	Plan Organize Evaluate - Control Assigning	

With the shift away from the private duty concept of nursing practice, which was precipitated by the depression of the 1930's, plus the advances in medicine which occurred during and after World War II (Dolan, 1973), this primary core technology was challenged by the growth of the intervening or curing technology.

Intervening Technology

Within the past decade, the key actors, physicians, nurses, administrators, and the public, have reached the consensus that nurses not only assist patients, but also actively intervene to affect the treatment regime. Within the parameters established by the State Nursing Practice Act, the nurse assesses the patient's biological, psycho-social, and spiritual needs and, combined with her knowledge of health and pathology, through an analytic process makes a nursing diagnosis or assessment (Johnson, 1959; Abdellah, 1973). This diagnosis is expressed in a form of an original nursing care plan, a modification of an existing treatment plan or a decision to let the original treatment plan remain in effect. This nursing care plan incorporates the physician's orders with the nursing requirements to achieve the patient transformation goal. The degree of formalization of this process varies from organization to organization, but there is always a recognized method for the nurse to use to comprehend the patient's current status, the criteria for intervention, intervention options, and the intervention limitations which will lead to the desired change in patient's health status.

It is within this intervening technology that there has been the most professional ferment. Physicians have established algorithms - the decision tree route to follow safe practice in those areas not already relegated to the independent funtion of the nurse (Levy, et.al., 1974; Greenfield, et.al., 1974; Winickoff, et.al., 1974). Nurses who espouse the primacy of the assisting technology or who reject the concept of the independent area of the nursing practice have engaged in serious debate about the legitimacy of this technology. There is still a vocal minority who will argue that intervening is not a proper function; they deny the reality of current practice. Social sanction of this change is evidenced by the fact that twenty states have changed their Nurse Practice Act to broaden the scope of practice (Bullough, 1974).

The primary unit operations in the intervening technology as shown in Figure 2 are 1) assessment, which is composed of observation and analysis, 2) medications, 3) treatments, and 4) documentation. It is important to distinguish among these four unit operations and to articulate the assessment and documentation clearly. Considerable importance is normally accorded to the administration of an accurate medicine or treatment to the right patient at the appropriate time, but the neutral observer may easily overlook the fact that a very important part of the entire process is not visible. The assessment, which is in large part comprised of the process of observation and analysis may occur as the nurse reads the chart, assists the patient, administers medications or treatments, as well as during formal history and physical examination sessions. Documentation, the concrete evidence of planned intervention, is also of importance and is discussed in more detail as part of the informing technology.

The Informing Technology

The consensus which seems to have occurred in relation to the existence of a legitimate intervening technology has not occurred in relation to the informing technology. This is generally regarded as clerking, telephoning, or non-productive time at the desk which is defined as a poor use of professional time. It has been described simply as necessary to the transmission of information (Kraegel, et.al., 1974). Counselling, a form of informing, has been described as one of the three dimensions of clinical competence (Reiter, 1971), and King (1971) comments that the characteristics that persist are technical skills, including communication.

To understand the informing technology, the concept of unit operations can be very helpful. The unit operations of informing are:

1. Transmission of the information, which can be accomplished by a messenger,
2. Translation of the information, which may be accomplished by a person familiar with the modus operandi of the organization and basic medical information and routines,
3. Transformation of the information, which involves the weighting of information (Kingdon, 1973: 42-7), and
4. Generation of information; the unique contribution of the nurse practitioner which is almost inseparable from the assessment unit operation. Clearly, the purpose of the assessment is to generate new information which must be transmitted, translated or transformed if it is to be useful.

Clearly, there is a qualitative difference among these unit operations. Generation of new information and its documentation is crucial to the provision of the appropriate assisting and intervention activities. Translation of information is commonly known as clerking, i.e., the process of changing information from one form to another. But transformation of information, deciding which information is important <u>to whom</u> amd with <u>what urgency</u>, is not clerking. It may look like clerking, as one sits at the desk reading the chart, writing notes, or making phone calls, but it is, in fact, of a different order, and is not easy to delegate. When it is delegated, the time involved in explaining and in checking (which usually involves clerking and changed staffing requirements) needs to be carefully estimated.

Again, in the individual case, the STS design team would need to decide what the informing technology consists of in a specifically bounded problem area before making a judgement regarding the most appropriate mix of personnel to perform the function. It is conceivable that, in some clinical situations, the generation of new information and the transformation demands, when combined with the assisting and intervening demands (which are essential and require a higher degree of professional expertise and the capability to function independently), are not so time consuming that the role occupant cannot also fulfill the rather incidental transmission and translation needs without the addition of new personnel. To state this differently, once the nurse is operating in the intervening technology and initiating, carrying out, and modifying nursing care treatment plans, she is also responsible for the informing process. Some of the informing needs are of a routine nature, others involve counselling or relating to other providers and agencies. What needs to be carefully examined is whether or not adding a clerk or manager is justified. The new person can generally perform only two or three of the unit operations in the informing technology, whereas the person capable of handling the transformation unit operation can perform all four of the unit operations in the informing technology, plus the assisting and the intervening technology. This allows for considerably greater staff flexibility. Once the decision has been reached that the volume of work is sufficient to require the addition of a differently skilled individual, the design team will need to be aware that everything which looks like clerking may not indeed be only clerking. Care should be taken that generation and transformation responsibilities are not minimized, lost, or made too difficult to accomplish effectively. The unit operations of generation of information and the transformation of information are particularly important because it is here that the nurse is able to influence and modify both the nursing and medical care plan.

The informing technology has additional importance because it is a link to the fourth technology, coordinating.

Coordination

Coordination here is not used in terms of the glue which holds various departments together. It might better be called managing, but managing may have negative connotations for professionals. It is also important that we use words which do not have another meaning in important related areas such as labor relations (Cleland, 1974).

To fully understand the coordinating technology as it is practiced in almost every setting, it is necessary to note that a nurse is seldom responsible for one patient at a time. In essence, she has a case load for whom she is responsible to meet their assisting needs, their intervention needs, and the attendant information requirements. Obviously, she cannot physically attend to all unit operations for all patients assigned to her care at the same time. They are seldom in the same room at the same time, and if they are, the technologies are too labor intensive to accomplish for more than one patient at a time. Instead, on the basis of her knowledge, experience, values, and understanding of organizational goals, she makes medical/nursing cost-benefit ratio decisions (Brackett, 1961). This is accomplished via the three unit operations assigned to the coordinating technology. They are planning, organizing, and evaluating. The individual treatment plans for the patients assigned to her care are <u>organized</u> into a work plan for the day (or whatever time unit is applicable). On the basis of her on-going <u>evaluation</u> of the changing mix of needs evidenced by "her" patients, and by the effects of the assistance and intervention which has taken place, she exerts professional control on the flow of her work.

As she works, moving from areas of dependence on medical authority to independent practice, the nurse's informing technology is the linking pin which partially determines her success as practitioner. The information technology conveys 1) the quality of the nurse's judgements concerning the priority of the performance of the unit operations (planning and organizing), 2) the quality of the performance of the unit operations in the assisting and intervening technologies, and 3) her evaluations to her peers, the physicians, the patient, the patient's family and other agencies via the information technology.

The competent nurse is separated from the less competent nurse partially on the basis of education, but primarily on the scope of practice accomplished in her coordinating function. This includes how well she integrates the individual nursing plans into a work plan for several patients, evaluates the outcomes and re-plans for individual patients as well as the group of patients for whom she is responsible. Her competency is not determined, as is frequently assumed, by the total number of tasks that are performed, the complexity of the individual tasks, or the amount of time she spends at a patient's bedside. To the extent that she can assess multiple patient's needs, assign priorities, evaluate outcomes and modify her practice she is a more competent nurse than one who is capable of performing only discrete tasks, however complicated they may be.

The four functions of assisting, intervening, informing and coordinating together comprise nursing technology. It is seldom, if ever, possible to practice one without involving the others. Seldom is one sufficient by itself. Although the importance of time allocated may vary with the presenting problem of the patient and the therapeutic goals of the responsible care organization (school, industry, public health department, hospital for the acutely or chronically ill), the technologies are usually neither linear nor easily separable. Particularly in most in-patient settings, the processes are very dependent upon one another. This has been noted before and has been shown graphically on a variance matrix generated by the authors. Examples of variances are shown in Figure 3.

It is apparent that the assessment function is enhanced and the informing process involves fewer individuals to the extent that the same person assists the patient and provides medications and treatments. Conversely, to the extent that the assisting functions (frequently described as lower order tasks) or medication and treatment regimes are removed to other departments or practitioners, the work system design must allow for a method of assuring the key variance control in the unit operations of assessing, planning, organizing, and evaluating without at the same time increasing dysfunctional clerking procedures or interfering with the vital generation of new information and transformation unit operations. Caution also needs to be exercised so that a proliferation of assisting functions does not occur in the name of job enrichment. Preoccupation with the incorporation of tangential functions can also interfere with the performance of the central unit operations.

The discussion above has presented the technology as if the individual nurse were the only practitioner responsible for care of the patient. While this may be the case, the usual pattern is that a group of nurses, of differing educational and skill levels, are responsible for the care of a relatively large group of patients (Sim, 1973). In this instance, one nurse has the responsibility for <u>assigning</u> responsibility for care among those individuals. Figure 2 indicates this additional unit operation. This person has the responsibility for coordinating preceding technologies and the unit operations for all the individual patients under her care through the combined efforts of her colleagues.

Strauss (1966) discusses the ambiguity with which nurses regard the administrative functions included in the informing and coordinating technologies. He also makes the observation that the public generally believes that nurses are not "doing real nursing" when they are serving as informers and coordinators.

Supervision, Teaching, Consultation, Research

The section above describes the technology of practitioners responsible for rendering direct service but does not address the problems related either to the supervision of other practitioners who are frequently necessary if the patient transformation goals are to be achieved, or to the other supporting functions: teaching, consultation and research. Briefly, the supervisory role can be clarified (refer to Figure 2) by noting that the first level of supervision retains overall responsibility for the basic unit operations already described as they apply to all the patients assigned to the nurse. However, the supervisor, in addition, assumes two unit operations in coordinating technology. She is now responsible for staffing -- hiring, firing, and promoting individuals -- and leading and motivating others to perform effectively. She may or may not also be the individual identified by the management of the organization as the person responsible for understanding and implementing the administrative policies.

To the extent that nurses are responsible for planning for health potential (Rinehart, 1969: 97-123), which precedes the planning for nursing care, the technologies of research, teaching, consulting, and administration will be of high priority and will directly affect the basic components of practice (Kreuter, 1957). Each of them are generic technologies, however, practiced by professionals of many descriptions, easily understood and well valued by enlightened administrators and health professionals. A nurse administrator, educator, consultant, or researcher is differentiated from others by her skills and competencies in the four core technologies: assisting, intervening, informing, and coordinating. It is the primary purpose of this paper to clarify these core technologies and their many interdependencies so that design teams may intelligently develop the work assignment to promote professional accountability, productivity and employee satisfaction in organizations whose mission is to provide nursing care to patients.

IMPLICATIONS FOR THE FUTURE

The foregoing technical analysis of nursing demonstrates that in professional service work, the technology can be separated from the social system in which it occurs. It also has clarified and codified some of the difficulties encountered in task approaches where tasks are delegated and responsibilities reassigned without a precise understanding of the other technologies which were also affected, but not rationally controlled. Therefore, it seems reasonable to suggest that the socio-technical approach to the work systems design of professionals is feasible and should be used.