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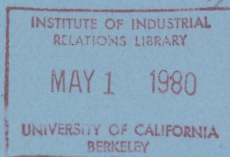
CENTER FOR QUALITY OF WORKING LIFE

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SYSTEM ANALYSIS & DESIGN:

Service Technology
Work Groups

by

James C. Taylor

CQWL-WP-78-1-A

UNIVERSITY OF CALIFORNIA
LOS ANGELES, CALIFORNIA 90024

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THE ORGANIZATIONAL CONTEXT

INTRODUCTION

The following report describes the application of sociotechnical systems (STS) analysis and design techniques in the redesign of three service divisions in a large scientific laboratory. The first of these divisions "Central Stores" is a group of 35 people composed mainly of warehouse workers and their supervisors. The second service group, "Employment Division", is a group of about 40 people including employment clerks, interviewers and management. The third group, called "Operations Division", is comprised of some 75 computer operators, together with a technical support, programming staff, and management, for a total of 110.

The lab itself is engaged in research in the physical sciences. It has close ties to several nearby university campuses, although it remains in most significant respects separate from them. The lab is located at the fringes of an expanding suburban area adjacent to a large city on the U.S. Pacific coast. The lab, started in the early 1950's and still at its original location, predates the nearby housing tracts by at least a decade. It is physically a great sprawling place of many buildings and much unused land. It has close connections with experimental sites located many miles away.

For the most part the overall impression an outsider can sense is an almost sedate yet purposeful pursuit of the several major program

projects currently underway. Since much of the funding is from federal grants and contracts the place has the deliberate pace and conservative style of a federal agency combined with the restful hum of a university campus.

Professional employees are drawn from major urban universities across the U.S., while service and non-professional personnel more often come from nearby. Thus the lab draws from the regional labor pool for the kind of employees who are the subject of the present report. This means that despite the different (and in some ways less pressureful) working conditions, and its less urban location the lab pays competitive wage rates to its non-professional clerical and service personnel. There are several employee organizations representing some groups of service employees, but most of the lab's non-professionals are not members of any union.

Historically, labor-management relations have been harmonious. In fact during its first 20 years those relations were apparently unblemished. In the late 1960's and early 1970's however, cutbacks in Federal spending forced the lab to undertake a 20 percent reduction in service personnel over a 4 year period. That these cutbacks and layoffs were unavoidable is understood by most employees yet the feeling remains, several years later, that lab management were either ill-advised in their reluctance to communicate the state of affairs until the layoffs were upon them, or that management were incompetent to be able to anticipate the problems until the last moment. In either case the disillusion experienced by lab employees has apparently forced their trust in management to decline somewhat from their earlier high level. Other

strains in labor-management relations include the redefinition of some
service job descriptions. In some cases these revisions have resulted
in a clear degrading of job status and job pay. In other cases a
lowering of status is at least questionable, since those job occupants
are not yet certain that wage freezes they are experiencing result from
general economic measures, or are the result of arrested wages because
of new, unfavorable (i.e. less generous) title comparisons for similar
job tasks on the outside. Since 1973 the fortunes of the lab have
looked up again financially as major contracts have increased and new
hiring has more than replaced those people laid off during the reduc-
tion in force. Thus recent events coupled with lowered attitudes in
the general workforce in the area now require management to attend
rather carefully to employee grievances, and to take a more active
interest in employee welfare and development. This management posture
has resulted in the creation and expansion of employee-centered activi-
ties such as counseling, training, and organization development (O.D.)
particularly through the creation of an "Employee Development Depart-
ment".

THE BEGINNINGS OF THE PROJECT
Sociotechnical Systems Analysis and Organizational Development at the Lab

In November, 1976 I was asked to visit the lab by the head of the
Organizational Development (O.D.) Group in the Employee Development
Department to discuss Socio-technical (STS) design. This manager was
interested in knowing the degree to which the STS ideas could be helpful

in solving some long standing organizational problems among service/
support groups in the lab. To this effect, I met with several of his
division's internal O.D. consultants. This group is engaged mainly in
activities such as process consultation with lab managers and their
subordinate groups, with team building within groups of lab employees,
with measurement of organizational behavior (developed in collaboration
with managers), and the teaching of training courses on O.D. topics.
These internal O.D. consultants were interested in the STS focus on
technical as well as social aspects, and the purpose of technical/
structural change in the service of O.D.

I was subsequently introduced to several lab managers (respon-
sible for service functions) and together with internal O.D. consultants,
discussed with them my ideas on STS analysis and design in computer-
based systems; and my interest in a participative design process which
would include some involvement of employees.

I was invited back to the lab in March 1977 and continued these
discussions with some of the managers from the previous session and some
service managers from yet different parts of the lab. It was clear that
both the STS design ideas and the notion of a participative process were
attractive to people in these service or support divisions. It is
significant to note that most managers selected to meet with me, and all
those subsequently interested in further discussion, were responsible
for a centralized service or support activity to the scientific func-
tions (whether Scientific Departments, or Research Programs). This
coincidence accounts for the particular emphasis on service units and

STS design in the present case. It is noteworthy that despite this common support orientation, the three units are very different in technology, in background, and in organizational factors of functional assignment. Thus the problems subsequently revealed among them are not in any way a function of their organizational reporting relationships to any one senior manager, or to the organization 'climate' in any particular building or location in the lab. Their similarities seem endemic to the lab as a whole, and to the role of support units. Also noteworthy is the fact that sooner or later the units actually involved in the present study expressed the concern that their job should be 'service not servitude', and that the lab's scientific departments were either inconsistent in their awareness of this or unconcerned about its effects.

I was invited to join the staff of Organizational Development as a "Participating Guest" for several months. As we discussed it, this period of time would permit me to engage quite deeply in the analysis and design efforts of the three service divisions whose managers had by that time expressed interest in such a project. This time allocated would give the process a nearly maximum concentration of my training efforts, and would give the divisional design teams a maximum of time commensurate with what their regular duties would permit.

The allocated time would further allow me the opportunity to observe the major (if not the total) portion of group process in the internal design teams we would form. In other design projects heretofore I had fulfilled the training role of the external consultant, and some small monitoring activity, but never had the opportunity to follow

the internal analysis and design process so fully. The internal O.D.

consultants and I discussed our roles in the process. It was decided

that I, as external consultant, would provide my usual training, guidance

and monitoring in each of the projects, and that one O.D. process con-

sultant (as internal consultant) would work in tandem with me to provide

initial team building, ongoing process consulting and observation. In

working this division of labor through we insured that the skills of

the external consultant (myself) and the skills of the internal consul-

tant would be mutually available -- leaving each the opportunity to

observe the other in a shared experience. We agreed in principle to

both be present at as many of the divisional design meetings as we

could, and to maintain ongoing dialogue of the process and feedback

our mutual learnings. This feature of the learning experience was an

interesting and useful benefit of the joint STS/O.D. consulting in

which we engaged. I had become increasingly interested in enhancing

the powerful of internal design teams to work together effectively in

meetings, especially as I had been concentrating on encouraging larger

and more diverse groups of employees to participate in a consensus

model of work system design. This present experience was also instru-

mental in permitting me to learn some effective methods of training and

counseling groups to work better together and to monitor their own

process while simultaneously training them and guiding them in a socio-

technical analysis of their own work system.

With the planning concluded, the O.D. consultants, the support

managers, and myself agreed to undertake the three projects beginning

August 1977.

BACKGROUND INFORMATION

The Matrix Structure of the Lab

The overall structure of the laboratory organization is a matrix of scientific and/or technical departments on one axis and experimental programs on the other. The intersections between the departments and programs are major projects or experiments. There are ample opportunities for professional employees of the lab (scientists and engineers) to identify strongly with one or another of the various programs and projects. These professionals are the primary members of the project teams. Their identification with the experimental projects can be virtually as strong as their identification with their scientific or engineering discipline. Most of the programs are very long lived, and so also are some of the projects within them. This longevity gives this matrix structure considerable stability which has obvious advantages from an operating perspective. It further produces some not unexpected consequences in longer term activities such as incomplete supervisory information for personnel evaluation. The three cases reported here, being centralized service units, are not a true part of this matrix. They serve the whole lab as single units, and despite the fact that they may have employees specifically assigned to particular programs in the lab these employees do have primary reporting relationships within their own divisions. This arrangement of specialization and centralization permits a complementary activity between the dominant matrix structure they serve and the lab-wide resources they represent.

Each of the service units provide the lab with a resource which is required economically, technically or perhaps socially to remain centralized. Examples below show this effect for each of the three service units studied in the present project.

In the case of the "Central Stores" case all lab programs require many of the same hardware items and office supplies. It is economical to order, store and distribute such items from a single point. Items that are used by a fewer number of units or programs need not be handled by central stores on purely economic grounds, but remain centralized on grounds of technological convenience. Examples of these less universal goods are electronic parts and supplies which are ordered, received, processed and distributed through the existing technical stores system. Some items distributed by central stores which are used by only one group (such as tires for the motor pool) were justified either on technical bases (central stores is the conduit between purchasing and receiving on one hand the users on the other) or on a social basis (materials department and central stores employs and supervises all materials handlers, and the motor pool doesn't have any). This purely social justification in the stores area was an unquestioned assumption until the time of the present study, when it was decided that tires would be delivered directly to motor pool from receiving.

The "Employment Division" is centralized in order to provide the lab with a uniform technology of advertising and recruiting. The economics of employment interviewing does not seem to play much role in justifying the centralization since the disciplinary/technical departments themselves do much of the critical analysis of candidates and all
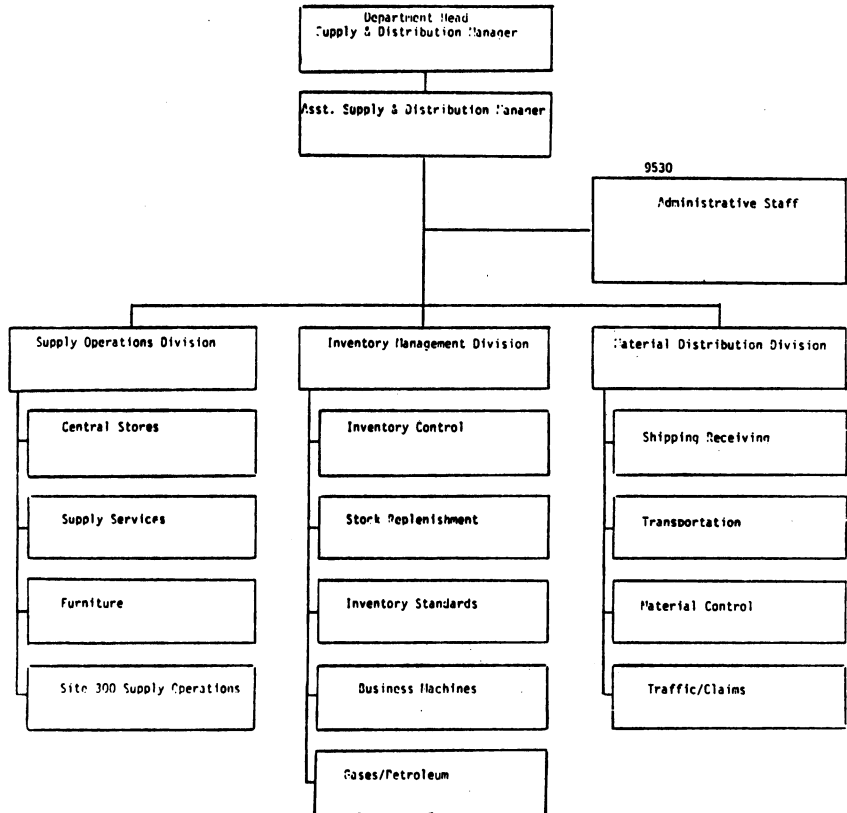
of the final decision making. Socially, however, these same departments use the employment division as a kind of personnel buffer and initial filter of employment candidates which manifests itself in all candidates for lab jobs being officially processed by this division -- even in cases where selection of a particular candidate has been predetermined.

The computer "Operations Division" is centralized primarily on the obvious economic basis of operating a single, large scientific computer system which is shared by the various lab programs. Some centralization on a social basis is evidenced by the assignment of operations division employees to a distinct and additional computer, located on the lab premises and belonging to a national consortium of scientific labs. The staff who operate that computer are employed and supervised by operations division, and feel a closer identity with the division than with the consortium. Centralization in computer operations appears to follow directly from the economic fact of the lab's large single economic investment in hardware, and of the social convenience of centrally supervising machine operators, rather than being justified on the argument of unique skills or facilities.

PART II

CENTRAL STORES GROUP

Organization

This Central Stores group of 35 people including four supervisors and the manager, provides the basic stock dispersal of material to the lab. Organizationally they belong within Supply Division of about 70 people which in turn is a part of Supply and Distribution Department. Figure 1 shows the department with Central Stores within it. Central Stores performs the primary (and direct service) task of the entire department. It is the centralized location, (a single building) for the filling of "customer" orders for material and supplies. With proper authorization, any lab employee may order supplies by mail, by phone, or in person. Supply Division maintains a catalogue of 30,000 items of standard stock developed over the years through lab demand. Supply Division not only provides direct order filling service to the lab but also services the intermediate or satellite store room operations which are maintained at program and department locations throughout the lab. These are a sister operation to Central Stores and they comprise another separate group (called "Supply Services" in Figure 1) of about 30 people within the Supply Division. The material they provide includes items which are frequently used primarily by one unit in the lab's matrix structure. These satellite store areas provide the lab with the matrix-type employees consistent with the larger structure; although they remain more integral to the supply division than to

FIGURE II -1

Department Head
Supply & Distribution Manager

Asst. Supply & Distribution Manager

9530
Administrative Staff

Supply Operations Division

Central Stores

Supply Services

Furniture

Site 300 Supply Operations

Inventory Management Division

Inventory Control

Stock Replenishment

Inventory Standards

Business Machines

Gases/Petroleum

Material Distribution Division

Shipping Receiving

Transportation

Material Control

Traffic/Claims

programmatic elements. This arrangement limits any strong identifica-
tion of supply personnel with the programs or departments they serve.
At the same time these satellite operations are distant enough from
central stores in a physical as well as organizational sense that
identification with satellite shop monitors by the shopkeepers ("material
handlers") in Central Stores is limited to an "us" and "them" relation-
ship, despite the fact that they constitute a single division.

The other major divisions in the Supply and Distribution Depart-
ment are Material Distribution Division, and Inventory Management
Division. The former is responsible for receiving all materials
purchased for the lab (which includes the storeroom materials for
supply division to disperse), and for the shipping and transportation
of material throughout the lab. The latter division, Inventory Manage-
ment, provides a middle-man role between the supplies inventory in
central stores and the purchasing agents who are part of another
department entirely.

Inventory Management Division monitors the quantity of material
in stock in Central Stores, and processes orders for depleted stock
which are issued by Central Stores. Inventory Management Division also
produces and updates the Central Stores catalogue.

History

The relationships between purchasing and supply was (from the
mid 1960's) one of a single department until early 1977, before the
present study began. The result of this long-term combination was an

unexpectedly poor communication pattern and a sense of neglect and discouragement on the part of employees in the central stores group.

The employee mix in Central Stores was also changing. Older, long-service material handlers (mainly white males) were retiring and were being replaced with significant numbers of women and blacks. These changes, together with the lab's actions regarding reductions in force, and the apparent downward revision in pay and status of many lab service titles, were by 1974 resulting in low employee morale in Central Stores and were providing two unions with sufficient material for serious membership drives.

Employees were in particular concerned with the job titles, merit pay increases and the promotion system. The results of an employee survey taken by an outside consultant in 1975 was so negative that little was done directly to use them in survey feedback discussions or to make them widely known. These survey results can be considered indirectly responsible for the changes which did follow, however. At this same time the stores "customers" in the lab were beginning to complain of supplies unavailability over long periods, as back orders (outages) started to creep up.

In response to these effects several changes were made in 1977. As mentioned above, the procurement and supply divisions were separated and placed within different departments. At the same time a new manager was appointed to the new Supply and Distribution Department, as depicted in Figure 1 above. This new manager came with a personnel and industrial relations background and has a reputation for being concerned about employees' feelings and well-being. His first official acts included

(first) meetings with small groups of department employees to learn their feelings and wants, (second) the review and promotion of several of the newer employees into more senior positions recently vacated through retirements, and (third) the appeal for an improved communication flow within the department. He took the first steps in effecting this third piece by opening up downward communications and announcing the start of several studies intended to improve work aspects of concern to management and workers alike. The present study is among them.

The Problem

The Central Stores group among all the units in his depar ment was of particular interest to this new manager. He stated that central stores was the trouble spot for several reasons. First it was exposed to their "public" -- the lab user. Second the source of most user complaints could be traced to central stores, and most employee complaints were from Central Stores personnel. Thirdly, Central Stores had remained effectively unchanged for 20 years -- the assumption being that nothing can remain static so long without dislocations. He might also have added that Central Stores functions were the primary task of the supply network.

The Study Proposal

I was introduced to this department manager in November 1976. He was interested in technical improvements if they could be made, but he was also concerned about the systemic effects of more modern

warehousing and order picking processes on the wellbeing of his
employees. He proposed that a technical study of the Central Stores be
undertaken by a large, independent consulting firm specializing in
inventory management; and that a sociotechnical systems (STS) analysis
of Central Stores group be concurrently undertaken by some of his
employees and managers. He felt that the technical consultants could
not be expected to hold appropriate expectations on the response of
employees to job restructuring, so the internal STS group should be
responsible for an integrated design including technical improvements.
He proposed that I act as external consultant to this group and that one
of the Employee Development Department O.D. specialists act as internal
consultant.

The department manager was clear that the relationships he
wanted between the technical study and the STS analysis was collateral
-- a relationship that would approach complementarity and avoid competi-
tion. He suspected that the technical consultants would probably advise
against automated picking components for the warehouse but that they
might recommend the installation of a mini-computer. I was initially
concerned about the limited degree of latitude this manager had in
accepting or rejecting such technical recommendations. He knew of my
concerns and he felt that despite the fact that the recommendations by
the Consulting firm would go directly to his boss, that they would be
treated none-the-less as advice, rather than dictates. Thus he felt
that he himself retained the power to modify or limit the implementation
if he had justification. He in turn was mildly concerned about the
complexity of the sociotechnical analysis, and its possible effects of

over-measurement on the willingness of Central Stores personnel to cooperate -- (the "guinea pig" effect).

The technical consultant (an engineering consultant firm) proposed to complete their study in 90 days. In order to have the internal design team complete the analysis phase of their STS study at the same time as the technical consultants, it was suggested that the design team meet at least eight hours per week.
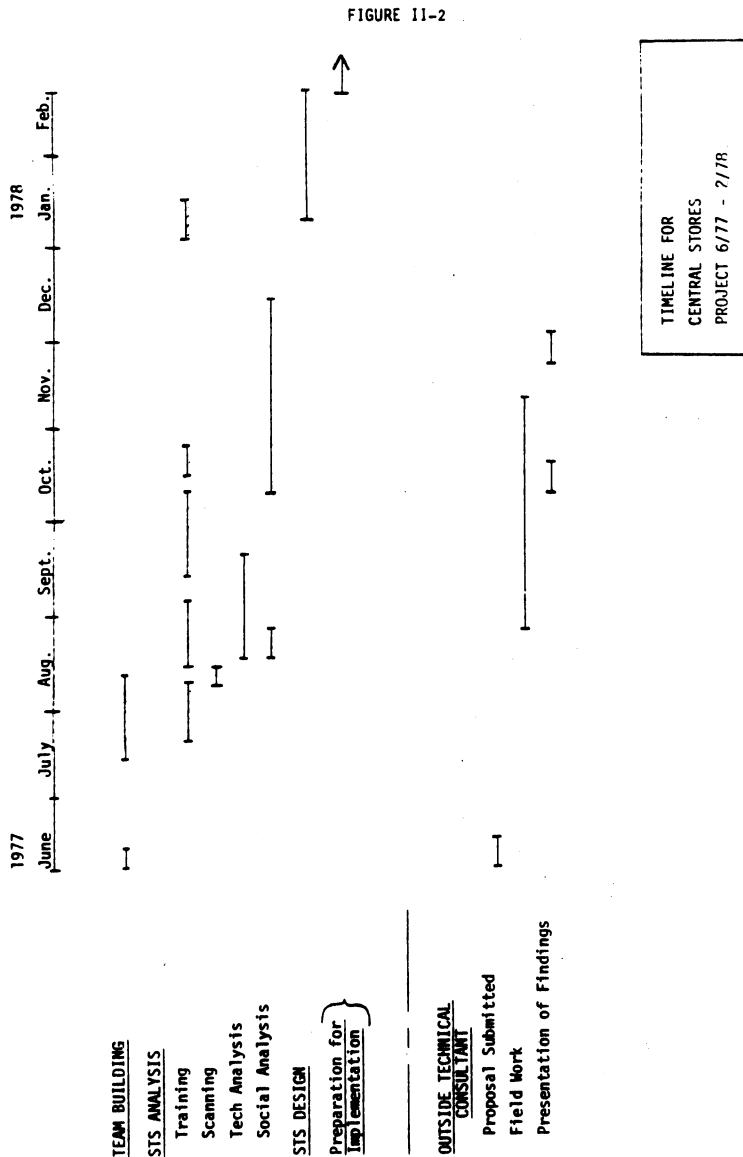
We discussed the composition of the internal design team and it was decided to include two material handlers, a foreman and two managers. A memo was sent out to all department employees in May 1977 announcing the technical consultants' impending study, and the proposed creation of the internal team "to ensure that quality of working life and technical measurements (are) enhanced". The internal group was selected following this memo. Volunteers were solicited among the material handlers and foremen in Central Stores. Two-thirds (14) of the 21 potential material handlers applied and two were selected by the supply division manager. No foreman volunteered, so one was asked by management to participate. The manager in charge of the central storeroom group and the assistant department manager were also appointed by the department manager as the final members of the team. The newly appointed members of the STS design group met with the external and internal consultants (June 1977) for introductions. At that meeting, management made assurances that no staff reductions or downgrading would take place as a result of the study. An overoptimistic estimate of 12 weeks was set for the Socio-technical analysis. In the following weeks the group received some team-building training to acquaint themselves with working together,

since none of them knew each other well or worked together on the job.
The transfer and promotion of one member shortly after the team
began to work reduced the number of members to four. It was decided not
to replace the missing member, and the design group then comprised one
material handler, one foreman and two managers. A graphic time line of
this Central Stores Project from June 1977 to February 1978 is shown in
Figure 2.

The Process of Team Building

Team building activities began with a pre-meeting sentence-
completion questionnaire designed to tap the members concerns about the
task they had and the issue of working together. The questions and the
two training meetings that followed were designed and administered by
the internal O.D. consultant. The first meeting (3 hours on July 19,
1977) was to discuss results of the questionnaire, which the internal
consultant had tallied and returned. The results showed:

A) A good deal of ambiguity about the purpose of the study, and the
various roles of the engineering consultant, the external consultant
(myself), and themselves, the design team.
B) They hoped that the team building exercise would help make their
study clearer -- clarification of roles, and guidelines for action. It
was apparent that their concerns at the time were for more on "content"
than on "process".

FIGURE II-2

1977   1978
June July Aug. Sept. Oct. Nov. Dec. Jan. Feb.

TEAM BUILDING

STS ANALYSIS
  Training
  Scanning
  Tech Analysis
  Social Analysis

STS DESIGN

Preparation for
Implementation

OUTSIDE TECHNICAL
CONSULTANT
  Proposal Submitted
  Field Work
  Presentation of Findings

TIMELINE FOR
CENTRAL STORES
PROJECT 6/77 - 2/78

C) With regard to questions on working together as a team they expressed hope and optimism that they would develop a team spirit, and really listen to one another.

D) They answered the questionnaire indicating that they would measure their success in terms of their ideas being implemented. (In the discussion about this team's success they subsequently added the process ideas of "listening" and "cooperation" among themselves as a successful outcome.) They noted that a sign of failure would be an absence of action taken on whatever they recommended.

The internal O.D. consultant noted following this meeting that the group moved quickly from one point to another, and the result on the group process was to "go off at tangents". Further, the internal consultant wondered if the group had the capacity to monitor their own behavior, and to raise questions even if they sounded "stupid".

The second team building meeting (3 hours) took place about a week later (July 28th). An agenda for the meeting was built, but then ignored. It was clear that the members of this new design team were concerned about their relationship to the study undertaken by the engineering consultants. Their concerns were reduced when they realized that both they, and the engineering consultant firm would make separate recommendations to management. The design team characterized their relation to the rest of the central stores as 'something in between a "line" role of making changes, and a "staff" role of offering suggestions'. They proposed to meet weekly with the engineering consultants if that were possible.

Following this second meeting the internal consultants (there
were two for a brief period) and the external consultant (myself)
discussed progress to date and our roles in the future. Some concern
for the way the senior management intervened to lead was mentioned, and
the absence of the appropriate division manager in the process was
discussed (the senior manager on the team was the assistant department
manager -- and at least by title, senior to the manager in whose division
the central stores groups fell). The role of this division manager was
never resolved, but was never problematic during the course of the
project.

The Consultants' Roles

Our roles were seen by the group as follows: the internal con-
sultant (a member of the Employee Development Department of the Lab)
had an ongoing relationship with the STS team. He would provide non
directive as well as structured inputs to the group about their process,
and would also listen to the content discussions of the team for his
own learning and reluctantly participate. This changing from process
to content was acknowledged as difficult and runs the risk of diminishing
the quality of process consultation. It was felt that one person could
attend to both process and content in a serial fashion, but it should
not be attempted simultaneously. My role as the external consultant, it
was felt, should hold responsibility for the STS analysis procedure. I
would initially set the order of attack, pace, and would determine the
group's readiness to go on to the next steps.

The design team's next meeting on August 5th, began the introduction of the sociotechnical systems analysis method. At this meeting the group decided to meet two half days per week for the duration of the analysis and subsequent design.

Sociotechnical Training

The initial training in STS analysis took the form of lecture and discussion led by the external consultant (See Taylor, 1978, for description). This training schedule covered the following: 1) overview of the STS method, 2) a description of the five steps in STS analysis (See Figure 3), 3) some theoretical background of organizations as sociotechnical systems, and 4) a scan (step 1 in the 5-step process) of the major features of the particular system to be studied. The next major steps in training would involve the technical analysis (6-8 hours followed by about 30 hours of analysis), followed by training in the social system analysis (8 hours, followed by 30-40 hours of analysis) and finally training in design of systems (4 hours). The initial training took nearly two half days (August 5/9).

1) The Scan

By the end of the second half-day, the formal scan of the Central Stores system had begun. This scanning process involves identification of system purpose, an initial determination of the boundaries of the system to be solved. The scan was completed by August 11th. The internal consultant's notes for August 11th report that the group members

Figure II 3

Steps in STS Analysis and Design

1. Scanning the Socio-technical System

2. Technical Analysis:

   a. Identification of unit operations

   b. Identification of key variances

3. Variance Control Analysis

4. Social System Analysis:

   a. Internal Role network

   b. Cross-boundary role networks

   c. Individual role analysis

5. The Socio-technical Design.

worked intensely on this day. They felt that they were already working as a team. Figure 4 contains the summary statement the STS group produced from their scan. The boundaries they defined included Central Stores, but did not include the satellite operations located out in the lab's departments and projects themselves. They dediced to deal with the monitors who operate the satellite stores as a special form of customer rather than as a member of their work system. They limited their technical boundary to the points where orders entered their system (by lab mail, by phone, or over the stores counter), and where the materials which users had ordered left the system (either over the counter and signed for, or on the delivery dock). The list of problems they hoped to be able to resolve through the study were the following:

Counter Problems

- "Impulse shoppers" at the counter take extra time to serve.

- Counter customers (and many phone orders too) don't use catalogue numbers.

Receiving Problems

- Receiving effort is partly done by receiving group and must be done over again by Central Stores.

- Parts inspection by other departments after receiving delay receipt by Central Stores (sometimes 3-4 months).

Increased Volume

- Written orders not filled fast enough.

Stock Records

- Stock levels and back orders updated on computer only weekly.

Stock Handling

- Fork life trucks are safety hazards and produce emissions.

<u>Figure 4</u>

<u>Scanning Control Stores Operations</u>

<u>Definitions</u>:

<u>System Objective</u>: To provide the best possible service in an efficient
and timely manner, with due consideration of employee input.

<u>Output or Product</u>: Requested material handled to counter customer or
moved to delivery area.

<u>Input</u>: Customer requests for material; written, counter, telephone.

<u>Boundaries</u>: Where telephone, counter or mail requests are received,
where material is turned over to a delivery area. Time boundary
is length of time it takes to supply material requested. People
boundaries include the Central Storeroom Group Leader down thru
all Material Handlers. Physical boundaries limited to Bldg. 411.

<u>Social System</u>: See Central Storeroom organization chart.

<u>Presenting Problems</u>: How to cope with increasing demands for material
with available work force, limited space, and in a timely manner.
Problems related to counter/impulse customers, computer updated
only weekly, safety/fumes problem of forklifts and timeliness of
paperwork on inspected items.

2)   The Technical System Analysis

The training for this phase began immediately after the scan was completed. Training dealt with concepts and methods for undertaking a logical analysis of the technical components of the work system and the grouping of these into "unit operations". Unit operations are logically integrated sets of tasks, one set being separated from the next by a change of state in the work process. The next important objective of the technical analysis is identification of key process variances. a variance is defined as a tendency for a work system to deviate from a normal or desired specification. This tendency arises sometimes as a result of characteristics associated with the input, and sometimes as a result of the work process itself in its normal operation. Variance analysis is not concerned with temporary problems such as machine breakdown or human error; it concentrates on system weaknesses in controlling these variances which are associated with the organization of work operations. An important objective of this method is to identify clearly those key variances that significantly affect the ability of a work system to pursue its major objectives.

Two hours on August 11th were devoted to this discussion, but as subsequent events were to show, the concept of "unit operations" had not been adequately communicated and the group required extra training several days later in order to fully understand the technical design

process. The confusion, as it turned out, was subsequently resolved
with little overall loss of time, but with an inordinate amount of
frustration caused by hurrying through the technical systems training on
August 11th. Technical variances were listed by the team for the Central
Stores, using the nominal group technique of structured brainstorming
(See Delbecq and Van de Ven, 1976). This process of listing, and
discussing variances continued for the next three half days (8/5-8/22).
Sometimes the discussion went smoothly and sometimes things became
confused. Several design team members were absent from some of these
meetings, and the remainder of the group reviewed the progress and the
concepts for those returning. The several iterations of the process
finally enabled the team to put into their own terms the concept of
"filling a customers order" as the central task of the Central Stores.
Furthermore, they were able to divide that process of filling an order
into three mutually exclusive and exhaustive stages, and to associate
technical variances with these stages. The balance between the external
consultant's control of the process of the analysis and the design team's
control of the content of the analysis created an inevitable tension
because at this stage of the process the team was still learning about
a perspective on their work system which they had never before taken.
Their confidence therefore in the analytic content was meager; the
external consultant's appeals for them to take ownership of results, and
his suggestions that the process was flexible (perhaps to an intolerable
degree) made the team anxious about their assuming responsibility for
the process. This anxiety, when finally articulated in a process
discussion, cleared the air and enabled their conclusion of the technical

analysis -- identification of key variances and their points of control in the system -- to be reached smoothly. Between August 11th and September 22nd, when a final summary of the analysis was written for distribution, the team had used 10 half days for a total of 40 hours. The technical systems summary is shown in Figure 5.

3) Analysis of Variance Control

In addition to the summary of the four key variance groups, the design team specified how their present system controlled for, or absorbs the key variances. (The "Table of Variance Control" for all 18 key variances is included in Appendix A). For the four groups of key variances this analysis revealed that Material Handlers were important to Central Stores Control activities. For coping with the first group of variances, "material characteristics", the material handlers coordinated their order-picking with the fork lift operators and the Section Leaders to retrieve large or heavy items, and they were the ones who walked the distances (sometimes considerable) for fast-moving items which were widely dispersed, throughout the warehouse. (These parts were located by stock number and part type, rather than clustered together by frequency of demand.)

Material handlers were the major means Central Stores had for coping with the second group of key variances, "counter activity" as well. Material handlers usually dealt with counter customers without assistance from their Section Chiefs. Since counter work was considered stressful and high pressured, material handlers were willing to accept

Figure 5

Technical System Analysis

The technical system analysis of the Building 411 Storeroom Issue Operation began in August, 1977, and was completed on September 18, 1977. The work process was first broken down into the basic operations, which were examined separately to identify variances in the process. Some 29 such "variances" were listed. These variances were in turn evaluated to choose the important or "key" variances among them. Eighteen key variances were thus identified, and were in turn examined to determine the manner in which they were presently controlled by the system.

Subsequent grouping of the key variances indicated they fell into four basic areas of concern, as follows:

1. Material characteristics; problems related to location, size, weight, sensitivity, hazardous, fast moving items.

2. Counter activity; primarily the heavy traffic which causes delays in filling written orders, and description problems due to inadequate information from the requester.

3. Workload/Volume; quantity of requests, number of line items per request, special accounts, time to fill and to write back orders.

4. Priority demands; the numbers of rush requests, abuse of the system, counter request when a mailed order would suffice.

a rotational arrangement to the counter of one day per week on direct
counter work, and one additional day on "backup". The material handlers
when on counter assignment, faced the inefficient condition of minimal
use of catalogue numbers combined with urgent pressure to fill, unaided,
counter customer requests. Since the section chiefs were busy with
administrative duties away from the counter, they provided little
practical assistance to their subordinates on the counter.

The third group of Key Variances, "Workload Cycles", were dealt
with by the section chiefs pressuring the material handlers for faster
work, and requiring overtime and Saturday work to catch up with demand.

The same demands/requests for cooperation from the material
handlers by the section chiefs were the primary method for coping with
the fourth group of Key Variances, "volume of priority work", and "rush
requests".

In sum, the key variances of Central Stores were met by the
material handlers who either requested the cooperation of others (e.g.,
fork lift operators and customers), or were expected by their super-
visors to deal with them without assistance.

Communicating the Technical Analysis

Despite the steady progress on completing the technical analysis
itself the design group had resisted the idea of a written summary. It
should be noted that they were visible as a team, and the other central
storeroom employees were aware of their twice-weekly meetings. Apart
from a single memo they issued on August 31st inviting suggestions and

comments, the design team was not communicating back to the store room
in any systematic fashion. The department manager was kept informed of
progress through the deputy department manager (who incidentally was
also the principle link between management, the design team, and the
outside engineering consultant firm). The other three members were
communicating very little to their workmates -- in fact one of the team
reported that when asked about progress on the study, he would answer
that "they would prepare a recommendation at the end". This had never
been the expectation of the internal consultant, the external consul-
tant or the department manager. It was clear that the consultants'
expectation of continual feedback to the central store room employees
had not been well communicated to the design team. This reluctance
to communicate back to the larger system is frequently found with work
systems designs of this kind. Design groups are usually too involved
and confused in learning the analysis process itself to want to try to
communicate. Further, with more work such groups feel that they are too
far along with a complex analysis to be able to explain it to others,
and finally, when they finish the analysis they are too glad to have it
done to want to think about putting it into more common terms for others.
This sequence of events all too often leads design groups to assume (and
hope) that problems will resolve themselves as long as the group prepares
the final recommendations. This appeared to be the logic at work with
the central stores design team at the conclusion of the technical analysis.
The external consultant suggested that a summary of that technical analy-
sis be prepared. The purpose of such a summary, it was argued, was that:

1) It would help the team itself to better understand the results of
   the process just completed.

2) This understanding would, in turn, help the team communicate their
   findings to the store room employees and management.

3) They would have the summary to work from at that later time when
   the new design was being developed.

To this suggestion, the design team responded that:

1) "We already understand the analysis";

2) "It took us so much time and effort to do it, that a summary would
   oversimplify it", and

3) "The summary may be too lengthy and would take too long to write".

The external consultant discussed what a simple summary might
look like. The necessity to make the message as simple as possible was
pointed to, irrespective of the time and effort taken for the analysis
itself. The one-page summary as shown in Figure 5 above, was prepared
at the September 22nd meeting.

No response was made by the design team to the external consul-
tant's suggestion that the technical analysis should be reported to the
store room employees. In fact, the team did not distribute it until
the final design recommendations were prepared in January 1978.

Relationship to the Engineering Consultants Study

The initial formal communications with the central store room through the first month of the project had been a single memo by the department head of May 25th (included in Appendix B), which announced the technical study of the warehouse by an independent engineering consulting firm. This memo also announced the formation of the internal design team of representative employees who would assure that the results would be good for the employees, as well as for productivity. The consulting firm actually began their field work and date collection during the first week in September.

During September and October the engineering consulting firm met with management several times for progress meetings, and continued their field work. One formal presentation of that firm's initial findings was made on October 10th and the design team were in the audience. The results to date suggested that a mini computer would improve central stores effectiveness.

The engineering consulting firm distributed a handout enumerating some 19 advantages of the mini computer, as well as some preliminary results of their time studies, studies of stock-bin space utilization, and reviews of customer activities.

The consulting firm promised to prepare a further report and more systemic recommendations during November. This presentation of October 10th gave the design team food for thought. Although they asked few questions during the meeting, they met together later that same day to discuss what they had heard. Among the 19 advantages listed by the

consulting firm, the use of a computerized system would improve the
time taken to fetch parts because fast moving components could be
randomly numbered and located near the counter. The computer could
also indicate the location where the parts could most efficiently be
collected. It was obvious to the design team members, following their
own technical analysis that although cumbersome the counter business
was very important. It was also obvious to them that in order to use
the computerized system or random parts' numbering, somebody would have
to provide catalogue numbers, rather than merely descriptions as before,
in order to fetch a part or parts for comparison or examination by the
counter customer. The team was concerned about the effects of the
technical consultant's recommendations. As a team they considered the
negative effects on the Material Handlers in particular of not being
able to draw similar parts from the same area in the store without
reference to numbers. Through the deputy department manager, they
passed their concerns along to the department manager. On the basis of
design team concerns on October 10th, the department manager asked the
outside consultant firm to consider the impact of the mini computer on
the counter business before their final recommendations were submitted.
The design team did not meet again with the outside consulting firm
until November 28th, but their mentor, the deputy department manager,
kept them informed and provided the design team with their successive
reports and recommendations. By the November 28th meeting, both the
design team and the engineering consulting firm had accepted the fact
that there would always be a lot of counter business and that such
transactions would be urgent business. The final draft of the engineering

firm's report was submitted on November 30th to the department manager, complete with suggestions on how to compromise the use of more efficient location of items (with or without mini computer) in face of continued item description troubles by the counter customers. This chain of communication between the design team and the technical consultants proved to be a powerful and effective way to use the consultants' expertise to Central Stores advantage.

4) Social System Analysis

During August, while the design team were working on the technical analysis, some time was spent in an abortive attempt to find out how people in the supply and distribution department felt about conditions, attitudes, etc., at work and what they might want from the study. The design team were very interested in obtaining such information as early as possible. A memo was issued on August 31st. In it was an official announcement by the design team that it was in operation, together with an appeal for ideas, comments and suggestions.

The memo, and a response form, was distributed to all stores employees. Through this mechanism the design team hoped to discover what complaints people had and what they wanted changed. The mechanism of a memo and an open-ended "suggestion form" seemed to be an efficient, if somewhat formal, way of collecting data on attitudes and problems in the central stores. While the team was still doing the technical analysis, by September 19th, almost three weeks after the circulation of that memo, only one response had been turned in to the team. In

assessing this dismal failure to establish communication and elicit response, the team discussed the message and the method of the attempt and decided the style of the letter and form were as much at fault as employee apathy and cynicism. Finished with the technical analysis and its summary, the design team determined to try again to tap co-workers' attitudes. They looked this time to the external consultant for help, since he had promised that they would be undertaking a "Social System" analysis following their review of the technical system. For the next four weeks the design team would be engaged with discussing the network of relationships both inside the stores operations and with the outside, what people in stores liked about their roles and what they did not and the way that these aspects could be measured.

Training in Social Systems Analysis

Training was begun on September 26th and totalled 12 hours over two weeks by the external consultant and like the training for the technical system analysis, took the form of lecture and discussion. "Social Role." was the major concept emphasized in the training. "Role" was proposed as the basic link between organizational requirements and demands on employees, and their own individual desires and character-istics. The network of work-related communication and co-ordination is tied together by the myriad role expectations of one system member of another, with "role" as the conceptual vehicle.

The Social System was described as providing the several functions of:

1) Attaining goals;

2) Adapting to environmental demands and disturbances;

3) Integrating internal environments, and

4) Providing support and development for individuals and units.

The following model (Figure 6) summarizes the conceptual content of the training. These concepts were discussed in terms of their own experiences in central stores.

The design team balanced their abstract discussions of social system concepts, and their own illustrations of them, by asking the following frequently repeated questions of themselves: "What is all this leading to/how is this going to lead to what we want?".

They decided on a semi-structured interview format and following a two hour lecture on interviewing technique by an outside expert, carefully constructed a series of questions to be asked of employees of the central stores and the satellite shops personnel. This process of monitoring the usefulness of their activities, building a list of questions to ask, deciding on a shorter list to actually use, and developing the specific wording, took 32 hours of work over four weeks (10/13-11/11). During the last week (11/7-11/11), a number of previously unresolved issues about the social analysis were dealt with. Among these issues were: 1) concerns about cooperation and candor from the

FIGURE II 6

SOCIAL SYSTEM MODEL

Relationships

Functions of Social System	Superior-Subordinate	Intra-Group Relations	Inter-Group Relations	Relations with Other Depts.	Organizational Climate	Activities on the Job
1. Goal Attainment						
2. Adaptation						
3. Integration						
4. Support & Development						

Each cell in the above matrix can be measured in any of these three ways:

Behavior   "How is it done?"

Satisfaction "How do I like it?"

Values   "How should it be?"

stores personnel, 2) dangers of asking questions about management, and questions about the work itself (which might elicit negative responses) and 3) whether the team members themselves should conduct the interviews.

The first concern was a real one for the team -- in addition to the virtual absence of response to their early appeal for comments, the design team members had been reporting rumours that stores employees felt the study was going too slowly and that it looked like a waste of time. The team was spurred by this criticism to redouble their efforts to begin the interviews, and hope for the best. The second set of concerns -- asking sensitive questions about management and jobs -- was of concern mainly to the management members of the design team, and the decision was made to ask these questions despite a normal reluctance to "stir up trouble".

The third issue was resolved by using the two lower-level members of the design team as interviewers, together with the internal and external consultants. It was agreed that strict confidentiality of responses would be maintained by the interviewers, so that the total combined responses to each question could be analyzed by the whole design team together.

On November 15th the design team announced in its second memo the upcoming interview survey, the interviewers, and the contents of the survey. The memo was sent to all five employees of central stores, and to a sample of eight satellite operatives. It explained that the team planned to complete the survey within ten days and wished to interview all those receiving the memo. The interviewing went smoothly,

given the design team's prior concerns. The employees were interested in participating and their candid comments to a final general question on the survey, indicated neither hostility to nor reservations about, the project.

The separate answers were typed up (during the week of November 21st) to assure confidentiality and comparison, and were clustered by question. Responses were kept separate for the eight satellite operations employees but were otherwise undifferentiated. The design team, together with the external and internal consultants, reviewed these data in four separate four hour meetings and summarized the answers by December 16th.

The analysis activity was an interesting and useful exercise for all concerned. The two managers on the design team who had not done the interviewing were surprised and sometimes non-plussed by the data. Discussions between them and the interviewers helped convince the managers of the validity of the data, and helped the interviewers appreciate and understand the degree of agreement they had obtained among their interviews. Interviewers were also able to expand upon the responses they had written in order to interpret unexpected classes of answers to several questions.

The survey analysis followed the structure of the interview itself, which was divided into the separate aspects reported below. This structure was a result of the social systems model depicted in Figure 5 above. A summary of the interviews dated December 16th was prepared by the design team members, and dealt with the work itself, the work group, immediate supervision, and higher management.

The results of the work itself questions parallel closely the results of the technical analysis reported above. As noted above, the key variances, or major sources of task differences which the Central Stores system had to cope with were:

1) The size, weight and location of materials;

2) The urgency of counter customers, and off-site requestors;

3) The uncertainty of material supply, to demand.

The survey showed that material handlers felt that they absorbed, or consumed these variances directly through their own actions. They wanted more cross-training in order to thoroughly learn the parts and stock. They courteously and efficiently filled counter customers orders, if possible, but felt that this counter business was stressful -- it was a challenge to know the parts and fetch them quickly; and frustrating to deal with important, sometimes demanding, customers. They dealt with the large size, and heavy weight of some frequently requested material by using smelly, noisy fork-lift trucks in the narrow aisles in which there was too little room for enough ladders.

The results on the questions dealing with social relations reveal an increasing distress by material handlers, with help given by superiors in dealing with their stress and discomfort on the job. Also, they report some (adequate) cooperation from co-workers in the stores, and some apparent thoughtlessness by those in satellite operations. About half the material handlers reported some distress in relation to their immediate supervisor's lower regard for work the respondent thought important, and supervisors "going to bat" for them with higher management.

These material handlers were even more critical of the level of management above their supervisors in not helping stores personnel cope with the stress and pressure of the control of key variances. They seemed to be saying "things would be a lot better around here if Group and Division management would help our supervisors and us in planning for and dealing with rush orders, demanding customers, slow purchasing (in face of increasing volume), and these narrow, crowded, smokey aisles."

The management pattern they reported was: Not to listen, or not to respond to attempts to communicate upward. Their view of the new department manager was, on the other hand, very positive, although he was felt to be too distant in terms of his place in the hierarchy to be aware of the management problems at their level.

The Group Process of the Design Team during Social System Analysis

The design team approached the task of planning for studying the human problems of their system with considerable uncertainty and caution. Caution, because of the apparent resistance by their work mates to come forward with information. Uncertainty, because they knew they were to be responsible for the structure and content of the data collection instrument -- a task for which they were unprepared. During the period of instrument design (October 20th), the internal consultant helped the team assess its own group effectiveness. The results of this measure revealed a high degree of trust among the team members, the frequent use of a consensus-based decision-making style, and a careful analytic approach to problem solving.

Clarity of their team goals was rated lower than other aspects of group behaviors. In view of the fact that the external consultant remained in control of (or was depended upon for) the process they were following, the goals were seen to be less clear to them than they were to him.

The team felt they progressed smoothly, if not rapidly, through the instrument design phase and were able to resolve the significant issues of content and method as described above. As the data collection itself approached however, individual members became quite anxious not only about employees' willingness to participate, but also, perhaps, because of what might be 'discovered'. Had they asked the right questions? -- Would they stir up a hornet's nest? Was all this work and worry worth the effort -- or would the department manager ignore it all? The process of jumping into the interviews despite these uncertainties has been described above. The interviews went smoothly, as did the analysis process. Obviously, the time taken to consider the context and format of the interview was well spent in the orderly analysis of the data. In addition, the interviewing process itself can be considered a bonus in analyzing the data. The two Central Stores interviewers were already familiar with much of the content and seemed to fall more easily to the task of drawing generalizations from the data than did the other two members of the design team who had not been interviewers. Writing the summary of the social system analysis raised no resistance from the design team at all, and they contributed to the final report (Appendix B) as a direct result of their discussions. Since the Christmas holidays were approaching, the design team decided

to suspend meetings until after New Year, when they would begin to consider redesign ideas for Central Stores. Although the Social Systems summary was written in December, general distribution was delayed until February, 1978, when the summary was included, with the earlier technical systems summary in the final report.

5) Creating the Redesign Proposal

On January 5th the design team met again to resume work. The external consultant presented a guideline for design (c.f. Cherns, 1976). This guide was intended to help the team use the data they had accumulated, together with the knowledge of other change recommendations being simultaneously generated by others (such as the outside engineering consulting firm, and several other internal task forces reviewing specific issues) in order to help recommend an integrated systematic design. This aspect of the design team's task was not as clear to them as it was to the external consultant. Their expectations were initially more toward a unique design intended to supercede the others.

The external consultant's expectation for the STS process was to modify, to complement, and to integrate the other suggestions currently being developed, as well as developing original ideas. The expectations of the department manager were somewhere between the two-- he was hopeful that the team would come up with "something new", yet at the same time utilising the consulting firm's technical recommendations.

Once oriented to this integrative task, the design team reviewed, on January 9th and 12th, the summaries they had prepared on the technical

and social systems analyses, together with the final draft recommenda-
tions of the engineering consulting firm. The external consultant
encouraged them to try to state their own best ideas for change, whether
these ideas had come out of the analysis process or not. They were also
encouraged to review the ideas and suggestions they had received from
the interviews, and to consider the recommendations of the outside
consulting firm. Apart from minor discouragement that "they" didn't
have any radical ideas for improvement, the team did combine the various
ideas for change that they had heard from others. On January 19th the
external consultant met with the team again to find that they were
emphasizing as a central design parameter the importance of counter
customers in the mission of Central Stores. This issue, as noted earlier,
had arisen as a consequence of their technical analysis in September,
and had been the focus of their criticism of the consulting firm's early
(October) recommendations. This emphasis on counter customers they felt,
was a useful device to assess the advantages and disadvantages of the
overall design. The external consultant urged the team to consider a
system of role expectations and rewards that would reinforce a spirit
of support, and guidance by the middle managers and supervisors for the
material handlers. Support for a service oriented, yet efficient system
of counter issue by competent material handlers must (it was stressed)
be manifest throughout the management hierarchy from the department
manager down. A draft recommendation was prepared on January 26th which
described a role for supervisors which would place them in closer control
of counter business and in more direct support for their subordinates.
This recommendation was submitted formally to the Department head on

February 13th. The Department head reviewed the recommendations and issued a cover memo and the design team's report to all members of the department on February 27th (Appendix B). This cover memo reported his consideration of all the recommendations and his willingness to implement most of them. He assigned the development of an implementation plan to his subordinate, the supply operations division manager for immediate action. The division manager personnally met with all division employees after first meeting with the design team, and with his subordinate supervisors the day following issuance of the above memo. These meetings were conducted with sensitivity and support on the part of the division manager. Although he had not been involved with the sociotechnical analysis and design, he wholeheartedly supported the results of their efforts and pursued the presentation of the proposal to the division with vigor.

This proposal also called for more support and training of material handlers by the section chiefs, the improvement of lighting in the stores area, installation of air conditioning, elimination of fork lifts, and the installation of a mini computer. The division leader assigned the planning and coordinating of the proposal (with the exception of the computer which couldn't be budgeted within the current fiscal year) to the Central Stores Group Supervisor.

The supervisors were initially upset by the proposed changes. In line with the Engineering Consultant's recommendation, the proposal itself originally called for a relocation of fast moving items nearer the counter together with a relocation of the three supervisors work stations to a relocated and re-designed counter. This suggestion was

later modified so that the three original sections were combined into two, and the remaining supervisor was assigned to a section responsible for the receiving functions and bulk item maintenance within Central Stores. The meeting and discussions with the division manager and the modification subsequently introduced caused the supervisors to be less reluctant. Two section chief/supervisors were recommended to be located near the counter and the material handlers to be reassigned from three sections to two. The bulky and heavy items were recommended to be relocated for better mechanical assistance. The key changes expected in social relations involved increasing the section chiefs' role in customer service together with increased support for their subordinates. It was felt that the supervisors' wide knowledge of material and their physical presence at the counter would improve communication with customers at the counter and increase goodwill. They are expected to provide a buffer between material handlers and customers with problems and they can obtain, or provide, additional help for periods of unanticipated high counter activity. They are also expected to educate users in using catalogue numbers in anticipation of the computerized system.

Process Notes at the Conclusion of the Design Phase

As noted earlier, the chain of communication between the design team and the technical consulting firm was a very effective method of using the consultant to best advantage. This communication chain, although unplanned, provided an easily structured and replicated process of problem solving between a technical designer and a user system in a

wide variety of applications. The model developed in central stores provides an important modification to the well-known advice to managers that technical designers should have close communication with users. This advice, usually resulting in interaction model shown in Figure 7 is rarely fully effective. The reasons for this ineffectiveness of the Model in Figure 7 are complex, but some of the important ones are as follows. The user's needs are translated by the designer and are usually cast in a way the designer believes Management will accept. In addition, the users are frequently ill-informed about the purpose of their system or the role of the proposed technical innovations, thus rendering their reactions to the designers questions less relevant than they might be.

In contrast with this, the present Central Stores project used the following model, shown as Figure 8. The design team, because of their sociotechnical analysis were informed about the nature of the system mission and objectives. As they were composed of a diagonal slice through their system's hierarchy they shared this information across the levels of managers, supervisors, and workers. The design team, as an informed group, could evaluate initial proposals of the technical designer. As a function of their composite membership they had close communication between management and workers and a good appreciation for problems of both groups. The management members of the team has close communication with the department manager, who in turn has maximum influence on the Technical Consultant to modify the proposed recommendations. The result was a high degree of understanding and acceptance of the engineering firm's proposal by the design team and

FIGURE II 7

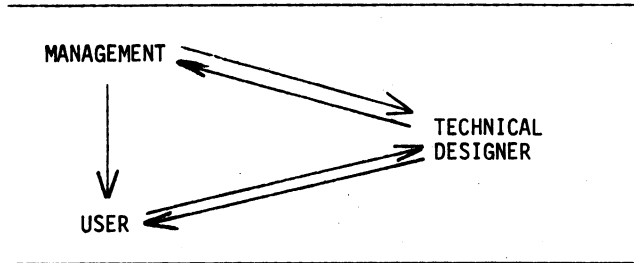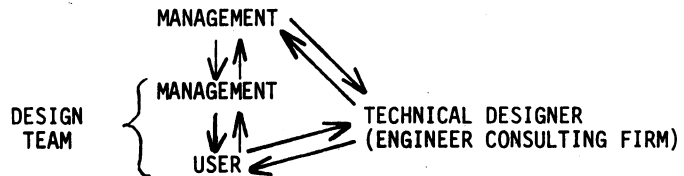A POPULAR DESIGNER-USER

INTERACTION MODEL

FIGURE II 8

DESIGNER-USER INTERACTION

MODEL IN CENTRAL STORES

their incorporation of that final proposal, with few amendments into their recommendations.

As the project unfolded the design team became more candid, and more prepared to share the leadership function than the internal consultant and I had expected, based that is on the early behavior of the group. The assistant department manager on the team did a good job of follow-through in communicating with the department manager and the outside consulting firm. This manager also did a fine job of pulling the team's summary discussions together into draft reports for their further editing, but other team members began independently to aid in report writing as well. It is interesting to note that the design team never (despite more urging from both Consultants) really used an agenda as a standard for time management in their meetings. When attempts were made at building an agenda, the diversion usually began after the first item was listed. If an agenda was built without interruption or digression it usually was not followed. We speculate that in cases of "temporary training groups" (like the present design team) where members expect to return to their separate organizational assignments following completion of their task, the group will tend toward maintaining organizational norms for group behaviors rather than spend time learning new behaviors. The internal consultants felt that process and structure of group meetings in Central Stores had a strong influence on the way the design team behaved.

Post Script

One may ask what the benefits are of such a project where the use of employee time is so great. From one point of view the criticism is justified that outside experts exist to do the very things these employees had done. In another study we might conclude that indeed the work of an outside engineering consultant suffices for an adequate technical analysis, and that the Socio-technical and O.D. consultants could have undertaken the Social Analysis and design recommendations without the heavy involvement of the employees.

I shall assert however, that this is not the case in Central Stores and I conclude that the study would not have resulted in the same recommendations without employee participation.

The strengths of what was accomplished in the present project reside in the perspective those employees brought to the study, and to the integration and optimization they were able to make between the conclusions of the technical analysis and of the social analysis. It was the employees who questioned the Engineering consultant's conclusions and recommendations (once invited to do so), and they spurred the department manager to demand modifications in those recommendations.

This Central Stores project illustrates the feasability of employee participation in analysing and redesigning their own organization. It establishes the use of a highly structured and complex analysis methodology like socio-technical analysis by internal organizational members. Further it calls out a model for collaboration between department managers and subordinates at several levels below them which at once permits the clear evidence of ongoing sanction and support by the former for the latter, and keeps the communication between them timely and relevant. This model of

employee-management participation (portrayed above as Figure 8) had
three advantages: 1) was responsible for more quickly overcoming and
initial employee reluctance to participate; 2) employees could effectively
and constructively question the recommendations made by external consultants;
and it permitted the effective use by employees of engineering and behavioral
science inputs for the redesign of their own organization.

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Appendices

Available from
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