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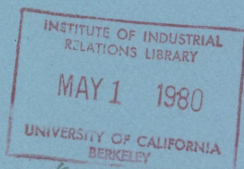
STUDIES IN PARTICIPATIVE SOCIO-TECHNICAL WORK

SYSTEM ANALYSIS & DESIGN

Service Technology
Work Groups

by

James C. Taylor



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UNIVERSITY OF CALIFORNIA
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Part IV: Computer Operations Division(COD)

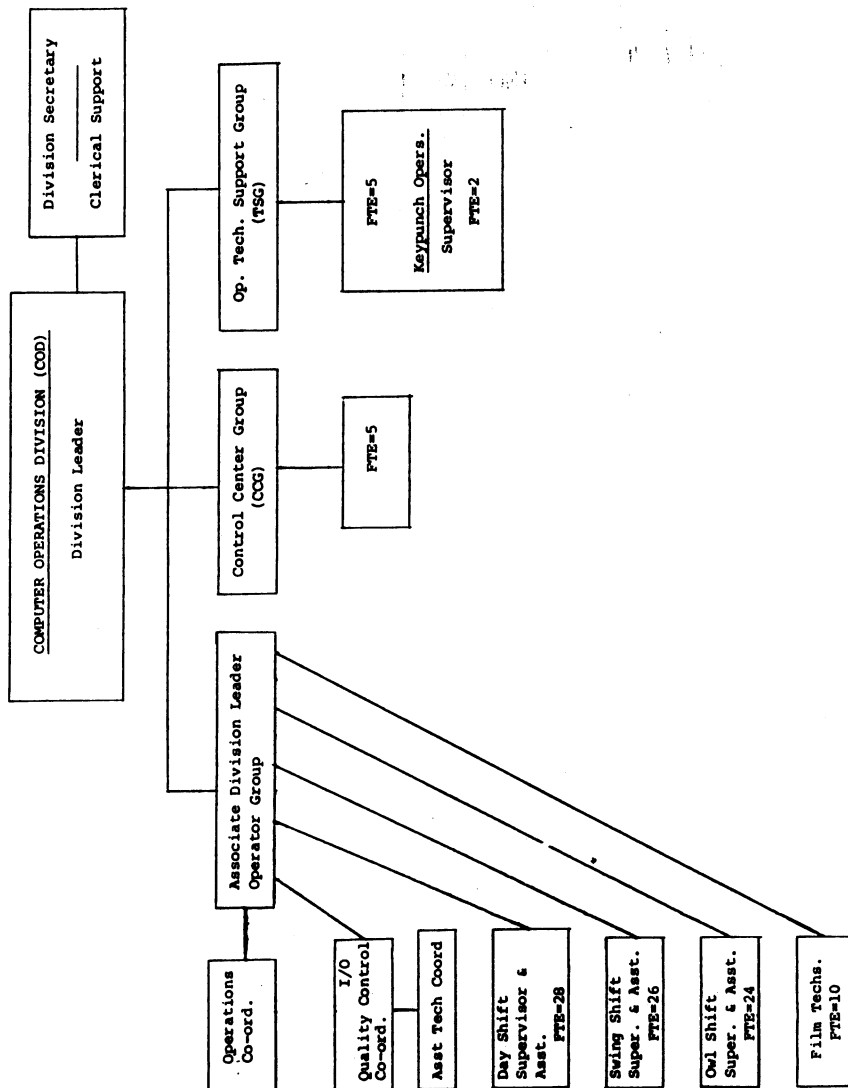
Organization

Computer Operations Division (COD) is comprised of about 125 people. It is one of five divisions in the lab's Computations Department. COD is responsible for providing direct services for the lab's 2000 computer users, by operating several large and small computers (plus peripheral devices and services) located in three different buildings. COD provides a daily accounting and analysis of all the computers, as well as maintaining a centralised point for handling user problems and coordination of hardware maintenance.

The computers are operated on a 24-hour basis, seven days per week. System maintenance accounts for seven per cent of this time. All professional departments of the lab use the computer facilities and the total number of actual "users" (approximately 2000) amounts to about 30% of all lab personnel.

In addition to COD, the other four division in the Computations Department are responsible respectively for (a) large-scale systems software and technical planning; (b) user software for the computer center; and (c) (d) two divisions of application programming (one is responsible for the small number of large scientific computer applications, and the other is responsible for the large number of smaller residual experimental projects). The two applications programming divisions represent the Computations Depart-

FIGURE IV-1



ment (among the other professional departments in the lab) in the departments/programmes matrix described in the earlier introduction (part I of the present paper). That means that the 130 programmers in the two applications divisions are assigned to and located in the various program and project locations throughout the lab. These programmers receive task supervision from program personnel, and administrative support and evaluation from computation division management personnel in a typical matrix structure.

Unlike the matrix location of these two programming divisions, the two systems divisions and the COD are centralized. For the two systems divisions this centralization is manifest in part in physical location, but primarily in terms of a single task and administrative hierarchy. Systems programmers work on software problems of a generalised nature, and design the way the EDP system and the computer center itself operates. For the COD, centralisation means that the computer center, and the cluster of several buildings in which the machines are located, provides a common service to the lab's computer users. The computer machine operators are not only situated at this central computer location, but the CO also provides a single task and administrative hierarchy for its operators. The COD is unusual in the amount of stature it has. Most operations groups in other organizations are not represented at as high a level as a 'division.'

The central structure of the COD is shown in Figure IV-1. The major group in terms of number of employees is the computer operator group (COG). One hundred and twelve employees, including a manager, staff specialist and eight supervisors are divided into a three-shift 24-hour operation which is further divided into machine operations and a film processing labora-

tory. Each of the three operations shifts has a supervisor, and assistant supervisor (both exempt grades), two "floor managers" (who are non-exempt personnel), and between 24 and 28 machine operators graded from trainee to senior ranks. The film processing lab has a single supervisor for 10 technicians over three shifts. Within this general structure of COG are a myriad of machine and user oriented jobs, and a complex fabric of administrative, co-ordinative, and operative tasks.

The two other groups in COD are very much smaller. Control Center Group (CCG) is comprised of six people including a manager and clerk. CCG acts as a centralised "problems office" for the lab's computer users and since most user "problems" involve machine or systems breakdowns the major time of CCG is spent in liaison between COD and/or employees of the two systems divisions. The Technical Support Group (TSG) includes a manager and a clerk, several keypunch operators, as well as several technicians responsible for internal time allocation and accounting systems for the EDP system. The COD division manager and clerk, as well as both CCG and TSG, are physically located in the same building as the computer input-output (I/O) center. The division offices, CCG and TSG, are only open during the day shift, although CCG personnel are on call throughout the evening and night shifts in the event of urgent or serious problems requiring their expertise.

History

The COD has been a source of personnel problems for at least a decade. Although the division has had several managers during that period, these problems have been commonly attributed more to the nature of the work itself than from personal management styles. Operator response to the sense of general malaise has been evident for many years. As early as 1969 a group of computer operators approached the lab's Personnel Department to intervene for them in asking the Computations Department manager to improve their jobs and working conditions. A series of studies followed in 1970 and 1971 which culminated in several assignment changes within Computations Department management and a radical departmental restructuring. Concurrent with this was the creation of the role of COD division manager. Yet another study dealing with COD morale resulted in some minor changes in working conditions in 1972. The change of COD management in 1971 seemed to have some positive impact on the division, while the morale survey, or rather its consequences, was not warmly received by division personnel.

The COD division manager, chosen in 1971 to fill that new role, was very interested in improving human relations aspects. As early as 1973 the COD division manager proceeded to encourage subordinate managers and supervisors to take advantage of workshops in communications, team-building, conflict management and leadership. She personally and actively pursued this course by inviting internal Organizational Development (OD) consultants from the Employee Development Department to help her management team work together more effectively.

Acknowledging the sense of operator frustration with their jobs and

with promotional opportunities, the division manager in 1974 created a training function and put in charge of it a former operator who had worked outside of the division as a programming technician for several years. This training officer was promoted to operations manager, a line management position, in 1976. During his tenure as training officer and later as operations manager, this man developed a number of programs designed to improve operator competence, personnel evaluations, training opportunities, and internal division co-ordination. Many of his programs were well received by operators, but many were not. These programs were variously characterized as well meaning but misdirected, ill-formed, or inappropriate. His additional duties as line manager (to whom the shift supervisors reported), combined with his interest in improving the operator's jobs made him quite visible to the operators. The combination of strong orders to his subordinate supervisors, and his many, sometimes short-lived, plans for improvement gave him a somewhat paradoxical and ironic reputation of a dreamer and dictator. The division manager, on the other hand, although respected by her management staff, was virtually invisible to the operators in the division.

By late 1976 when I first met with the COD division manager and the operations manager, the turnover among operators was high (40%) and signs of operator frustration were increasing. Management was concerned about their ability to maintain past service levels with a relatively untrained young and alienated workforce. They were spending an inordinate amount of management time dealing with production crises. The division manager was by this time spending most of her time analysing computer availability and down-time reports, and working with her subordinate management staff

to improve usage time. The high operator turnover combined with her own preoccupation with managing machine availability accounted for the fact that she spent little time in the machine room. As a result, few of the machine operators ever saw her during their working shifts. Some of the operators on evening and night shifts claimed they could not even recognise the COD manager, much less ever having spoken with her. Her perceived "aloofness" coupled with the operations manager's "interference" with operator jobs pitted the operators and their supervisors against management as well as against one another.

Planning for the Project

I was introduced to the COD division manager by the lab's OD manager at a meeting of Computations Department division heads in November 1976. The division manager was interested in the potential effects of socio-technical systems (STS) design, and invited me to meet with her and the operations manager. The OD manager consultant and I met twice subsequently (February 1977; April 1977) with the division manager and the operations manager. The COD managers were very interested in the process and were very careful in their examination of the ideas.

By the third meeting they were convinced that an STS analysis could be most useful, and had decided to invite the other two managers in the division (manager TSG and manager CCG) and another member of management staff to my presentation of STS ideas and an initial scan of their division. This meeting was arranged in late April 1977, and was followed by another of the same group on May 20th. These two meetings were primarily to incorporate and involve a wider circle of commitment. Progress seemed slow to me at that point in the process, but was necessary to obtain a deeper management understanding of the proposal before them, as well as the wider commitment represented by the additional managers.

The division manager was concerned that each relevant party in turn had an opportunity to question and commit themselves fully. These were technical managers and they obviously enjoyed the careful process of examining the proposed method. As "EDP people" they made use of inductive reasoning in carefully questioning each assumption and its related assertion. Another reason why they approached the project so tentatively was

the absence of any support from department management. The COD manager and her operations manager had met with the Computations Department manager in mid April 1977. They had explained the project they had in mind and wanted to inform him of their interests. The department manager evinced no commitment at all to their proposal. He made no move to block it, but cautioned them to be aware of potential disruptions in direct delivery of service, and any effects on other divisions in Computation Department.

This five-person COD management team, by May 1977, had become the sanctioning group (later, and with two additional members, they were to become the Steering Committee). They discussed selecting an analysis committee and its role. They considered the benefits and risks of analysis, and of design. They were careful to distinguish between the two. It was clear to these five managers that an internally motivated analysis committee was necessary. They originally wanted to call for volunteers to select among them, based on their interest in organizational improvement and quality of working life. I had suggested 4 to 6 members as being ideal - and I urged them to consider a core committee which would undertake the analysis and the design proposal. They accepted both of these suggestions for the present, although they were soon to decide that a larger "core" group of 10 would be better. They were also clear about the need for a Steering Committee which would exercise an authentic veto power through a continuing monitoring process and a strong support function based on its early and direct statement for the area of freedom granted to the "core" group. Finally, this group of managers recognised the 8 supervisors in the COD as a unique constituency who had to be the next group to be incorporated into those participating. The project was by now official, with myself as "external consultant" and the OD manager as "internal

consultant."

Figure IV-2 provides a time-line comparison of the various activities in the COD socio-technical design project, to be described in the remainder of the present paper, and includes the pre-project planning and sanctioning activities described in preceeding paragraphs as well.

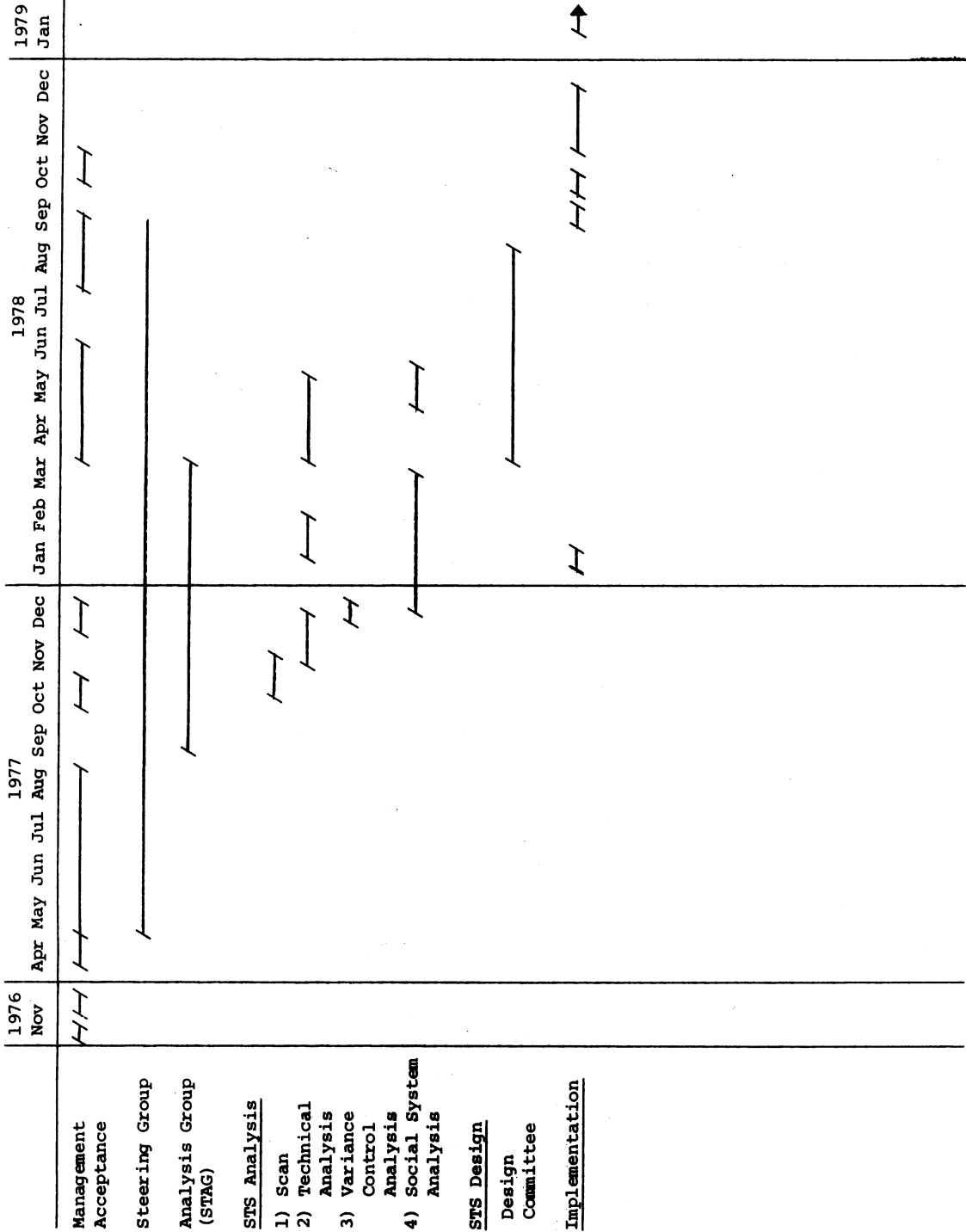
By mid June 1977 the supervisors had been introduced to the ideas and invited to a meeting with the managers and we two consultants. In fact, only the division manager and the operations manager met with the supervisors for the next two meetings. The supervisors were interested and concerned. The timing in the meeting with them was none too soon. The issues raised and discussed at that meeting were as follows:

- Concern that the "core" group stay within the boundaries set by Steering Committee
- Concern that the project would really produce a product that would be implemented
- Concern that management had already made commitments for specific changes
- An indirect, but nonetheless manifest, concern about possible effects on their own jobs

Their suggestions were as follows:

- Supervisors help in the selection of the "core"
- Core group representatives come from all functional groups (not be limited to 4 to 6, expand to include various interests)
- Team training be given the core group
- Keep everybody (not just Steering Committee) informed about progress
- The introduction of the project to the division should be carefully done and with fanfare.

FIGURE IV-2



The supervisors agreed to consider the proposed project further at a meeting among themselves and agreed to meet again with the managers and consultants after that.

That next joint meeting took place two months later on August 18th. At this meeting the supervisors indicated that they were not willing to accept in advance "anything" the core group would come up with. Based on past experience they believed it too difficult for the core group to communicate the process and progress of such an undertaking fully enough for the supervisors to trust in the participation concepts the consultants and managers seemed to be proposing. In addition, they said, there is no extra time for such an undertaking without impacting on production. They insisted that the core group, if formed, be relieved of their regular duties to do the job right. The three managers present agreed with the supervisors' concerns and proposed that the supervisors be as involved as they could be in both the Steering Committee and the "core" group; and that core group members would be relieved for at least three-and-a-half days per week until the project was finished. The supervisors agreed to select several of their number for participation in the project. The first meeting of the "official" Steering Committee was called for the next week. It would include two representatives selected by the supervisors.

The Steering Committee met in full on August 25th. In addition to the division manager, the operations manager, the management staff person and the managers of CCG and TSG, were two supervisors. This was to be the composition of the Steering Committee from that point. This committee dealt with the size and composition of the "core" group, and how selection was to be made. It was decided that the core group could be composed of

10 members: 2 operators from each shift, one photo lab technician, one member each from CCG and TSG and one supervisor. It was decided that all representatives would be selected by their own "constituants" and that for the operators this nomination should be done by election.

On September 6th a memorandum briefly describing the project, the core group and the election process was issued by management. A series of meetings was held by the TSG manager and the division manager to explain the project and to distribute the memo to all employees in the division. A large number of employees did attend, and the remainder received copies of the memo by mail. (For memo see Appendix IV-A). Deadlines for the election/selection process were the next week. Employees were invited to meet the internal and external consultants during their shift in order to discuss the STS process, and questions employees had. A first meeting of the core group was scheduled for 10 days hence.

It is significant to note that this memo of September 6th referred to what had up to that point been called the "core group", as the "Analysis Committee". Although in this memo the role of this "analysis committee" was set forth with the intention of authorising both system analysing and design, the role description was unclear.

The meetings held by the two consultants served to further familiarize division employees (especially those interested in becoming members of the "Analysis Committee"). The meetings in general had the effect to provide more information to those who were already interested. Some scepticism and cynicism was noted in people who attended these meetings, and the turnout was not large. The meetings also acted to provide a

sounding board for some of the gripes employees had. These complaints revolved around frustrations with "unchangeable" rules and regulations, and of a division between the older more cynical employees and the newer employees. Some complaints about supervision and management were also raised.

The Project Begins

The newly elected analysis committee met for the first time on September 16th. The supervisory member and the external consultant were absent. The team was 6 men and 4 women, and also included a mix of racial background and length of service. The internal consultant introduced his role and acted as nominal chairman for this first meeting. His role, he explained, would be to help the committee develop its own leadership and monitor the way it worked together. The role of the external consultants, by contrast, was that of the expert in the analysis/design process and to provide the tool by which their project would be accomplished.

The members present discussed a name for the committee, and after reference to the memo of September 6th they decided on "Socio Technical Analysis Group (STAG)". This decision required a discussion of the meaning of the term "analysis", and it raised the issue of whether the Steering Committee meant by that to withhold from STAG the authority for redesigning the system. Several of the members had evidently heard that management planned to do the design themselves. Thus the acronym STAG, it was argued, was appropriate. This issue led to a whole host of concerns and reservations of the "real" goals of the project, management's ulterior motives and whether it would be any different from past activities. Some members were sceptical, and others were upset because of those doubts and lack of energy. Committee members were also concerned about the impact of their time off on production. They agreed that with their concerns and the ambiguity of their "charge" from management they needed to meet with the division manager and her boss, the department manager as soon as possible.

As it turned out, that could not be until a week later, and then only with the division manager.

The group also discussed a meeting schedule and their role in representing and communicating with their co-workers. They decided that they would meet all day on Tuesday, Wednesday and Thursday each week starting with a three-day team building session. Further, each group member would work out with his/her supervisor how Mondays and Fridays would be used in communicating with co-workers versus time devoted to the regular job. Finally (and apparently as a symbol of their own personal control over the process) they all agreed to identify an alternative member in the event that any of them chose not to continue on STAG.

Their next meeting was September 23rd. They met together for a few minutes before the division manager was scheduled to come. The external consultant and internal consultant attended but two committee members, including the supervisory representative were absent. Their questions for the division manager were as follows:

Can the department afford to take us away from our work so long?

Will this cause our manpower figures to be questioned and reduced?

What commitment do we have from our co-workers to cover our work for us?

What can be done about computer users if they are a source of our problems?

The division manager answered that the project would not jeopardise either their job security, or to a reduction in force in general. Further,

she said the supervisors would obtain the adequate coverage for them. Her motive she said was to pinpoint and attack the free-floating problems of morale and mission accomplishment which were endemic to the division. Finally, she said that although they would not try to approach the users directly they would have an impact (a) through "cleaning up their own house" first; and (b) by developing the sort of well-reasoned argument for improvement to approach the user with, that the STS analysis promised. After a little more discussion the division manager voiced how glad she was that the project had begun and wished them good luck.

As the committee continued that second meeting, the topic of discussion turned again to division employees scepticism and criticism of the project. "It was different from committees in the past" they reasoned, "because they had been elected by the co-workers, not merely volunteered or selected by management". The members reported that people in the division needed some tangible evidence that this project would be different from those in the past. If such a sign would be forthcoming they knew it would have to come from them. They realised that the key to overcoming division resistance and scepticism was communication and open relationships between themselves, the Steering Committee and their constituents. But they were also uncertain as to what they could deliver. They did decide that whatever happened they as a committee would prepare and distribute a weekly summary. This summary would be addressed to their co-workers, each of whom would receive a copy, as well as to the Steering Committee. They agreed to reserve time each week to prepare this summary. It would report not merely what they had done, but also whatever they had learned. It would be prepared on Thursday and distributed Friday morning. It would be a committee effort - no one person on the committee would be left "holding the bag".

During the next week the committee would not meet, but the week following would see the beginning of the team building activity.

Training

The training was separated into "team building" and "STS analysis": team building was considered especially important in this case given the large size of the group (10), the reservations about a project like this succeeding (considerable), the interaction style of employees in the COD toward one another (critical), and the fact that the non-supervisory employees (9 of the 10 committee members) would have had little experience working in an autonomous group.

The team building was taken before the STS training. The internal consultant conducted the training. The committee was taken to a conference centre located some 20 miles from the lab, where they worked on team building for 3 days (October 5th to 7th). The activities were highly structured for the first day, and became less structured as the committee, in becoming a team, began to take responsibility for its own direction on the second two days.

Agenda on day one included short lectures and exercises on individual roles in groups, leadership functions and activities, decision-making styles and results, and conflict handling. By the second day the internal consultant asked the group to complete a short questionnaire dealing with their internal relations, such as listening, trust, influence, openness; and then the group discussed the meaning of the results. After lunch on the second day the internal consultant made a small speech about the team's responsibility for its own learning, and the consultant helping role as he saw it; and then he sat down, symbolising his relinquishing any formal authority he may have had as "moderator" or "instructor". The group was then faced with recognising its own strengths and weaknesses and choosing a

leadership and decision-making style for the project to come. Work continued for the next one-and-a-half days. When the team reconvened again the following week they were still struggling with the process issues of leadership and conflict handling, but they were beginning to replace cynicism and apathy with an active examination of leadership functions and individual roles. This situation was new for both consultants. The external consultant had hoped that this team building would help the group work together more effectively and he was pleased with subsequent results. The internal consultant, who designed and implemented this phase of the training, had not worked with this sort of group before. It was a newly formed group operating in a fixed time dimension with a heavy training component threaded through from beginning to end. This sort of task dependence on the external consultant had to be complemented by strong shared, and internal leadership and autonomy by the group.

The internal consultant felt he had achieved this goal. What follows is a quote from "STAG" memo to the division at the end of the second week:

"Learning to work together as a team has been the most difficult part...trying to get ten different philosophies and personalities to function as a unit, if you think about it, is almost impossible. Several blow-ups occurred but were eventually resolved. Team function and co-ordination is still going on..."

(October 14, 1977)

The team building had been planned for 2 days, with a simulation STS analysis to be run on the third day of that training week. Because of the depth and intensity of issues the group was working through, the internal consultant made no move to cut short the discussion of interpersonal issues. As a consequence, the STS simulation was delayed until the first team meeting of the following week.

During the next week (October 11th to 13th), the external consultant led several hours of formal lecture and discussion on socio-technical theory. Discussion dealt with organizations as open, socio-technical systems, with an emphasis on definitions of "analysis", "technology", "input-throughout-output", "state changes" in the conversion process, and "key technical variances". The process of STS analysis and design was listed and described as the set of steps in Figure IV-3.

The STS simulation took one whole day (October 13th). It was designed and carried out by both the internal and external consultants. The basis of the exercise was adapted from an existing organizational simulation. The adaptation provided a fast paced production cycle (about an hour) and can be played by as few as ten people. The simulation should be played through at least two cycles in order to generate the complexity of interaction among the various aspects of organizational environment, management style, organizational structure, production, co-ordination and co-operation. Typically, in the first round, the rules of play, an organizational structure, and product, are stated by the instructor. The instructor asks the players to draw lots for organizational roles. The instructor then provides the raw materials for production, and then keeps time for the players during the first cycle or round. The first round is played, and briefly discussed. A second round is then played. The players may choose whether to change roles or organizational structure in this second round. The first two rounds of play, including the initial instructions, and discussion of the rounds of play themselves can take up to three-and-a-half hours. A third round of play, should it be used, would take an additional one-and-a-quarter hours. In the present case it was decided to use two rounds only, because play had gone well and enough data were available

Figure IV-3

Steps in Socio-Technical Design

- Step 1 - Scanning the socio-technical system
- Step 2 - Technical system analysis
 - Identification of unit operation
 - Identification of key variances
- Step 3 - Variance control analysis
- Step 4 - Social system analysis
 - Internal role network
 - Cross boundary role network
 - Individual role analysis
- Step 5 - The socio-technical design

for an analysis of the simulated organization as an open socio-technical system (STS). The afternoon of October 13th was spent analysing the simulated system. A conventional scan of the system (see Taylor, 1978) was undertaken which emphasised system boundaries, (time, territory, technology) production inputs and outputs (raw material, and completed product), system objectives (stated in the instructions, but tempered by experience with the finished product in the play itself).

The external consultant led the group through a "technical analysis" of the simulated system including the identification of "unit operations" and "key technical variances", as well as the analysis and description of "key variance control". The scan and the technical analysis provided the players (now discussants) with an understanding of the system's mission and requirements, and a language to discuss it with one another. The internal and external consultants then drew the group into the social system analysis, which took the form of a discussion of their own interpersonal relations and role behaviours in the game. This proved (as would be expected) to be the most interesting aspect to the group. They identified their distress with the emergence of two "warring" internal factions among the organization of players which reduced or eliminated co-operation and co-ordination necessary to earn maximum points. The design implication of getting these "warring factions" together was obvious to all concerned. As the consultants pointed out, that problem of internal conflict could be solved either by management strictly co-ordinating among the two groups, or by a change in structure permitting the two factions to become one. The simulation was considered a success. It had taken an extra day, but it had clearly demonstrated the purposes and outcomes of an STS analysis. This simulation exercise completed, the initial training phase of the pro-

ject in Computer Operation Division (COD). The Socio-Technical Analysis Group (STAG) was anxious to begin their analysis. The following sections describe the flow of activities in each of the steps in Figure IV-3, as well as a description of the team process of working together, as observed and measured by the consultants.

The STS Analysis

1.) The Scan

Step one of the STS process is the overall scan of the system and its environment. In essence the task is one of identifying the boundaries of the system to be analysed, and to briefly review the major social and technical objectives, and the major problems facing people there. A lecture and discussion of the purpose and process of the scan had been undertaken the week previously; and STAG had experienced the scan of their organizational stimulation. Because the process of the scan was already a familiar one to STAG, they progressed into it smoothly. Most of the three meeting days of October 18-20 were spent doing the scan. This was STAG's first activity where a topic had been carried on more than one day, and to some STAG members at least, the scan seemed to take a very long time. What was worse was that an attempt to conclude the effort by presenting to the Steering Committee was delayed a week because of scheduling difficulties. The scan was finally presented on Nov. 1st, returned for revision and accepted by the Steering Committee on November 2nd.

The results of the scan were as follows:

1) Boundaries

- A. Physical: The three buildings in which computers were located.
- B. Temporal: 24 hours, 7 day question
- C. Technical: The point at which user requests (inputs) enter the system, and the point at which the transformed data (output) leaves the system

2) Objectives

- A. Technical: Individual user satisfaction, together with satisfaction of all users
- B. Social: COD employee satisfaction

3) Problems

- A. Team effort lacking
- B. Inconsistent communication

- C. Co-ordination lacking
- D. Supervision diffuse and inconsistent
- E. Overlapping authority
- F. Training inadequate
- G. Rewards inappropriate

The team added the following summary to their final draft:

"By breaking down the components of the scan, we realized that some aspects were actually abstracts and some aspects were less involved than a first look would indicate. Inputs at first were seen as concrete things such as cares and tape. We later determined that input was actually user need and untransformed data. Our initial list of problems within the division was quite long. A second look developed only seven major categories under which all of the other items of our first list fell. Essentially, the scan has given us a new way to look at things and recognition of the boundaries within the scope of the socio-technical system."

(Nov. 4, 1977)

Relations with the Steering Committee

From their very first meeting the STAG had been concerned about their role in analysis and design. Although the September 6th memo from division management had specified both functions in the description of the "Analysis Committee", some members of STAG persisted in the feeling that their role was strictly one of analysis. This ambiguity, together with a possessiveness or resentment of several workspace and personnel changes announced by division management during early October spurred STAG to prepare their own "charter" and to invite the Steering Committee to discuss it with them. Their invitation of October 18th requested a moratorium on job changes - and it was signed from the "Socio-Technical Analysis and Design Group (STAG)". By October 19th, when the two committee's met together, STAG had prepared a "charter" for distribution to the Steering Committee members. Essentially the STAG charter proposed analysis, design proposal, and implementation coordination. The Steering Committee discussed the various issues raised. In particular STAG was assured of being consulted if reorganization was needed before they were finished. The Steering Committee promised to respond to the proposed charter within the week. By October 25th, the Steering Committee informed STAG, by memo, that its function was solely analysis. The memo made explicit that a design committee would be formed when it was needed and that it would have a majority of STAG as its core. That issue was closed - and the bridge (of design) would be crossed when they came to it.

The second and third meetings between STAG and the Steering Committee took place around the presentation of the scan by STAG. A process issue,

apparent in these early meetings was an absence of leadership and focus in the meetings. This was because neither STAG or Steering Committee felt it was their role to lead it. As a consequence, the meetings drifted without attention to what was being covered. The steering committee members responded more as individuals than as if they recognised among themselves a common purpose of structure and guidance for STAG. The net result after the second meeting was frustration and discouragement on the part of STAG members. They resolved to provide direction in the form of an agenda, and leadership in a spokesman rôle filled by a younger member of STAG, who would be seen as perhaps less biased in making the presentation. The third meeting was more efficient to everyone's relief.

2.) The Technical Analysis

The technical analysis began during the third week while STAG were waiting to present their scan to the Steering Committee. The technical analysis was completed in four weeks. Much of the conceptual learning had already taken place in their STS training analysis of the organizational simulation described above. The external consultants did review the process concepts, and method for undertaking a logical analysis of the technical components of the work system, and the grouping of these into 'Unit operations'.

As used in socio-technical analysis, unit operations are logically integrated sets of tasks, one set being separated from the next by a change of state in the work process. An important part is that unit operations are all together pieces of a technologically meaningful whole, while unit operations as separable parts of this technical whole are themselves whole pieces. One STAG member in discussing this criterion to another stated it thus: "A circus tiger is still a tiger without his feeder, his trainer, his sweeper, etc.; but a tiger cut in two is not two tigers or one tiger anymore". The unit operations for the COD technical transformation were identified by October 28th. They are shown in Figure IV-4, together with the major technical system inputs. Although STAG were not totally satisfied with the results and discussed it further in the following weeks, this list of four unit operations was to remain unchanged.

The next important objective of the technical analysis is identification of key process variances. A variance is defined as a tendency for the throughput of a work system to deviate from a normal or desired specification. This throughput variance arises as a result of some character-

istic associated with the input, or the work process itself in its normal operation. Variance analysis is not concerned with temporary problems such as major hardware breakdown or human negligence. The technical analysis in COD (as elsewhere) concentrated on a technical system weakness which required absorbing or controlling by the work organization in order to function in a 'realistically effective' manner. An important objective of this analysis method is to identify clearly those key variances that significantly affect the ability of a work system to pursue its major objectives. For computer operators, minor machine malfunctions, program 'bugs' and intermittent power supply are part of "normal operations". These are variances in the sense used here, and they are anticipated.

The process of listing process variances began with the comprehensive identification of variances for each unit operation. Some 54 technical variances were listed for Unit Operation I, using structured brainstorming method (see Delbeq and Van de Ven 1976; 'Nominal Group Technique'). After a delay of one week (while they met with Steering Committee and revised their scan), STAG continued the listing and discussion of variances (Nov. 8-10). The original list of 54 variances for Unit Operation I was reduced to 15, and in so doing the boundaries of that Unit Operation were thoroughly discussed and understood, and the notion of variance was strengthened. Similar discussions on the variances associated with the other three Unit Operations also narrowed those respective variance lists and continued the analysis done to that point. STAG worked very hard on this listing and discussion. If anything, in their zeal to "do it right", they perhaps worked too hard. They had, in the absence of the external consultant, taken up a discussion of the definition of "variances" contained in several STS documents they had been given several weeks earlier. These documents,

FIGURE IV-4

RELATIONSHIPS BETWEEN BASIC COD
INPUTS AND TECHNICAL UNIT OPERATIONS

Input \ Unit Operations	I*	II	III	IV
	RECEIVED INFORMATION	AVAILABLE DATA	PROCESSED DATA	TRANSFORMED DATA
USER NEEDS →				
DATA →				
RAW SUPPLIES →				

- *I. Received Information. The place in the system where all instructions necessary to perform a function have been gathered.
- II. Data Available. The point where all information to be processed (along with the instructions for processing it) is complete, and the processing is ready to be carried out.
- III. Processed Data. The result of performing the function (after the two preceding steps have been carried out).
- IV. Transformed Data. The step that takes processed data into its final form (readability, legibility and accessibility).

Although throughput can pass through all four unit operations, all throughput may not necessarily need all four steps.

although complimentary in all the essential aspects of their treatment of STS analysis and design, did use different and (it turned out) conflicting examples of "variances". These differences were thoroughly discussed but no conclusion was reached. Because of their "inability" to reach a decision, STAG then fell into a point of low energy and could work no longer on discussing variances until the external consultant met with them the following day. The external consultant answered the questions they had (his answers, fortunately, were congruent with the major conclusions of STAG), and STAG continued the technical analysis process by identifying the "key variances" from the list of variances they had developed.

During week 6 (Nov. 29 - Dec. 1) STAG identified the COD criteria for effectiveness in quality, quantity and cost of producing their output. The direct effect of variances on these criteria were examined in order to identify them as "key variances". An additional exercise was undertaken in examining the strength and direction of relationships among the newly identified key variances and the others. Additional key variances were thus identified by this indirect effect, or chain reaction they created. On December 1st., STAG reported in the weekly memo to the division that they had completed their technical analysis in the form of key variances ('Step 2' in the STS process); and that they were examining those keys to see how and where they affect the system. (The analysis of variance control - Step 3). They were moving well and smoothly and realised that the social systems analysis was almost in sight. In less than two months they would have completed the first three steps of the process. In addition, through their close communication with the co-workers and with management, they also felt that they had coincidentally made progress in learning how people in the COD saw the organization and how they felt about it.

The results of the technical system analysis revealed some nine "key variances" or essential technical requirements in the conversion process of producing transformed data. (The complete "Technical Analysis Summary" is in Appendix IV-B). The nine variances are as follows; in the order of their appearance or creation in the conversion process:

1. Quality of user's job instructions
2. Priority of jobs
3. Time of day job requested
4. Turnaround time for various tasks related to a job
5. Type of media from which object data are drawn
6. Quality of object data per job
7. Volume of jobs
8. Quantity of transformed data produced
9. Quality of transformed data produced.

These key variances were considered by STAG to be "...highly significant in that actions that affect them also affect the operation of the whole system (including the people who run it)". (Dec. 21, 1977)

Communication with the Division

From the first meeting STAG had promised to communicate as frequently and as fully as they could both to the steering committee and to their co-workers. They had fulfilled this promise in several ways. First, they issued a brief "Weekly Summary Report" in which they reported their accomplishments, their learnings and frustrations, and their intended next steps. Second, they met with their co-workers (usually individually) on Friday when the summary was distributed, on the week-ends that they worked (usually one in three), and on Mondays. Third, STAG discussed the content and feeling-tone of the feedback they received; This discussion was usually the first agenda item of the week (Tuesday mornings); these discussions helped STAG members improve this communication process. By the time the technical analysis had been completed seven weekly summaries had been issued.

Despite the clear structure and their willingness to follow through, STAG found their efforts to communicate were not easy or fun, especially at the beginning. The first Tuesday morning following the 1st. weekly summary, STAG discovered a whole host of communication issues. Among those issues were the following:

- The summary was not enough - they had to further explain what they wrote about.
- Their co-workers were anxious for results and felt delay meant bureaucratic "B.S."
- Co-workers wondered when STAG would start "interviewing" them.
- Co-workers felt that STAG members should work with the shift on Mondays and Fridays.
- Co-workers didn't feel much would come of their efforts.

Considerable discussion followed and it was decided that STAG members must continue these personal communication efforts throughout the project in order to stay in touch with and communicate to the division. As weeks passed, STAG members continued to hear people talking about problems but also about solutions. Many co-workers definitely wanted an opportunity to talk to or ask questions of STAG members in addition to the memos. Still others would show no interest in the project at all or continued to be critical of the content of the weekly summary.

This sort of communication was difficult but exciting. STAG knew they were reaching more division members all the time, and the degree of co-workers acceptance of the project was growing. Open communication like this has risks as well. One such risk became painfully evident when someone anonymously circulated a statement, attached to a recent STAG memo, stating that "jargon" is an author's way of "concealing (his) thought...because he did not know what he was saying; or he did not know how to say it; or he was apprehensive about saying it right out". The overtones of the manner and message, and the near certainty that it came from outside the division, put a new dimension on the project. STAG knew that through the open circulation of their weekly summaries they were subject to being watched and ridiculed by others in the lab, who the STAG felt, considered the COD inferior.

What a powerful motivation to pull inward--but they did not very much. STAG continued to communicate and improve their communication. Apart from rumored threats that others in the department would circulate sarcastic annotations, attached to STAG's future summaries, nothing more was heard of phantom critics.

The STAG's efforts at improved communication weren't always successful. In one instance of a weekly summary, they included several lecture outlines that the external consultant had distributed to them. Although the outlines were made clear by lectures which accompanied them they were at best irrelevant, and at worst a confusion for enhancing division understanding or acceptance.

A major, but previously unplanned elaboration on the communication with the division was the consequence of a traumatic event in the progress of the project. November 29, 1977, (after the project had been running two months), the operations manager informed STAG that the COD manager was being seriously considered for a promotion and transfer. With that the fortunes of the project seemed to ebb. The members were discouraged and anxious to speak with the division manager directly. She encouraged them to seek support from the department manager (who previously had shown little interest or support). The division manager proposed that STAG show the department manager how people in COD felt about the project and what had been done. Several Steering Committee members and several STAG members reported that the department manager had recently spoken to them about the project and had seemed interested in supporting it. STAG and the Steering Committee undertook to plan a presentation of what had been done so far. This work included a summary of the plan and the technical analysis - as well as a forecast of the social system results based on the STAG feedback meetings with their co-workers. STAG would prepare the materials and make the presentation. All other project work was reduced to near zero for the next two weeks while preparations were made for the presentation to the department manager on December 21st. The presentation was well done

and the department manager promised continued support - and appointed the COD control center group (CCG) manager as acting division leader until the project was completed. The ex-CCG manager had been a member of the Steering Committee and was familiar with the project.

As a result of preparing the presentation to the department manager, the STS project was delayed three weeks, and considerable uncertainty about the fortunes of the project was introduced. On the positive side STAG and the division came away with a growing understanding of the technical analysis, the purpose of the study, and a 35-minute video tape explaining those aspects which was subsequently viewed by most employees of the division.

Group Process

The internal consultant had prepared STAG with the original 3-day team building exercise in early October 1977. He continued to help them improve and monitor their group process. The group ordinarily took a light-hearted attitude towards the internal consultant, as if to say "we are working the way we ordinarily work and talking about it takes more time than its worth". But when they had an issue to work through that they could identify, they welcomed the internal consultant's help. As external consultant, I relied heavily upon him to help the group stay aware of their own use of time and resources.

The STS analysis was complex, ambiguous work for STAG members who were more used to doing work than analysing it or planning it. When they reached frustration levels with one activity, despite their best efforts to shift to another of the many tasks they were doing, the frustration seemed, sometimes, to reduce their problem-solving ability in other activities as well. One reason for this initially was the problem-solving and conflict-handling modes exhibited by the various members. Sometimes members would hold on to an argument despite its negative consequences, other times members would leave without working, while others withdrew and couldn't be drawn in for long periods.

STAG worked very hard on addressing leadership behavior and group member responsibilities, and the lapses toward obstructive or passive behavior became less frequent. As they were learning how to work as a group, they were also learning how to work efficiently on tasks which did

not require all the members for a quality result. It was decided fairly early to divide up the task among sub-groups where it could be divided, and to knit the results together by the whole committee. More difficult was the problem of an indivisible task which would be better served by 10 people working together. Dividing into smaller groups and duplicating their effort was never seriously considered, and dividing into two sub-groups, one to work and the other to monitor group process in the first was rejected. So the STAG, when it had an indivisible task worked on it all together. Since frustration and conflict frequently accompanied this choice of attack, members would deal with it by withdrawing anyway which effectively reduced the size of the working group.

3.) Analysis of Variance Control

During the time STAG was preparing their presentation for the department manager they were also discussing the way their system dealt with the key variances they had identified. Following STS analysis techniques, they were constructing a "Table of Variance Control" in which they listed where a key variance occurred and where it was first observed, where it was controlled and by whom (the table is itself a part of Appendix A.) In so doing they were mapping the current "essential" organizational behavior.

A summary of the nine key variances identified and the activities used to control them is presented in the following section.

Key Variances and their Control

Turnaround: The length of time from when data enters the system to the delivery of the transformed result is affected by many circumstances at many points in the technical system. Many identified sources of variance are outside the scope of COD, such as user-controlled job volume and priority, and equipment performance. Control activities such as operator coordination of jobs across shifts, however, can be an important way of minimizing further delays. Such coordination was not done as well as it needed to be.

Volume: The number of jobs in the system at a given time affects other key variances such as turnaround, quality of output, quantity of data and job priority. Volume and quality are directly related because larger volume can lead to more errors or poor quality, which result in re-runs and increased volume. Much of the control of this variance lies outside the division also. COD control activities were mainly those of rearranging time

allocation, or reducing purge times, or of "hanging tapes" faster--only the last of which is an operator activity and which, as an effective control device, could not be relied upon.

Quality of data: Transformation of erroneous data produces undesired results. Users, operators, and equipment are sources of poor quality. Control of the quality of the data within the division can be provided by validity checks; e.g., check sums on public files, by operators verifying tape and drive to avoid misassignments, by keypunch operators verifying their work and being familiar with compiler languages, correcting apparent logical mistakes, and by division personnel monitoring equipment operation and detecting intermittent failures. As was the case above, operator verification and quality control usually remained at substandard levels due to ambiguous assignment or responsibility and inadequate training.

Quality of Instruction: Deficiencies in the quality of instructions submitted by users has an important effect on COD productivity and on the cost of work done. Obvious connections between faulty, incomplete, or unclear instructions can at best delay work and at worst create an undetectable mistake. Operator competence and understanding can facilitate dealing with differences in the quality of instruction, but such competence was lacking in many operators and the press of work reduced this facility in those who were skilled. The open format for job instructions also invited a wide range of instruction styles.

Quantity of data: Large quantities of data to be stored or printed cause delays and tend to produce psychological stress leading to insufficient checking or mistakes. This variance is affected by users in the size of their individual requests and by division personnel in the care and at-

tention paid to both the work and the equipment.

Job priority: Production operators are familiar with the bid-priority scheme used on the timesharing system for controlling work flow. The handling of special requests on a priority basis by keypunch and other groups in the division requires either a broad knowledge of the laboratory's mission and the relative priority of the project making the request, or a policy established by one with that knowledge. In large measure this knowledge was lacking among COD employees.

Media from which data fetched: The differences in quality among tape, card or other devices from which data come to be fed into the system, have a direct effect on the output quality, the turnaround, or the priority of the job. Equipment malfunction can result in destroyed data or delays in processing. Direct operator control over this variance was limited, although the maintenance coordination activities of CCG played a vital role.

Time of day: The variance "time of day" is used as a base or control for variations. Machine maintenance schedules are based on time of day in relation to user activity and to partially control user activity. Speed in responding to requests is affected by time of day; for example, rush hour turnaround is slower due to the heavier volume of requests and rush hours tend to be the same each day.

A variance supported by time of day is the response time of repair personnel - specifically, their normal working hours. It takes longer to fix a malfunction after normal working hours because of the time required

for repair personnel to travel from their homes to the computer center.

The level of user interaction can be estimated based on the time of day. There is more interaction from 09:00-12:00 and 13:00-18:00. There is more production (operator initiated computer activity) run between 23:00-05:00. Personnel assignments were based upon this data, but a "bulge in the pipeline" frequently occurred at change of shift (18:00) without adequate coordination between shift operators.

While undertaking this analysis, STAG found that in the current system the machine operators were centrally involved in the control of virtually all the nine key variances, through the exercise of a variety of activities. The users and their division coordinators were also identified as central to the control functions - except for dealing with volume of work. The division Control Center Group (CCG), and to a lesser extent the divisional Technical Support Group (TSG) were identified in their maintenance and liaison functions as participating in the variances of job turnaround, "quality input data", "time of day jobs submitted" and "output quality". Management, and in particular, supervisors, were not identified as heavily involved in key variance control. The COD Machine Coordinators, and the senior operator floor managers were also not specifically identified in Variance Control, although it must be assumed that as operators they are centrally involved.

This overall pattern of Variance Control seems validated by the social system analysis undertaken, subsequently to be reported in more detail below. In particular, one interview question asked respondents specifically

for the purpose of interaction with other members of COD. The operator's answers to those questions revealed that CCG was seen to give frequent directives or commands in monitoring machine status and malfunctions or to exchange information with operators in the service of controlling variance in quality and quantity of data, time of day, and volume. Despite the directive style in which CCG addressed them, two-thirds of the operators felt that system maintenance, coordination and scheduling was handled well. Operators reported some information passing back and forth between themselves and the users (mostly by telephone/teletype) in control of scheduling and instruction variances, and that they interacted well in solving problems. Contact with floor managers (senior operators) was seen as overwhelmingly informational or helpful with respect to instructional, equipment and data quality variances; which implies cooperative relationships to technical variance control rather than a hierarchical relationship of vested authority implied in operators relations with CCG. In fact very few operators reported that they "contacted floor managers for approval before action". Fewer operators reported any contact with machine coordinators (also senior operators) and the majority of those who did, noted a "trainer" or "scheduler" role which can only partly be considered direct "variance control" activities. Although operators reported frequent contact with supervisors, few reasons given relate to variance control. Primary reasons given for interacting with supervisors were machine assignment scheduling, vacation scheduling (including days off, etc.), and performance appraisal. Fewer operators reported any interaction with managers and the reasons for contact were vague references to "memos" and "service".

4.) Social System Analysis

These data reported in the preceeding paragraphs were only a part of the result of several weeks learning, planning, interviewing and analysis, which began in the last week of December. The intention of a social system analysis in STS is to examine the human side of the enterprize, both as it affects organizational aspects such as smooth performance and co-operation, task achievement, flexibility and adaptability; and as it affects the individual employee's attitudes and morale.

In a socio-technical analysis, the analysis of variance control permits examination of purely technical solutions together with consideration of social action in the coordination and control of key variances. In this sense the control analysis forms a bridge between technical considerations and social ones.

The social analysis has a symbolic significance to project, such as this one in COD, in that it appears very relevant, and clearly has more direct impact on employees and managers in the system. This impact came in the form of interviews with all employees. The degree of relevance relates to the opportunity for individual employees to express their felt problems and discomforts, as contrasted with the more distant and common problems of the system itself. Although COD employees had been kept informed on at least a weekly basis by their representatives to the STAG, the sense that the project was "getting somewhere" heightened with the prospect that they would all soon be interviewed on a wide range of topics and issues.

Training in social systems theory and methods took place between December 27, 1977 and January 6, 1978. The final interview form was developed between January 3rd. and 12th. The interviews themselves were undertaken between January 16th. and 26th. Analysis began January 26th, and was concluded February 24th. Writing the social analysis report itself was started February 19th, but was begun in earnest March 6th.

Conceptual Training for the Social System Analysis

The first activity included a lecture by the external consultant to STAG on December 27th, dealing with the concept of social "role" as the basic link between organizational requests and demands on employees, and their own individual desires and characteristics. The social system was defined as the network of work-related communication and coordination which is connected by the reciprocal role expectations among system members.

"Relationships" in this network were defined to include the following: (1) supervisors with subordinates, (2) members of the same work groups with one another, (3) members of different groups at the same level, (4) people inside the system with people outside, and (5) the general "climate" of relationships within the system. An additional aspect included is (6) the relationship between the role occupant and his/her job. Job related feelings are strong determinants of morale and can be assumed shared by social system members in the same or similar jobs.

The social system was also described as serving four "functions", adapted from Talcott Parsons' 1954 standards for social stratification. These functions are as follows: Attaining primary system Goals (G); Adapting (A) the system to its external environment for immediate survival; Integrating (I) the system's internal environment for conflict management; Providing the development and maintenance of Latent (L) system resources required for long term survival.

These four "functions" can be addressed by each of the six classes of "relationships" described above, which results in a matrix, or

grid, of functions-by-relationships where each interconnection or cell in the grid can specify a particular social system behavior. Figure IV-5 graphically depicts this conceptual content of the training which the team was encouraged to think about.

FIGURE IV-5Social System ModelRelationships

Functions of Social Systems	Relationships					
	1.	2.	3.	4.	5.	6.
	Superior - Subordinate	Intra-group relations	Inter-group relations	Relations with other Depts.	Organizational Climate	Activities on the Job
G. Goal Attainment						
A. Adaptation						
I. Integration						
L. Latent Resources						

The Interviews

Development of the employee interview. This lecture was delivered again in abbreviated form to the steering committee on January 4, 1978. Meanwhile, using "nominal group technique" (Van de Ven, 1975), STAG had been generating a list of possible questions to be asked in an interview of all of the COD employees and managers. Many of those questions grew out of the "feedback" meetings STAG members had been holding with co-workers. Other items resulted directly from the feelings of STAG members themselves, while some items followed from the lecture material. The remainder of December 27th-28th was spent in coding each question on the list in terms of the four "functions" and of the six "relationships" of the social system model described above. The questions were then tallied in the matrix of relations to functions, to provide STAG with a reference to see what aspects (cells) of the social system model has been give greatest emphasis (perhaps over-emphasis), and which aspects might need to be expanded in coverage.

The January 4th. meeting between STAG and the steering committee introduced the latter with the conceptual material STAG had already received, and it also provided a form of steering committee feedback. The steering committee was uncomfortable with interviews as the primary methodology, they were cautious in the use of sensitive questions which might bias answers either positively or negatively, and they were interested in evaluative data of tangential concern to STAG. Steering Committee agreed with the general plan but urged the consultants to develop a paper and pencil questionnaire to parallel the interviews. The issue at stake was the gen-

eration of quantitative data which could be compared with data from subsequent measurement. The steering committee recommended that one of its manager members join STAG during the final development of the interview for maximum coordination between the two bodies. This was agreed to by all and undertaken on January 6th. A two-hour lecture on interview construction and administration was presented to the expanded STAG by an outside trainer. An interview of some 60 questions was developed during the next 3 days and was finalized with steering committee approval on January 12th. The steering committee, however, insisted on some changes which had the negative consequences of introducing some generalized questions and some "process-created" questions about several individual management employees. Interviewing was to start immediately.

Administering the Interview. The STAG weekly summaries had for several issues previous to January 12th, described progress on developing the interview questions. The issue for the week ending January 12th announced that interviewing would begin that day. The confidential intent of the survey had already been well publicized. The interviews would be identified only by the group to which the respondent belonged. Each interviewer drew his/her sample from a roster in terms of who was available. The interviews were held in private and in quiet locations. The respondent was told the purposes of the interview (to map the social system in COD, to get new information, to check information obtained in the "feedback" meetings, and to do all this with people in COD at the same time) and the method, time, etc. The respondent was given a blank copy of the interview form to follow the questions as the interviewer asked them. Finally, the answers written down were read back to the respondent for approval. The

advantages and disadvantages to interviewing were both apparent during the following week. First, the STAG members acting as the primary interviewers, began to sense that the responses they were getting from operators were different and less vehement from the comments and complaints they had received during the earlier "feedback" sessions. The response of the supervisory member of STAG (who was not interviewing operators) was that the complaints about supervisory evaluation, and the effects of other's work habits which the supervisors heard a lot were not coming through as frequent complaints. The consultants met with STAG, and with the supervisors as a group to discuss these apparent anomalies. Were the interviews becoming a "white-wash" or was there some other explanation? The STAG, meeting together on January 19th. for the first time since the interviewing began, discussed the specific questions. They believed they were not getting the sort of critical comments they had expected. In the case of one question about evaluations, STAG decided that much of the distress they had heard was about the evaluation process in October 1977, immediately following September evaluation; while in January 1978, COD employees seemed, in general, not unhappy with the evaluation methods. (There were, as the first tally would subsequently show, still quite a number of COD employees who were distressed at the unfair distribution of salary increases). STAG also concluded that in general the early comments were from "gripe sessions" where employees were listing their complaints; while the interviews were attempting to find out how employees saw COD activities - both the bad and the good. Under the latter conditions, they reasoned, people would probably be more accurate in identifying the important "distresses" as well as the system's good points; while under the former method, unimportant grievances and real problems might be raised with apparently the same intensity.

They also recognized that the early feedback or gripe sessions were not representative samples of the division, while the interviews were covering the entire division at the same time.

The concern of the supervisors regarding the interviews were of a different nature. They had heard from their representative on STAG that operators were not reporting much concern or distress with days off policy, weekend work, the disruptive work habits of other employees, or with supervisory performance evaluations. An hour's discussion between the consultants and the supervisors resulted in the supervisors' recognizing that their view of employee concern was limited in large part to their contact with operators. This contact as was noted above, is limited almost totally to administration. Supervisors schedule operator workdays and machine assignments, and they evaluate them. Operators would, thus, raise issues regarding these aspects with their supervisors more frequently than other issues. Yet there was no way for supervisors to know which of these aspects really distress their operators. The supervisors agreed that what they were hearing from the current interview reports, might be a valid result after all.

The interviews were long (1½-3 hours long) and there were (with the newly appointed management members) 12 STAG interviewers. The consultants undertook several interviews apiece themselves, but the vast majority were done by STAG members. A total of 107 interviews were completed (response rate in excess of 85%) within two weeks, and by January 26th. the analysis of the data had begun.

The answers to each interview question were typed and then clustered

by the following groups:

Each shift of Operators (day, evening, night), Photo Lab, CCG, TSG, supervisors and staff.

STAG met with the two consultants who described the process of analysing the questions as essentially a tallying one, categorizing behaviors, for each employee group and question. If there were common trends across groups then a summary statement could be made about any given question as a whole. STAG were further encouraged to analyse sets of questions as they were categorized by the social systems model (c.f., Fig. IV-5) described above. Analysis of the data was completed by March 15, 1978.

The Social System Results

The interview questionnaire itself contained a final count of 46 questions clustered into the following categories:

- I. Job
- II. Career Development
- III. Training
- IV. Peers
- V. Other groups
- VI. Management/Supervision
- VII. Suggestions for improvement

The present section summarizing the COD results of the interviews is arranged in order of the above categories.

Jobs. Most of COD employees felt that service to users, and quality of product, were their most important job aspects. A majority of operators on all three shifts reported that the variety and job rotation was the most enjoyable part of their work, yet a third of them also felt that aspects of scheduling of machine assignment was the most negative part of their jobs. About half said that some specialization on one machine was a good idea. Other negative aspects were working weekends, and the uncooperative attitudes of other people around them. Although working conditions were not the major distressors, an overwhelming majority of respondents, when asked about working conditions, mentioned the floor plan arrangement, and noise levels as needing improvement.

Over half the respondents felt that their jobs provide average freedom, and about half felt that their responsibility and authority matches their job classifications. 95% of those answering felt that training could and should be improved...it should be firmly scheduled, with a professional training staff and better (clearer and more comprehensive) manuals.

Communications were a source of much comment. Although half the respondents said they were asked for their ideas, and found their ideas were listened to, three-quarters of the total feel that the exchange of information within COD is still not adequate. Individual feelings about performance feedback was quite negative. Three-quarters of all respondents said they received little or no feedback on their work. A quarter said they only got criticism or negative feedback, while a quarter said they did receive adequate feedback on their work. In terms of feeling fairly treated by management, a ratio of 7:4 said that they personally were fairly treated, but nearly the same ratio also said that others were not treated fairly.

Personal evaluation received mixed comments. On the one hand the frequency of evaluation and the form used were considered good, yet the results of evaluation evoked negative feelings by two-thirds of the respondents. Antagonism of fair treatment in pay raises was leveled at the evaluation program, and there was consternation over the poor work motivation of other workers, especially highly paid longer service personnel.

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- VI. Management/Supervision
- VII. Suggestions for improvement

The present section summarizing the COD results of the interviews is arranged in order of the above categories. The overall results will be summarized in a subsequent section, based on the functions-by-relationships grid presented in Figure IV-5 above.

1) Jobs Most of COD employees felt that service to users, and quality of product, were their most important job aspects. A majority of operators on all three shifts reported that the variety and job rotation was the most enjoyable part of their work (L-6)*, yet a third of them also felt that aspects of scheduling of machine assignment was the most negative part of their jobs (L-1). About half said that some specialization on one machine was a good idea. Other negative aspects were working weekends, and the uncooperative attitudes of other people around them (L-2). Although working conditions were not the major distressors, and overwhelming majority of respondents, when asked about working conditions, mentioned the floor plan arrangement and noise levels as needing improvement.

Over half the respondents felt that their jobs provide average freedom,

*Numbers in parentheses refer to the categories in Figure IV-5, to which the interview responses referred to, as appropriate. These assignments of responses to categories will be summarized below in box-score form in Figure IV-6.

and about half felt that their responsibility and authority matches their job classifications (L-6). Ninety-five percent of those answering felt that training could and should be improved...it should be firmly scheduled, with a professional training staff and better (clearer and more comprehensive) manuals (G-4).

Communications were a source of much comment. Although half the respondents said they were asked for their ideas (G-5), and found their ideas were listened to, three-quarters of the total feel that the exchange of information within COD is still not adequate (I-3). Individual feelings about performance feedback was quite negative (G-5). Three-quarters of all respondents said they received little or no feedback on their work. A quarter said they only got criticism or negative feedback, while a quarter said they did receive adequate feedback on their work. In terms of feeling fairly treated by management, a ratio of 7:4 said that they personally were fairly treated, but nearly the same ratio also said that others were not treated fairly (I-3).

Personal evaluation received mixed comments. On the one hand the frequency of evaluation and the form used were considered good, yet the results of evaluation evoked negative feelings by two-thirds of the respondents. Antagonism of fair treatment in pay raises was leveled at the evaluation program (L-4), and there was consternation over the poor work motivation of other workers (L-2), especially highly paid, longer-service personnel.

II) Career Development Over half (52%) of the employees interviewed had positive feelings concerning career development opportunities (L-5). Positive feelings included chances to take classes during lab time, good equip-

ment to learn with, opportunities to take advantage of, in terms of classes, and available counseling for all types of career planning. Negative aspects included people feeling limited because they had reached the top in their field, no place to go within COD, that one must have a degree to move higher within the lab and that COD management discourages employees from going to school by not allowing time off (L-3). The respondents were almost evenly split on whether they thought their classification growth was in line with their job performance.

III) Training Sixty percent of the respondents felt that the training they received was bad (L-5) or that they gained knowledge through their own initiative and not through any training program (L-6). Specialization on one machine had the advantage of permitting better job training opportunities (G-6), although as mentioned above, respondents also preferred the variety of job rotation. Over 90% of respondents felt that training needed to be improved, with suggestions including standard training schedule, use of professional training staff, and the use of more formal classroom training (L-4), as well as on-the-job training. The training of new employees on an administrative computer system before those employees had been granted security clearance (about six months) was seen as having some negative and some positive aspects by equal numbers of respondents. Negative comments included the development of an unrealistic (i.e., inflated) view of the operators' job as it was done at that location, and the boredom and poor work habits caused by overmanning and enforced idleness at the administrative computer (L-6). On the positive side, it was felt that the technical training itself, as provided by senior operators at that location, was excellent (G-2).

IV) Relations with Peers Asked about how well members of one's section or group worked together, the respondents in the programming and supervision groups reported quite positively. Operators on the other hand assessed working together as only adequate. A question about the effects of others' work habits elicited a number of complaints. Operators reported that people did not do the jobs they are supposed to do (G-2), and no one in authority would attempt to control the situation (G-1, I-1). Fully one-third of the operators said that some people did not work at all and management or supervisors never challenged this. Wandering off, leaving machines, and horseplay were all mentioned as causing adverse effects on co-workers (I-2). Tardiness was reported as a large cause of preemptive and disruptive rearrangement of shift schedules and machine schedules which the operators disliked (I-2). Reports of co-workers not leaving clean machines or relaying information to the next shift were also heard (G-3).

V) Relations with Other Groups Nearly three-quarters of those responding said there was not an adequate exchange of ideas and opinions related to the work (G-4). Operators complaints included communications from outside which were inadequate, inaccurate, redundant and untimely, and that they were told what to do rather than being asked for their opinions (I-4). Many operators did not know the function of membership of either of the COD programming groups (CCG and TSG) (G-3). The operator shift groups considered themselves separate groups rather than together as part of a 24-hour team (I-3). Over a third of the respondents reported that in general the hardware and operating system maintenance, coordination, and scheduling was handled well. In part this was an expression of positive evaluation of the outside contractors (L-4), but implicitly a compliment to the work of the CCG (L-3).

Interaction with the users was mostly through the media of teletypes, telephones and written instructions. Most users were seen as helpful and informative, although some were reported as self-centered or not understanding machine and operator limits and functions. It was reported that user motivation could be more thorough and clear (A-4).

The "other groups" referred to by interview respondents included a wide range of groups, both internal and external to COD. The specific recommendations and suggestions, therefore, were many and varied, but they included more meetings between groups, solicitation of ideas from lower level employees, and technical updates which are centrally created and uniformly distributed (G-4, G-5).

VI) Relations with Management and Supervisors Operators had very little idea where policies and standard operating procedures are generated or implemented. The role of their management, although identifiable, was thus ambiguous (G-3, G-4).

In response to one question "How well do you think your immediate supervisor represents your work group?", the operators on all three shifts complained that they did not know much about their supervisors communications to others outside the work group (A-1). Although some shifts thought the supervisor represented their group adequately, few on any shift really felt confident in their answers. Their supervisors simply left them uninformed as to what was being communicated on their behalf. Receiving recognition for a job well done and being kept informed of ones performance was seen as poorly handled by over 60% of the operating personnel (L-1). Nearly three-quarters report that not everyone in COD was treated fairly by management and speci-

fically by supervisors. Favoritism was frequently cited as a manifestation, and discouragement was the result (L-1).

Supervisory technical guidance for specific pieces of hardware was clear in some areas but unclear in many others (G-1). For instance, in the case of a tape-to-film conversion process, less than 5% reported that the supervisor controlled it. A representative quotation describes the state of this particular operation.

"I think anyone who is feeling important can control the FR-80 at any given time, because there are so many people (graphics engineering, supervisors, photolab) who seem to feel that the FR-80 is their equipment."

Of all the communication they had, operators reported that they were most frequently in touch with their supervisors and with their floor managers (a lead operator position). Three-quarters of the operators said that they had little or no contact with higher management (I-3). Interaction with supervisors mainly involved scheduling, and evaluation of operator job performance (L-1). About 50% of all operators felt positive about their supervisors, while the responses of the other 50% was divided on a ratio of three neutral to two negative. Interaction with floor managers mostly involved seeking help or information to carry out daily job activities (G-2). Floor managers were seen positively by 80% of the operators and negatively by only 20%. Good working relations and helpful assistance were cited as reasons for this positive assessment.

VII Suggestions for Improvement Most respondents wanted less weekend work. They wanted supervisors to have the authority and freedom to run their shift, and for those supervisors to spend more time on the floor as "working" rather than "administrative" supervisors. An official training program

was also frequently mentioned as a necessary improvement in COD. Personnel evaluations, it was felt, should be based on skill and performance instead of personality. These evaluations should be based on current rather than past performance, and should reflect positive as well as negative factors. Employees should be treated like adults, not children, should be clearly told of the expectations on them, and allowed to work out the details needed to get the job done. It was pointed out that stress and pressure on employees created by the job ("nit picking") and the general climate ("you are always wrong") was the cause of morale problems, high turnover, and excessive use of sick leave.

SUMMARY OF SOCIAL SYSTEM ANALYSIS

Figure IV-6 presents the summary results of the interview data in a box-score format. In it are tallied the references to the function-by-relationship categories made in the preceeding results section, while adding to them a plus/minus sign referencing the valence of the answers. Those cells in Figure IV-6 with the larger number of signs (either plus or minus) represent content areas responded to frequently by those interviewed; either because these content areas were covered heavily in the interview questions or because respondents brought them out. The direction of the signs themselves signify the predominant value of the statements made or answers given during the interviews. Thus, for instance, superior-subordinate relations (column 1, Fig. IV-6) received frequent mention, and most of that mention was negative in attitude or feeling tone. Frequent mention was made of the negative relationships with other departments (column 4, Fig. IV-6). Topics dealing with the functions of goal attainment (row G) and development of latent system resources (row L, Fig. IV-6) were frequently the subjects of answers or statements by respondents.

FIGURE IV-6

Summary Results of the
Social System Analysis

Relationships

Functions of Social Systems	Relationships					
	1. Superior - Subordinate	2. Intra-group relations	3. Inter-group relations	4. Relations with other Depts.	5. Organizational Climate	6. Activities on the Job
G. Goal Attainment	== *	- †	==	== +	- +	+
A. Adaptation	-			==		
I. Integration	-	-	==	-	-	
L. Latent Resources	== ==	==	- +	== +	- +	- †

*Each sign in the cells represents the value of interview responses to one item or topic pertaining to that cell.

Apparent from the description of the results themselves in the preceeding section, Figure IV-6 shows supervision to have had a negative impact in both helping attain work goals (G-1) and in developing subordinate employees for the longer run advantage of the division, lab, and for employees themselves (L-1). Relationships with other departments also show this negative pattern (G-4, L-4). Little comment during the interviews was made regarding coordination with other departments to achieve smooth relations or flexibility (A-4, I-4). In general, adaptation (A) and integration (I) are both fairly weak areas, being little mentioned either positively or negatively. Some opportunities are shown in latent resource development as permitted by the nature of the job (L-6), and some freedom in accomplishing day to day job activities (G-6); both of which contribute to satisfaction with the work itself.

In sum, Figure IV-6 presents a picture of an organization which is concerned primarily with problems of developing individual skills and careers (L). This suggests that the functions of communication and coordination between inside and outside, as well as within the COD itself, may have been under-emphasized in COD.

With the social system analysis completed, the Social-Technical Analysis Group (STAG) prepared a report for their steering committee and for the rest of the COD to examine and confirm. This report was drafted, and on April 4, 1978 STAG distributed the report. The extract below is taken from that report and concludes with the STAG's recommendation for change of the COD social system. This conclusion included aspects of all four of Parson's (1958) functions (GAIL) in various forms. On April 4th STAG also announced that it was going out of business to make way for a "design committee," com-

posed of some former STAG members and some new members, to develop and propose an integrated socio-technical design for COD.

Extracts from STAG Social Analysis Report

Generally, the responses show that people like their work, either for the variety of tasks, the people they work with, or the chances for advancement. Many feel satisfaction in the importance of their job and the latitude they have in performing it.

The issues of weekend work, cooperation, recognition, and management "style" generated some of the strongest negative feelings. Here, management is generally line management closest to the respondent - e.g., supervisor or group leader... The desire for informal recognition is related to concerns about management "style." Inconsistent or unequal enforcement of regulations, favoritism in schedules and promotions, and inadequate control of non-performers are examples of complaints... Floor managers could help in day-to-day work situations, but supervisors were seen to be rarely available for such help. The floor managers are doing what some of the operators want their supervisors to do or think supervisors should do...

The survey showed that not working together was a major difficulty and concern. There was little cooperation seen, particularly among peers. When there was cooperation, it was within cliques - not a widespread helping attitude. This not only caused bad feelings towards others, it also shifted perceived work responsibilities from the less cooperative (others) to the more diligent (self).

The desire for improved communications correlates with the general feeling that there is insufficient exchange of ideas, and with the widespread lack of knowledge about Division organization. Ideas seem to be given, not exchanged. Some feel they are not only never asked, but their voluntary suggestions are ignored. There were several useful suggestions for improving communications in the responses.

Many individuals in the Division do not know how the Division is organized, nor who is in the Division. One result is that an idea dies because its owner does not know where to plant it. Generally, work gets done despite this confusion, but it might be more satisfying if relationships were clear. An orientation might remedy this confusion by explaining the relationship of the job to the Division and to the Laboratory's goals.

Many Division personnel felt left out of the goal-setting process. There seemed to be no clear definition of goals. If there are goals, they are not communicated to all...

Critical responses about relationships applied to almost all human contacts, including supervisors, users, peers, other COD groups, and all Computation employees. Respondents at all levels feel that they are last in the pecking order. Many resent the feeling that they are not informed about system changes, improved program facilities, and other things that would make their work more effective.

Although few respondents were violently dissatisfied with division organization, the survey has identified some areas which deserve attention. These area include:

- 1) Weekend scheduling.
- 2) Employee satisfaction, derived recognition, evaluation, advancement, etc.
- 3) Relationships between division members, and with others.
- 4) Communications - information about the job and job changes in both directions.
- 5) Training - formal or informal, but consistent.

Group Process in Social Analysis

The group process experienced by STAG when the social analysis originally began was merely a continuation of the somewhat dispirited behavior of completing the analysis of technical variances for presentation to the department manager, in late December, 1977. The analysis of variance control still needed doing (not being completed itself until mid-February) and was undertaken concurrently with the onset of the social system analysis.

The period between January 4th and 12th, however, marked a change in the group composition and a concomitant change in mutual relations between STAG and steering committee. The initial interview development efforts were presented to the steering committee on January 4th and that body expressed some discomfort with the outcomes. The steering committee thus suggested that one of their number (the manager of TSG) be temporarily assigned to STAG to help the Steering committee stay in closer touch with developments. The result on group behavior was immediate and dramatic. The new management member took the role of group discussion leader and drew the STAG through the concluding set of interview questions. His leadership behavior in itself was a useful input to STAG. He was both well liked and trusted and the leadership style he brought was both sensitive and effective. The closer communication between STAG and the steering committee had both negative and positive aspects. On the positive side the steering committee felt that their interests and concerns were attended to, and the climate between themselves and STAG was for the period of interview planning less adversarial and more cooperative. The negative aspect of the closer steering committee ties was the inclusion of some questions

in the final interview form which were at best irrelevant to the analysis and at worst personally punishing to certain members of the division.

Once the interview form had been approved on January 12th and interviewing had begun, the group did not meet again (except for the discussion of certain inconsistencies during the interviews) until January 25th, when data analysis began. At the advice of the external consultant the interview data were collated by item, and by work group for the first analysis meeting January 25th. The external consultant further advised STAG to divide into small groups to review and summarize the results of one item, and then to report that summary back to the whole STAG. The first few questions in the interview were thus analysed by the external consultant and several STAG members as a model for STAG. On the following day the external consultant left for six weeks.

The internal consultant rejoined STAG for the following six weeks, February 1st to mid-March. He felt responsible for monitoring the small group process for social system analysis recommended by the external consultant. By and large that effort proved fruitless as STAG tended to work on the analysis of each item as a total group, or if divided into smaller groups then the larger group would not accept the small group results without considerable discussion. The result was that completion of the data analysis was delayed as much as four weeks beyond the external consultant's expected completion date. The motives for this mode of working as a total group rather than dividing into smaller groups for data analysis are unclear. The self-limiting dynamics of the larger STAG group behavior have been described above. Since dividing labor into smaller subgroups had been an intended style of working for some time, and had been used effectively on

very short term tasks earlier, the tendency to work as a larger group for the social analysis is further confounding.

The internal consultant struggled hard to convince STAG of the wisdom of smaller groupings for data tallying and analysis to little avail. His role was greatly challenged during this time, and the internal consultant came to realize the ambiguous nature of his place in the STAG. Since the time following the initial team process training in October, 1977, the internal consultant had played a participant rather than expert role. During that six-month period his attempts to monitor group process were often met with apathy if not derision. He felt trapped by the ambiguity of the role, and he felt that STAG felt trapped with him because they never had the opportunity to decide if they wanted team building or to have a "process consultant." Given subsequent events it would appear that it was this lack of STAG influence in the decision to undertake the initial process training that engendered the resentment of STAG members to the internal consultant's process interventions.

STAG relationships with the steering committee reverted during the data analysis period to the sort of polite but adversarial confrontation which had characterized their meetings before the interviews with division personnel. Because the technical analysis was being reviewed during this same period (February and March) the steering committee had more to react to than simply the social analysis results as they unfolded. The technical analysis was criticized as being unclear and general, while the social analysis made everybody nervous until results could be phrased in a way that adhered to the interview content and were not sweeping criticisms or glittering generalizations. To further confound matters, the interim division manager had strong feelings about both the technical analysis and

the social analysis which were sometimes at odds with the steering committee views. A complicated process developed in which all parties came together periodically to work differences out. This process was preferred by all concerned when compared with subgroups or individuals representing various factions to work among themselves. It has been speculated that this preference was based on a general distrust among the members of the separate groups.

When the outside consultant returned in late March, STAG was prepared to complete the social system report. STAG had divided themselves into three subgroups, one was writing the social summary, one was assigned to seeing that appropriate appendices to the social report were accurate and consistent, and a third group was rewriting the technical report.

The computations department manager had visited the STAG meetings on several occasions following their presentation of the partially completed technical analysis in late December. STAG members suspected that he was dismayed that their progress was so slow, and that the project was taking so long. He had visited on one occasion, mentioning that he expected to be able to stay for an hour and a half. STAG had, that day, been rewriting the reports in their three subgroups. The department manager had left after 45 minutes and he had seemed as uncomfortable with his visit, as STAG felt having him there. In a meeting with the two project consultants in late March the department manager did express some concern over the time being spent, but he was also sympathetic to the consultants' argument that much of the delay and confusion was caused by the management turnover and STAG efforts to reestablish support for the project. Delays caused at that point put STAG behind schedule and made the external consultant's six-

week absence more crucial than it would have been.

On April 4th STAG finally issued a memo to COD announcing that the Social and Technical Analysis Reports had been completed and they had been approved by the steering committee. They announced that as a functioning body STAG would be retired to be replaced by a design group who would use the reports as the basis of a new work organization for COD. The week of April 4th was noteworthy also because the selection of a new COD division manager was announced.

Even at that time of "good" relations between STAG and the steering committee, the latter group was concerned about the amount of trust between them. They concluded that the joint relationships needed to be worked on. A possible solution proposed was the disbanding of both groups and a reformation of a single design team, drawing some members from both prior groups, with a maximum size of 12. This new combined group could report directly to the COD management. The first order of business for such a group, it was proposed, was team building, despite their resistance to concurrent attempts by the internal consultants to help monitor group process. STAG, it was clear, was well aware of the importance of early recognition of group process, and the impact of "owning" that decision. They were very sure that they wanted training to enable the proposed design group to function with a minimum of friction and a maximum of teamwork.

The Redesign of COD

The design process actually began in a formal way in January, 1978. Tentative first steps were taken during the time STAG was still struggling with the data analysis of their interviews. In late January, STAG met to discuss their future regarding COD design. In that meeting they listed their concerns for the design process and their relationships with the steering committee, the problems of the interim division management, as well as an agenda for a pending joint meeting with steering committee on the topic of design. At that time COD was still headed by an interim manager, and a permanent successor was not in sight. Although this stand-in manager was interested in the STS process and supportive of it he was also a strong and vital force on the COD during this time. Because of this STAG were interested to see that the interim manager's influence on the design process was to be anticipated. They wished to prepare for that influence as early as the impending joint meeting mentioned above. STAG also realized the value of starting this preparation early because the external consultant would be absent for six weeks. Any assistance provided by the outside would have to be at the current time rather than later. The external consultant lead STAG in a discussion of the principles of STS design (Cherns, 1976) and they talked about his ideas about the process of design in COD and its probable consequences.

The joint meeting between STAG and steering committee which followed was not altogether a successful preview for design issues because some steering committee members were too interested in the pending analysis of the social system data to attend for long to abstract principles of design, or to seriously consider any methods of reorganizing for design and for improving relationships between STAG and themselves.

The issue of design and planning for design rested for over two months until April 1978, when the social and technical analysis were completed. At that time the new "design" committee (DC) was formed of seven continuing members of STAG, two members of the old steering committee and an assistant supervisor. At the same time the new permanent division manager decided to retain and expand the steering committee to advise him on the design recommendations developed by DC. The new manager had no previous experience in COD and he would need some period of adjustment to the operation of the division as well as to the ongoing efforts. The steering committee, he reasoned, would help him in understanding and evaluating the work of the DC.

In an early meeting on April 13th, the DC was concerned (as their predecessor STAG had been) with relationships with the steering committee. They were anxious to find a mutually supportive and cooperative attitude because the ex-STAG members were still smarting from the process of obtaining approval for the Social System report - a process described as "a series of rejections which finally added up to grudging acceptance." They wanted to meet with the steering committee and draft a letter or contract of intent to cooperate.

Other pressing items of business for DC was to clarify the role of the external consultant, to specify the design steps, and to review the principles of decision making, and group leadership. The group process for DC, it was decided, would be their own responsibility. The internal consultant for STAG was leaving the lab about the first of May and, although he had introduced his replacement to DC, they had chosen not to use the replacement's services.

THE DESIGN

The DC had clearly learned something of contracts from its predecessor STAG. In its first meetings in mid April, it drafted statements of expectation for its consultant, for the steering committee, and for itself. These expectations were modified with input from the consultant, steering committee and division manager. The DC met three days a week for design work and one day weekly for discussion with the steering committee. In addition to that weekly meeting, the steering committee sat with the DC for the first 30 minutes to hear the previous day's work. The steering committee thus maintained closer contact with the design committee than with the STAG. The DC issued memos to the COD employees on a "as needed" basis (roughly weekly for a month), in which ideas and proposals were presented and suggestions were sought. No actual shift-wide or divisional meetings were held to discuss the redesign proposal as it was being developed.

The initial design process itself was a succession of different cuts at the same target, all of which eventually converged on the initial proposal. Among the various initial design perspectives used by the design committee, were the joint optimization of the social and technical requirements, as identified in the analyses, the use of a list of 12 principles of design (Cherns, 1976) against which to test any proposals, a set of ideal proposals for COD changes generated by individual DC members, and a list of specific change areas to address such problems as working environment, training, days-off scheduling, and so forth. The DC worked on one or another of these perspectives for three weeks, frequently working on a number of them at once, by dividing the labor up among themselves. A proposal, including alternatives, for division redesign was distributed to the division (several copies to each work group) by early May. The second process was that of multiple,

overlapping discussions among COD employees, over the course of several weeks. For three weeks, discussions were held in the division, and in the end the DC collected all the reactions and suggestions to assemble an interim proposal for circulation.

During June the division manager and the steering committee continued to review the interim proposal and to make suggestions to the DC. The manager, for instance, was able to tell the DC what he wanted changed and why. He changed little of the proposal, but made his personal objections quite plain. By early July the DC was writing the proposal for a final time for submission to the steering committee and division manager on July 20th. The manager considered the alternatives proposed and made his final decisions on what was to be. The proposal was distributed to COD (several copies to each group). A hallmark of the design was its development within the principle of "minimum critical specification" which forces the DC always to describe what was necessary, but only what was necessary. This guiding principle was paramount among those applied to the design process and was manifest in its effects, through to the final design.

The design proposal although discussed and modified from its original form in the preliminary version of early May, was basically the same in July. Everyone interested in doing so had a chance to comment on it. In the main, those comments resulted in better understanding for the questioners, and better justification for those answering. Although the steering committee's comments were more specific, they were also mainly editorial improvements and matters of consistency, rather than fundamental changes. The division manager suggested some major changes to the proposed redesign during the period May-July, and spent much time developing and discussing these with

the DC, steering committee, and division personnel. In the end he accepted the design in principle, and took responsibility for implementing the project.

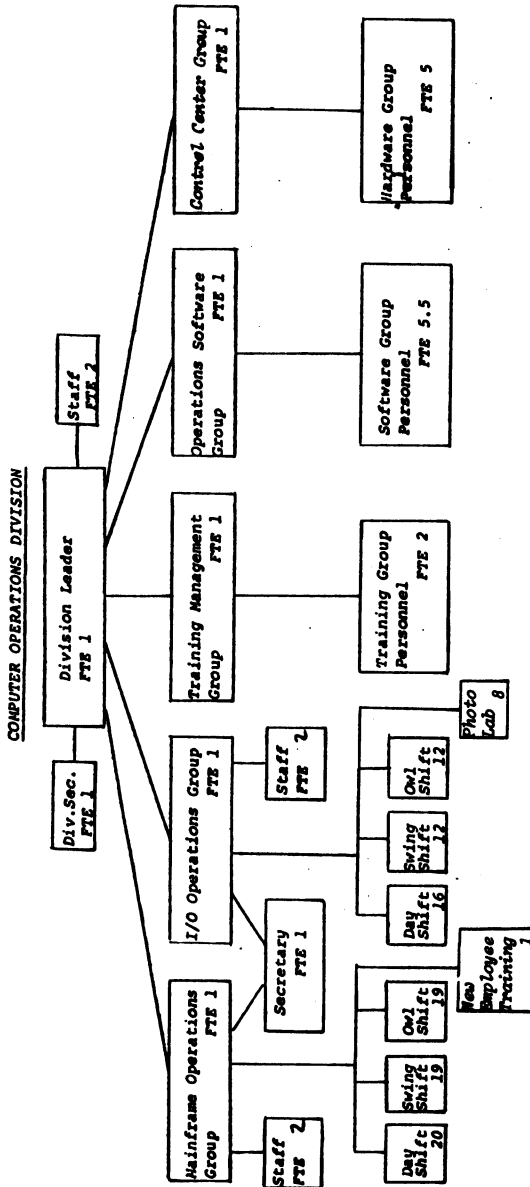
After the division manager took it on, the resulting design was still clearly rooted in the socio-technical analysis, and specifically justified in those terms in the final proposal document. The design was clearly intended to attack the issue of greater morale and motivation by reorienting the management of COD, not merely to system maintenance as a stochastic process, but to a highly variable user service/operation as well.

The analysis had characterized operators as responsible for controlling many key variances in the process of transforming data to user requirement, and they had previously been managed as doing a deterministic, programmable task. It follows that operators would sense this mismatch and would leave to find jobs in which they could be important contributors, or stay in COD and define themselves as unimportant, replaceable elements among the managers, programmers and control clerks who were really the important ones.

The STS design addressed the control of key variances and the development and maintenance of operator staff as a valued and necessary resource. The design achieved these aspects in balance with COD managements' sense of appropriate delegation of authority.

The details of the STS design involved a reorganization of COD and some physical relocation of hardware, and personnel. Figure IV-7 shows the new structure. This reorganization included a formally recognized training function, and an operations oriented line-management hierarchy, divided into sections, "I/O" and "mainframe", each with its own senior supervisor reporting to the

FIGURE IV-7



COD manager. This separation of operations into two was intended to provide both enough stability and fixed jobs to promote operator competence, and enough difference to enhance operator sense of variety. Operators would be able to transfer to another unit after attaining competence in one.

Another important aspect to the design were suggestions for reducing weekend working either to all weekends on overtime or to 2/3 weekends off. The design also included suggestions that the style of management become more participatory, more direct in communication, and more involved in employee development. The two senior supervisors' work week was set at four ten-hour days to permit joint coverage of one supervisor for the other and to permit both time to visit with employees on all three shifts. Improvements in the communications with users were also recommended and an organizational role was proposed to route such communications directly to where they were needed within COD. Improvements in environmental aspects of use of industrial chemicals, noise, lighting, and ventilation were also proposed. The proposal itself is contained in Appendix IV- .

IMPLEMENTATION

The task of putting the COD design in place has been largely completed (February, 1979). The process of doing so, however, has proceeded from the time of the final proposal in July, 1978, when the division manager decided on a process of improving the supervisory and management functioning, in which all COD employees would be permitted to bid for the new leadership roles created by the design. Furthermore the implementation process is not presently complete and will not be complete until the training positions and training organization have been staffed and charged with responsibility, sometime, in 1979.

Implementation took several forms. The DC attempted to specify how their proposals should be carried out, but these attempts were frequently met with reminders by management and the consultants of the principle of "minimum critical specification." The design team eventually came to a position of suggesting several ways of proceeding with a particular recommendation, but leaving final decision to the parties specifically involved (including some who were yet to be appointed).

Implementation was also a product of choosing the senior supervisor for mainframe and I/O units. In this choice, the division manager confirmed the proposed management philosophy of participation and sensitivity to operating personnel. Together these two senior supervisors (selected in October, 1978) began the process of planning and implementing the remainder of the design of operations. Meetings were held between the two senior supervisors and the operators and shift supervisors every two weeks. These discussions covered current progress on the design and employees were also invited to take "pot shots" at past events and future possibilities. The division manager invited bidding on the new shift supervisory position and the senior supervisors interviewed all applicants. They were most interested in the applicants ability and interest in getting along with others, as well as the usual criterion of technical competence and ability to learn. Once the selections had been made (all from within COD), the senior supervisors invited operators to voice their functional operations choice (I/O or mainframe), and their choice of shift and/or supervisor. There was little problem in this phase of implementation and the groups self-selected in appropriate numbers without much external coordination. Implementation of supervisory changes also included finding work and creating useful jobs for those ex-supervisors who were counseled not to seek the new supervisory positions. Retention of

staffing levels and job grades had been an original condition of STS project sanction, so equivalent jobs had to be found for these ex-supervisors. They have proven a benefit in staff positions to the senior supervisors in technical planning and STS design implementation.

The senior supervisors continued their bi-weekly meetings until January, 1979, when the shift supervisors actually took over the new two-function operations design. These meetings were perhaps more open and candid than anything previously in COD. The senior supervisors had not been previously engaged in either the STS analysis or design efforts. They reported that some employee comments made during their bi-weekly meetings were critical of the communications efforts during analysis and design, and some were critical of the design itself. A majority of employees, however, seemed to be reasonably content with the prior communications and satisfied that the design would be an improvement.

Several delays in implementation were created by slow or inconsistent policy interpretation by lab staff department units. In particular, the selection of shift supervisors was delayed (thus delaying operator self-selection of function, and COD supervisory training) nearly two months, by an unresponsive compensation system in lab personnel which would not initially allow new supervisors to be appointed at differing entry pay levels.

Training has been an important implementation device in the COD design, not only in what it has done (knit the new management team together in a December off-site session), and what it will do (in creating an excellence in operators' ability and enhanced self-esteem), but also in what it has not done. Strategic decisions by the division manager have left the staffing of

the COD training function for later, and the effects of this decision are being felt only weeks into the full operation of the new design. After only two weeks on the job, shift supervisors were discovering that there was "...a hell of a lot more to supervision than they had originally thought," and there were some laments that training in human relations and team building, with the rest of the COD management, would be better sooner than later. More serious, however, was the shortage of trained operators within each of the two operations functions to manage all stochastic events as they occurred. Within days of undertaking the new design, operators were being lent from one unit to another and being asked to work overtime to handle crises as they occurred. Although operators are in general optimistic about the new design, there are protests from some as they continue to be interrupted in their own work to be borrowed by another unit. Training to bring all operators up to minimum competence levels for "normal" stochastic events is urgently required.

Implementation has also included the physical changes to move I/O equipment and facilities together in one area, and to rearrange management offices to be as close to the operating units as possible within space limitations. These changes spanned the period October, 1978-January, 1979. Implementation of environmental improvements, such as noise abatement have not yet been effected.

Results to Date

The senior supervisors report that the design, at this stage, is seen by COD personnel as a set of suggestions rather than dictates, and they feel that the flexible implementation strategy has been a real benefit for system ownership of the changes. These supervisors also see their roles and their

staff resources as permitting a real long-range planning function with the larger computation department, which had never existed in the past. They are optimistic about the long run and pragmatic about the present short term limitations on operations flexibility because of under-qualified employees.

Operators themselves are pleased with the new work schedule, which permits them two out of three weekends off. This is the most visible benefit so far. Changes in the physical layout of COD are seen as yet incomplete, although generally in line with operator interests. Operators seem willing to try the new division structure and initial reactions to it are largely favorable, ignoring the temporary lack of internal resources to cope with stochastic events.

The division manager stated in October, 1978, (in a report to his department manager), that STS accomplished a completely open process of dealing with problems, and the delivery of a design proposal and implementation plan. It also provided for a better informed organization. Costs of the participative STS approach, on the other hand, were: higher expectations by employees than could be delivered, less than total employee commitment to the final product, and an inordinate amount of time to complete (10 months) plus a high internal labor input (over five man-years). In sum, the COD manager feels that the final product was well thought out and of high quality, and that it has a high potential for success.