AN APPLICATION OF SOCIO-TECHNICAL SYSTEMS ANALYSIS TO OPERATIONAL AUDITING METHODOLOGY: THEORY AND APPLICATION

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AN APPLICATION OF SOCIO-TECHNICAL SYSTEMS ANALYSIS TO OPERATIONAL AUDITING METHODOLOGY: THEORY AND APPLICATION

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PREFACE

Internal auditing emerged early in the Twentieth Century as a subsidiary activity of accounting (Sawyer,1981, p.18). Internal auditors were usually employed in the accounting department and checked routine accounting activities. Their primary concern was compliance with financial accounting controls.

Over more than five decades, internal auditors' responsibilities have grown to include evaluation of operations and management controls. This evaluation encompasses what have come to be known as the "Three E's" : Efficiency, Economy, and Effectiveness (Morse, 1971; Nich, et al., 1987). According to Morse (1971) the purpose of Operational Auditing is "to identify opportunities for greater efficiency and economy or for improved effectiveness in carrying out procedures or operations."

Internal Auditing has not, however, always succeeded in its new role as Operational Auditing. Nich, et al. (1987) state that two of the reasons for this lack of success are that "internal auditors are neither organizationally positioned nor particularly competent to play a broader role [as operational auditors]" (p.4). Nich, et al. (1987) recognize the relevance of attempting to evaluate efficiency, economy, and effectiveness. They state, however, that operational

auditors cannot always perform that function because of deficiencies in extant operational auditing methods. They believe that the deficiencies stem in part from the transactional orientation in Operational Auditing methods that has been carried over from Financial Auditing methods.

One obvious solution to the problem of deficient methodologies, and one proposed by Nich, et al. (1987) is to adopt various methods of other, related disciplines. Two areas they suggest are Information Systems and Industrial Engineering. Other disciplines could be suggested. This paper, however, proposes the adoption of one particular methodology, Socio-Technical Systems Analysis (STSA), as an appropriate methodology for Operational Auditing.

STSA is a design and analysis approach that attempts to jointly optimize both technical and social system needs of the organization. "The STS approach views the organizational control system as a network of interacting and interdependent subsystems" (Thomas, 1985). The four steps of a Socio-Technical Analysis are the Organizational Scan, the Technical System Analysis, the Social System Analysis, and the Design, Analysis, Redesign Effort. The four steps systematically link a study of the organization's goals and objectives to an analysis of policies and procedures and, ultimately, an identification of problems and possible solutions.

Chapter I of this paper will discuss in detail the extant operational auditing methodology. Chapter II will discuss in more detail the goals and objectives of opera-

tional auditing, and possible reasons why the goals and objectives are not currently being met. The progress of Operational Auditing toward a more systems oriented view of the organization is demonstrated.

Chapter III of this paper will present the theory and background of STSA, and STSA is proposed as a methodology that could be incorporated into Operational Auditing methodology in order to alleviate some of the existing problems. Chapter III includes the rationale for proposing STSA as an Operational Auditing methodology. Chapter IV will present an example of the STSA process adapted for operational auditing use.

I would like to take this opportunity to express my thanks to a number of people who have helped me along the way. First, to Dr. Maryann Mowen, who encouraged me to apply to the Accounting program and to pursue my dreams. Also, to Dr. Groff, Dr. Lau, Dr. Patz, and Dr. Durkee for teaching me so much and encouraging me to higher aspirations. Thanks to Mary Sheets, for her invaluable insight into the "real" world of internal auditing, and to Jeff Johnson and Steve Garner for their invaluable insight.

Special thanks go to my committee members, Dr. Lacy and Dr. Armstrong: to Dr. Lacy for permitting this project in the first place, in the face of grave reservations, and Dr. Armstrong for listening to endless soul searching and teeth gnashing at the beginning of this project when I was trying to sort it all out. I also owe a debt to Dr. Armstrong for getting me interested in the area of auditing in the first

place.

My deepest gratitude goes to my Advisor, Dr. Mike Thomas, for introducing me to Socio-Technical Systems Analysis, for having the patience to learn about internal auditing, for sharing my enthusiasm for this project, for helping me sort out some of the more gruesome details, and, most of all, for having faith in me and being a true friend. As is typical in a research work, I have more than once fallen into the morass: thank you Dr. Thomas for pulling me out.

Finally, my thanks to Jeffrey McKeage, who, despite rumors, did not go to Illinois merely to get away from home while I completed this work. Our phone bills are testimony to the extensive technical advice he has given me as well as invaluable moral support.

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CHAPTER I

INTERNAL AUDIT METHODOLOGY

Introduction: Internal Auditing Functions

Internal auditing is an increasingly important function in businesses, yet because it is a relatively recent development, some confusion exists as to its exact role within the organization. The internal audit function is to some degree prescribed by the management of the particular organization within which it exists, and so no definition or description of the function should be considered absolute.

The Institute of Internal Auditors (IIA) furnishes the following definition of internal auditing:

> Internal auditing is an independent appraisal function established within an organization to examine and evaluate its activities as a service to the organization. (Brink, 1982, p. 3)

Internal auditing exists to assist management by examining activities in relation to organizational goals and objectives. Thornhill (1981, p. 29) states that the internal auditor provides "objective analyses, appraisals, recommendations, and pertinent comment" concerning the activities reviewed and the congruence (or lack thereof) of activities with goals.

Thornhill further states that another way to think of internal auditing is as a control function which examines

and evaluates other controls. He classifies these other controls as pertaining to organizational structure; policies and procedures; accounting and historical records; performance standards; and reporting and the information system. The internal auditor determines whether the organizational structure promotes efficiency and effectiveness through policies and procedures that are economical, adequate, understood, and followed (Cadmus, 1964, p. 13). Similarly, the internal auditor is concerned that standards exist for measuring efficiency in the resources used by the organization (Brink, 1982, p. 14). Internal auditors also review the reliability and integrity of financial accounting information, as well as the means used to report such information within the company (Brink, 1982, p. 44).

The internal auditor pursues his examination of controls through the avenues of financial and operational auditing. Internal auditing started out in the early 1900s when "internal auditors were usually employed in the accounting department where they checked routine financial activities. They sought to determine whether other employees were complying with financial and accounting procedures, whether assets were maintained under appropriate security, and whether there were any indications of fraud or other wrongdoing" (Sawyer, 1981, p. 18). Financial auditing is primarily concerned with internal accounting control and retains a pronounced similarity to public (external) auditing. Indeed, internal auditors may work closely with public auditors to ensure an effective internal control

system.

Management soon realized, though, that the internal auditor's unique knowledge both of the business and of accounting controls made the Internal Audit function a suitable candidate for expanded responsibility in evaluating operations and administrative controls. Internal auditing provides an independent viewpoint and, due to the its interaction with diverse components of the business, can provide a department's management with information it needs to formulate a more accurate picture of its role within the company. Brink (1982, p. 4) notes that "internal auditors who do their jobs effectively become experts in what makes for the best possible design and implementation of all types of control."

Within both financial and operational auditing, internal auditing is concerned with three basic issues. The first issue is whether controls have been devised and implemented that will help management attain the organization's goals and objectives. This necessitates an understanding on the part of the auditor of the goals and objectives of the entity under audit. Only with such an understanding can the internal auditor delineate which controls are necessary, and which types will be effective in achieving particular control objectives.

Once the internal auditor determines that existing or proposed controls are appropriate, the second function is to test the existing controls for compliance. Even though a control mechanism is theoretically effective, it will not in

reality be effective unless it is operating as intended.

Finally, the auditor evaluates the quality of the entity's performance in carrying out its responsibilities. This evaluation is intended to "ascertain whether the organization's objectives and goals have been achieved" (IIA, 1978, p. 17; Brink, 1982, p. 42). This evaluation extends to the organization's strategic goals and objectives (Thornhill, 1981, pp. 29-30) - or, as Campfield notes, the internal auditor "review[s] and evaluate[s] management's planning and performance at various levels of responsibility" (p. 33). It is in this area that internal auditing shifts from a departmental (functional) perspective to an inter-departmental (organizational) perspective (Sawyer, - 1981, p. 114).[1] The rest of this chapter discusses the methodology used to accomplish the internal audit functions.

Internal Audit Methodology

The audit programs for both financial and operational auditing tend to follow similar formats, which are related to the more general internal audit objectives and functions discussed in the previous sections. Since numerous authors have proposed various partitionings of the audit process, a brief discussion of these divergent (yet similar) viewpoints is necessary.

Cadmus (1964), Sawyer (1981) and Thornhill (1981) all promulgate four major steps: Familiarization (or Preliminary Survey); Verification (or Field Work); Evaluation and Recommendation; and Reporting. Morse (1971) gives four

steps also, but they are the Preliminary Survey of the Activity; Familiarization (studying the charter or assignment of responsibilities); a study of the Policies and Procedures of the entity; and Reporting of Results. This list could be considered deficient as there appears to be no link from familiarization activities to the drawing of conclusions.

Brink and Witt (1982) delineate seven steps in the audit process: Familiarization (in the office); Familiarization in the Field; Verification; Analysis; Evaluation; consideration of means to achieve greater effectiveness; and prompting management to implement needed changes. Kropatkin (1984), however, provides the most unwieldy list with thirty-nine steps in the audit process.[2] These steps can be categorized into the following four stages: Preliminary Survey; Survey in the Field; Verification; and Summation.

From reviewing these lists, a pragmatic conclusion might be that the internal audit process consists of four necessary steps. These steps would most likely take the form of those promulgated by Cadmus, Sawyer, and Thornhill. Within the basic categories of Familiarization, Verification, Evaluation and Recommendation, and Reporting all of the other lists could be classified, without omitting any necessary activities. Having reached this consensus, each step will next be discussed in detail.

Step I - Familiarization

A framework for this initial survey is the management

control system (figure 1). The elements of this system are used as the criteria in identifying problems - a problem is considered to be a deviation from the accepted standard. Types of problems are the lack of a needed control, a control that is not complied with, a control that is not cost effective, or a general lack of efficiency and effectiveness in operations. A production process that includes no inspection of the finished product is an example of a missing control.

Kropatkin, (1984, pp. 22-33), in discussing Familiarization, notes that the work done during this step can be crucial to the success of the audit. During this step, the auditor determines the purpose of the audit (compliance, financial attestation, internal control evaluation, operational, etc.) and the desired result of the audit work (i.e., a list of internal control weaknesses). This is also considered the time to plan the length of the engage ment and the personnel needed to complete the engagement. While Cadmus, Sawyer, and Brink and Witt treat these decisions as more or less given, Thornhill and Kropatkin emphasize the unique nature of each audit situation and the need to carefully assess the goals of the audit at the beginning of each engagement.

Once the auditors know what is to be accomplished, a schedule is set for each audit step's expected completion date and audit report issuance. The Director of Internal Audits will assess the manpower needed to complete the project, and will assign personnel accordingly. This

FIGURE 1. THE MANAGEMENT CONTROL SYSTEM[a]

Area	Element
Organizational Control	Organizational Chart Job Descriptions Procedure Manuals Stated Corporate Objectives
Planning and Information System	Long-range Planning (Strategic and Operational) Operating Budgets Cost Accounting Systems Cost Controls
Asset Management	Liquid Asset Control Credit and Receivable Control Inventory Control Capital Budgeting System
Marketing System	Product Planning Market Research Sales Forecasting Sales Analysis
Production System	Production Planning Quality Control Labor Relations Purchasing and Procurement

includes not only allocating appropriate man-hours, but assessing any particular or unusual skills or knowledge needed to perform the audit adequately. Arrangements are made for work space for the auditors, if necessary.

Another characteristic of the Familiarization step is the performance of background work in the audit office. This would include reviewing the permanent files pertaining to the entity under audit. Included in these files would be the entity's policies and procedures, it's charter or statement of authority, flowcharts on the entity's procedures, and prior years' working papers as well as the results of any previous audits. The auditors should pay particular attention to previous audit findings that have not been satisfactorily resolved.

During this step the auditors should also gather any industry or segment information that would be pertinent to analytic review procedures or trend analysis. If the auditor has access to them, he or she should review documents used by the auditee as well as reports (such as cost variance reports) available to the auditee. Also, the auditor should prepare a guide for the staff auditors in areas that will need special attention.

During this step, the auditor will review the entity's goals and objectives. It is at this time that the auditor asks "what could be wrong" and seeks to answer this question as well. This searching for problems must be tied to the entity's goals and objectives, and should lead to theories about the source of the problem which can then be tested.

It is during Familiarization that the internal auditor goes to the site and starts to question the auditees. Cadmus (1964, p. 26) states that, in Familiarization, "... the emphasis should be on discussion and learning about what is being controlled." The auditor is trying to learn the objectives of the entity, how the entity works to accomplish these objectives, and how the entity determines results (success or failure) (Cadmus, 1964, pp. 25-26). From asking what is done and how it is done, the auditor might also inquire "Why is this done, and why this way?" (Sawyer, 1973, p. 126).

The Familiarization step is intended to delineate the work for the Verification step - the auditor, during Familiarization, should be forming an initial impression of the entity's strengths and weaknesses, and this impression will later be tested through the gathering of supporting (or refuting) evidence. Kropatkin (1984) advocates that the auditor try to put himself in the shoes of the auditee, continually asking how, if he were an employee, would he try to "beat the system." Morse (1971) encourages the identification of key features which appear difficult to control and susceptible to break-down, with attention later focused on these key aspects. Gathering and organizing this information is sometimes facilitated by the use of a Record of Impressions (figure 2).

In order to identify (tentatively) these problem areas, the auditor asks questions of the auditees and observes daily operations. The auditor will also usually make a

flowchart of the entity's operations and document flow as an aid to identifying control weaknesses.[4] According to Morse, (1971, p. 43), some questions that the auditor will want answers to are:

- does management use operating standards and goals?
- is there a lack of clarity in written instructions?
- are the personnel capable of performing their assignments?
- do responsible parties fail to accept responsibilities?
- is there duplication of effort?
- is there improper or wasteful use of funds?
- is the organizational structure cumbersome or extravagant?
- does wasteful or ineffective use of employees exist?
- are there work backlogs?

This list is not exhaustive - for example, the Control Questionnaire in Figure 3 lists more specific questions that might be asked during an audit of a manufacturing entity.

An example of Familiarization in an operational audit setting might go as follows: the Production Department's goal is to produce 5000 widgets per week. The department is sustaining an unusually high rejection rate. In observations and consultations, the internal auditor has noted indications of a high turnover rate. One reasonable theory is that the rejection rate is high because the workers are not very familiar with the operation of the machinery. Thus, we have a problem - too many rejections -which may be

This record documents the auditor's impressions from observations and interviews conducted during the Familiarization Stage.

	Yes or No
Employee Moral	
Do employees seem to have a good attitude toward their fellow employees, their jobs, their supervisors, and the company?	_____
Do they accept their assignments readily?	_____
Do they appear to support departmental and company goals?	_____
Working Habits	
Do people appear to be working at a reasonable tempo?	_____
Do they appear to be conducting an excessive amount of personal business at work?	_____
Are working hours, lunch hours, and coffee breaks observed?	_____
Is supervision sympathetic toward employee complaints? Is supervision willing to take appropriate corrective action?	_____
Does the manager seem to keep the employees informed?	_____
Organization and Staffing	
Does the organization seem to be well organized to accomplish objectives?	_____
Are tasks segregated properly?	_____
Does work appear to flow in an orderly and economical manner?	_____
Do employees appear to be working within their job classifications?	_____
Do new employees appear to be receiving sufficient orientation and training?	_____
Supervision	
Do supervisors appear to know their jobs, and do they have the respect of their employees?	_____
Do supervisors seem to be exercising control and providing direction to employees?	_____

FIGURE 2. RECORD OF IMPRESSIONS[5]

Interface with Other Organizations

Does the organization seem to communicate effectively with interfacing organizations? _____
Are there any obvious conflicts? _____
Does there seem to be evidence of genuine cooperation? _____

Working Areas

Do working areas seem to be properly laid out and maintained? _____
Do location, noise levels, lighting, temperature, and house-keeping seem adequate and lend themselves to an effective operation? _____
Does machinery and equipment seem to be properly maintained? _____
Do employees seem to have adequate equipment? _____

In the following space explain any adverse ratings. If specific deficiency findings appear relevant to any of the adverse ratings, reference them.

FIGURE 2 (CONTINUED)

Administration

What means are used for recording employees' attendance?
What means are used for recording employees' time charges?
What means of monitoring are used to ensure the accuracy of the attendance records and time charges?
How are attendance and labor hours balanced?
What is the basis for redistributing labor charges from pool work orders to ultimate work orders?
What methods are used to control payments to suppliers?
What methods are used to safeguard assets and facilities?
How are the entrance and exit of personnel controlled?
How are the entrance and exit of materials controlled?
How are valuable documents controlled?
How is the need for repetitive reports determined?
How are telephone and telegram expenses controlled?
How are files kept up-to-date?
How are insurable valuables determined?

Production Services

What methods are used to schedule and control the manufacture of assemblies?
How are behind-schedule conditions determined and reported?
What assurance is provided that current, accurate planning documents (shop orders, tool orders, etc.) are used?
What provision is made that the latest blueprints will be used?
What are the methods used to forecast needs for component parts and other materials and supplies?
What provision is made for scheduling and taking cycle inventories?
What methods are used to evaluate employee productivity?
What provisions have been made to procure materials and services at the most favorable prices?
What provisions have been made to account for and safeguard severable fixed assets?
What provisions have been made for issuing, safeguarding, and accounting for standard tools and supplies?
What provisions have been made to identify tools?
How are tools inventoried?
What provision has been made for preventive and corrective maintenance?

Production

What means are used to control vehicles and gasoline and to provide for appropriate maintenance?
What provisions have been made for the detection, accumulation, and disposition of scrapped and surplus materials?

FIGURE 3. CONTROL QUESTIONNAIRE[6]

Production, continued

What means are used to ensure the prompt shipment of completed assemblies?
What methods are used to expedite the receipt of parts and the reporting of parts shortages?
What means are used to maintain parts and stock bins?
What provision has been made to detect the excess usage of material?
What are the methods employed to control high-value stock levels?

Quality Control

What methods are used in the inspection of assemblies to assure compliance with quality standards and engineering drawings and specifications?
What records of rejection are maintained?
What are the procedures for reviewing and evaluating discrepant parts and materials?
What provision has been made for the inspection of production tooling?
How are production and inspection stamps controlled?
What provision has been made for the certification of gauges and equipment?

FIGURE 3 (CONTINUED)

controllable by the company (perhaps through better training of new workers). The auditor's initial impression regarding the problem and its cause will come from the Familiarization step. At this stage, however, the auditor has only a theory that this is the problem - or, more usually, a few theories about possible sources of the problem. He or she will have to gather more substantial evidence before being convinced of this theory's validity.

One final observation about the Familiarization step is that it resembles the evaluation of the internal control system that is performed prior to substantive testing in public audits. A primary goal at this stage is the determination of which aspects of the management control system can be relied upon and which cannot. The difference, however, is that in a public audit, an internal control weakness would lead to more extensive substantive testing, since the main goal of testing the internal control system is to determine whether the system will produce reliable evidence. In internal auditing a control weakness is an audit finding in itself, since a main goal is to evaluate the effectiveness and efficiency of controls.

Step II - Verification

Kropatkin (1984, p. 11) defines Verification as "the evidential check on the tentative conclusions reached in [Step I, Familiarization]." The auditor should have in mind a specific conclusion for which he or she needs supporting evidence. Once a tentative conclusion concerning a possible

weakness is formulated, evidence must be gathered to support (or refute) the conclusion. Depending on the type of audit, this process may be quite straightforward, following procedures similar to those used in public auditing. This process may, in other circumstances, require a great deal of creativity; not only in gathering the evidence, but in deciding what type of evidence would provide the type of assurance needed in the circumstances. A danger exists that auditors will gather evidence and perform checks based on what has been done customarily or on some arbitrary list of available procedures.

Although the internal auditor may not have access to a list of specific procedures to follow for any particular circumstance, the profession has developed some guidelines that the auditor should follow. As with public auditing, internal audit evidence must be "sufficient, competent, and relevant" (Arens and Loebbecke, 1984, Sawyer, 1973). This means that there must be enough data to support a particular conclusion, and it must be reliable. In addition, the evidence must provide the appropriate type of assurance to support the conclusion. For example, if the auditor wants to verify that raw materials are delivered to the assembly line on a timely basis, it would not be appropriate to look on receiving documents at the warehouse for the date the materials arrived at the warehouse. Rather, the auditor would look at materials handling records for times the materials were delivered, or possibly on cost accounting reports for instances of work stoppages due to unavailable

materials.

Sawyer (1973) distinguishes four categories of evidence: Physical, Documentary, Testimonial, or Analytical. Physical evidence is that which the auditor can see and be relatively sure of what he is seeing. If he sees a truck, he believes that the truck exists. Physical evidence is usually the most compelling. However, seeing is not always believing. For example, few auditors would be qualified to look at a stone and ascertain whether it is a diamond or merely cut glass. In this circumstance, the auditor would need documentary (a certificate of authenticity) or testimonial (a statement from an jeweler) evidence. Either of these types of evidence is less convincing than physical evidence, simply because the auditor cannot be absolutely sure of the reliability of the source.

The fourth category, Analytical, consists of reasoning, judgement, and logical thought. This is often the least convincing (though quite valid) evidence simply because of its lack of verifiability and objectivity. Other people, with different backgrounds, may not agree with the auditor's reasoning. Conclusions based on analysis usually require a greater quantity of data to support them.

Sawyer (1973) also lists four forms of field work: Analysis, Verification, Investigation, and Evaluation. Analysis can be defined as the breaking-down of the object of study into its component parts in order to gain a more thorough understanding of its nature. Verification consists of comparisons between two sources of information for

correlations. Investigation is an inquiry that involves a focused approach, such as pointed questions about a particular problem. Sawyer lists Evaluation as a form of field work because the auditor is constantly evaluating evidence as it is gathered to determine if the evidence is sufficient and to formulate an initial impression of the results to which the evidence is leading.

To Sawyer's list of general field work forms can be added a list of "audit tools" promulgated by various authors. For example, Dittenhofer (1985) lists as evidence confirmation, verification, and observation. Morris adds interviews, flowcharting, statistical sampling, regressing analysis, PERT techniques, financial analysis, and linear programming (1978, 1981). These are the most widely used techniques, but there are others.

Step III - Evaluation and Recommendation

Kropatkin (1984, p. 197) characterizes Evaluation as determining "what was versus what should have been" and Cadmus (1964, p. 30) defines it as the "investigation of deviations and formulation of solutions." In this step, the auditor evaluates his tentative conclusions in the light of the evidence that has been gathered. The auditor is concerned not only with the findings themselves, but with their significance to the entity as a whole.

The auditor must keep in mind that he is searching for deviations of reality from organizational goals and objectives. Conclusions may have to be discarded or modified, or

more evidence may have to be gathered, due to unexpected revelations.

This step is characterized by a mass of information that must be reviewed and synthesized in order to reach a meaningful conclusion. In addition to having a clear idea of the goals and objectives of the auditee, the auditor must have defined and performed the correct evidence-gathering procedures. Little hope remains for accomplishing the audit objectives if the auditor finds himself at the Evaluation and Recommendation step lacking the appropriate evidential matter to support his tentative conclusions formed during the Familiarization phase.

During this step, the auditor also will identify possible solutions to problems. This activity generally requires creative thinking by, and cooperation of, the auditee. The auditor must sit down with the auditee and other interested organizational members and discuss various alternative actions. A break-down in communications and/or coordination at this point can mean a real lack of effectiveness in identifying and implementing solutions.

As an example of the Evaluation and Recommendation step, consider the situation introduced earlier where the company was experiencing an unacceptable rejection rate in production. The auditor tentatively concluded that the auditee's problem stemmed from workers' lack of familiarity with the production machines, due to a high rate of employee turnover. Upon closer inspection and gathering of evidence, the auditors conclude that this poor training stems from the

company's lack of a specific training program - managers in each area are expected to teach the employee what he or she needs to know in order to perform the job. No uniform standards exist regarding training in specific skills for a particular job and, during busy periods, the managers may give the employee only perfunctory instructions, expecting the employee to pick up further knowledge on the job.

The auditor, together with the representatives from Personnel, Finance, Top Management, and the auditee, develop possible solutions to this problem. One solution could be to replace all of the existing managers with new managers. Another solution might be to develop a formal training program for all new employees, utilizing more of a classroom-type approach. Another alternative might be to adopt a "buddy" system, whereby each new employee receives basic instructions and orientation from the manager, and then is assigned to an experienced employee for more detailed instructions and consultations when the new employee encounters a problem or has a question.

The first solution (dismissing the current managers) would not be very palatable to the current managers (or the auditor). The second alternative seems workable, but would require a rather large expenditure to initiate. Together, the auditor and auditee determine that the third alternative (the "buddy" system) is the most feasible at the present time.

Step IV - Reporting

Cadmus has defined reporting as "the formal communication of significant results" (1964, p. 30). Two important ideas in this definition are "formal" and "significant." As was mentioned in connection with Evaluation and Recommendation, the auditor usually will discuss findings with the auditee before the report is issued. Thus, the problem can often be resolved immediately, and upper-level management need only be informed that the problem exists and that a solution is being implemented. An exception to this, of course, is when the auditee fails to acknowledge that a problem exists or to take corrective action.

The auditor will only include significant findings in the formal report. During any audit, the auditor is likely to find a variety of minor problems that need to be corrected. Often, the situation is only a matter of informing employees as to the correct procedure to be followed, or helping an employee to learn the correct way to deal with a particularly complex procedure. These sorts of situations can usually be dealt with as the audit proceeds, and need not be specifically brought to the attention of upper-level management.

Generally, an Operational Audit Report is unlike a public audit report. Rather than expressing an opinion as to the fairness of presentation of Financial Accounting information, the auditor is attempting to identify operational areas that need coordinated managerial attention and

action. The Operational Audit Report is usually very detailed, including a discussion of the objectives of the audit, the problems identified, and possible corrective actions. If an action has been implemented, or a specific alternative is considered preferable, this too would be included in the audit report.

Once the audit report is issued, the auditor's job is almost done. The final task is to follow up on findings to determine whether corrective action was indeed taken and whether these actions have had the desired (and expected) results.

Conclusion

The basic audit methodology outlined in this chapter is very similar to that used in public auditing to evaluate the system of internal control. Two differences between public auditing and internal auditing exist: control objectives in an internal audit may not be predefined, and in the case of an operational audit the audit extends beyond an evaluation of the effectiveness of controls to the identification of possible solutions to control problems.

Not only is the basic methodology very similar to that used in public auditing, but the techniques (such as flowcharting, control questionnaires, looking at documents) are taken from that field. While the extant methodology and techniques serve internal auditing well up to a point, within the realm of operational auditing additional methodologies and techniques may be needed to ensure that the

operational auditor meets the prescribed goals and objectives. The next chapter discusses these goals and objectives as well as some of the existing problems in operational auditing.

ENDNOTES

1. While Sawyer characterizes the departmental perspective as organizational and the inter-departmental perspective as functional, the bulk of the sources cited in this work use the designations given in the text.

2. Kropatkin's thirty-nine steps are:
    1. Identify the precise nature of the project and the desired end product.
    2. Obtain related audit reports, permanent files, previous working papers, tax returns and similar historical information. Follow up on recommendations for action from the previous audit.
    3. Get industry analyses of the auditee for similar or related entities.
    4. Establish tentative time parameters for the assignment.
    5. Determine required staff resources.
    6. Entrance conference with the auditee. Establish mutually agreed-upon audit objectives.
    7. Request initial working data for preliminary study.
    8. Reserve adequate staff working space and secure commitments for computer time and secretarial and duplicating services.
    9. Prepare a survey guide as a broad-based working road map for the staff auditors to follow.
    10. Physically inspect the entire organization and facilities.
    11. Compare observations of physical items to the paper records of the organization.
    12. Determine whether all the processes and functions logically relate to the physical aspect previously observed.
    13. Prepare flow charts for process and organizational understanding.
    14. Pay strict attention to cash.
    15. Scrutinize all accounts, looking for unusual trends or items.
    16. Consider plant operations.
    17. Consider the keepers of the books.
    18. Check any union arrangements.
    19. Ask "What could be wrong?"
    20. Take appropriate samples.

21. Determine what is being tested before taking any sample.
22. Decide why the object of the testing is being tested.
23. Decide precisely what would constitute an error.
24. Consider what will be done with the test results.
25. Know the difference between statistical sampling and judgement samples and how and when each can be used effectively.
26. Three main averages: a. Measures of dispersion, b. normal distribution, c. probability distribution.
27. Consider how dispersion should be mathematically calculated and used to measure the reliability of an average.
28. Consider the use of computer cross-matching for a 100 percent sweep of any automated data.
29. Stay on top of training needs - Sampling techniques: Unrestricted samples, stratified samples, cluster samples, acceptance samples, discovery samples, internal samples, dollar unit samples.
30. Don't audit around the computer.
31. Check computer security.
32. Know how to use computer matches to assist in uncovering abnormal or incorrect postings or entries in any combined, comparative, or interlocking set of records.
33. Don't be overwhelmed by cost accounting assignments.
34. Stay alert to the possibilities for fraud and abuse.
35. Sharpen your reporting skills.
36. Make recommendations fit the report and the reader.
37. Keep in touch with personnel (auditees) about findings as you proceed - no surprises at report time.
38. Make sure you get replies that are responsive to the matters recommended or reported.
39. Have an explanatory exit conference.

3. John C. Burton, "Management Auditing," The Journal of Accountancy 125:5 (May, 1968), p. 42.

4. Flowcharts, the Record of Impressions, and Control Questionnaires are only a few of the workpapers used by Internal Auditors. For more examples, see Sawyer (1973), Thornhill (1985), and Appendixes C and D of Brink and Witt (1982).

5. Sawyer, Modern Internal Auditing. Altamonte Springs, FL: The Institute of Internal Auditors, Inc., 1981, p.111.

6. Sawyer, 1981, p. 116.

CHAPTER II

INTERNAL AUDITING GOALS, OBJECTIVES AND METHODOLOGICAL INSUFFICIENCIES

Operational Auditing Goals and Objectives

Although the control issues discussed in the previous chapter form the basis of both Financial and Operational Auditing, the goals of each form of auditing are not identical. Financial Auditing is concerned with examining and evaluating Financial Accounting controls with the goal of ensuring that the accounting system produces reliable Financial Statements. In regards to systems, the focus is on the Financial Accounting Information System. For evaluating controls in this system, the methodology of public auditing is eminently suitable and has been proven effective.

Operational Auditing objectives, however, are concerned with the "Three E's" (Efficiency, Economy, and Effectiveness) of the entire organization (Morse, 1971; Nich, et al., 1987). Operational Auditing goals are not only concerned with whether controls are appropriate and effective, but also whether goals and objectives are being achieved, (either because or in spite of the state of the control

system). The auditor's concern with the efficiency, economy, and effectiveness of operations is a different emphasis than that of assessing system reliability.

Historical Development of Operational Auditing

In reference to Operational Auditing, Brown (1987) has noted that

> Operational Audits are varied and diverse in nature. Specific 'cookbook' audit programs are seldom satisfactory guides to planning and performing the engagement. This is because they may not take into consideration unique characteristics or peculiarities which exist and thus may omit areas which require investigation. (p. 45)

For over ten years, internal auditors have been cognizant of the fact that Financial (external) Auditing methodology is not sufficient to achieve the goals of Operational Auditing. The Honorable Jean-Pierre Goyer (1976) noted that

> We have to find ways to audit effectiveness--an soon...we are incurring unproductive costs because of the duplication and overlapping in our audit efforts. In many cases, also, these efforts are dissipated because audit reports are not tailored to meet the needs of the recipient and thus are not fully effective. (p. 43)

Goyer considered one of the causes of this lack of audit effectiveness to be "an increasing lack of audit techniques" appropriate to the evaluation of operations and organizational goal attainment (1976, p. 44). He further states that "new and reliable methods must be found to facilitate the fulfillment of new audit requirements for such activities as evaluation of an organizations's results and how

well the operations were administered" (1976, p. 45).

Numerous prescriptions to the methodology problem have been proposed, but most of them have centered on techniques to be used in the various stages of the audit, such as Familiarization techniques or evidence gathering techniques for use in the Verification step.[1] Maguire (1978) advocated integrating Industrial Engineering principles into the design of Operational Auditing checklists. Accordingly, this integration would include three main aspects:

- analysis, measurement, and improvement of the methods of performing tasks assigned to workers;
- design and installation of better systems of integrating duties assigned to a group;
- specification, prediction, and evaluation of the results obtained in operations.

Johnstone (1978) was one of the first authors to propose a systems viewpoint in Operational Auditing. While Johnstone proposed "an evaluation of what would be the most satisfactory system from a purely theoretical viewpoint" (p. 26), he did not give advice on how to operationalize this evaluation. Later that same year, Henderson and Hernandez (1979) suggested focusing on the management information system and the decision process. The decision process consists of formulating alternatives, evaluating alternatives, and choosing an alternative. They proposed that internal auditors could examine the information system inputs into the decision process, the methodology for formulating alternatives, and the analytical technique used

to guide choice of alternatives. This framework, which could be useful in examing the strategic management of an organization, does not seem to have been widely adopted yet.

Warfield (1979) proposed an "Audit Program for Organizational Control and Effectiveness" that centers on the factors of Organizational Objectives and Responsibilities, Organizational Structure, Decision Making, Performance Evaluation, Communication, and Organizational Change. Warfield's program was one of the first to consider the social element in organizations, and some of these concepts have been adopted in Internal Auditing. However, like many of the proposed "revolutionary" methodologies, Warfield's approach is basically one of extended questionnaires, with little or no provision for integration of evidence gathered.

Crockett (1980) noted that work done during the Familiarization stage should enable auditors to identify "problem areas, sensitive areas, and operations that are crucial to the success of the auditee" (p. 69). Generally, Crockett's discussion is a flowchart model of the Operational Audit process, and the most notable characteristic of his discussion is the above quoted identification of critical operations. Crockett notes that "these should emerge as auditors review the output of control systems, discuss operations with line management, and observe operations with an experienced eye. There are numerous Operational Auditing questionnaires available to guide auditors in this phase" (p. 69). So again, although Crockett points out an important (and needed) shift in emphasis, he does not necessarily

propose a new methodology.

A radical departure from extant methodology appeared late in 1980 as "The Process Control Approach [PCA] to Internal Auditing" proposed by Paul. PCA is a methodology which "enables the auditor to link error occurrence with error detection and... to monitor the system of internal control" (p. 34). The PCA is a fairly sophisticated statistical approach that allows the auditor to determine whether a system is in- or out-of-control, and may allow identification of the cause of an out-of-control situation. It is based on the statistical premise that variations in data are either random or systematic, and use of the approach requires some degree of sophistication in the use of statistical tools and enough historical data to compute base statistics. A computer would probably be necessary, in order that the calculations not become too tedious or time-consuming. The PCA appears to only be applicable to systems variables that can be quantitatively described, but when used in appropriate situations it seems very useful. While the validity of these concepts is generally acknowledged in Operational Auditing literature, application of this methodology may be limited, particularly by a lack of technical sophistication on the part of some Internal Audit staffs, and a lack of computer tools to assist the auditor in such analysis. The availability of increasingly sophisticated software for microcomputers can be expected to alleviate the second condition to a great extent.

In 1982, Binns proposed the design of Standard Opera-

ting Procedures (SOP) questionnaires based on a SOP manual. The SOP questionnaire is an enhanced version of the traditional compliance questionnaire. Its primary advantage is that it relates compliance questions directly to compliance objectives, usually by reference to the compliance standard in each question or group of questions. Binns notes that the SOP questionnaire does not always answer the question of why a particular policy is not complied with or why a policy has been adopted in the first place.

In contrast to the compliance approach, Hyde (1982) joined Johnstone and Paul in advocating the adoption of principles from systems engineering and scientific methods. However, Hyde presents at best a cursory inspection of these principles and methods.

An outstanding development in 1985 is the "Operational Audit Risk-and-Technique Matrix" proposed by Flesher. The Risk-and-Technique Matrix is a "means of relating a department's or function's operating objectives and management techniques to the various risks involved" (p. 45). The matrix is constructed as in Figure 4. The first column consists of goals or objectives of the organization. The second column contains risks that could contribute to not achieving the goals in Column 1. This column could possibly contain opportunities as well, although Flesher does not discuss the possibility. Column 3 contains management techniques (controls) that will alleviate or prevent the risks, and Column 4 contains Operational Auditing procedures that should be employed to determine whether the management

FIGURE 4. OPERATIONAL AUDIT RISK-AND-TECHNIQUE MATRIX

Operational Objectives	Risks	Management Techniques	Operational Auditing Procedures

techniques are being followed. The matrix, if used properly, can be both a guideline for developing audit tests and a tool for analysis of audit findings. The Risk-and-Technique Matrix could also be an effective tool for auditors trying to analyze the social system of the organization, as will be discussed in the next chapter.

Finally, Brown's (1987) solution to the lack of satisfactory audit guides was to propose the Commonsense Approach to Operational Auditing (CAA). The CAA approach starts with the objectives of internal controls, and is very similar to the general process outlined in Chapter I. Brown specifically notes that relating specific prescribed controls to the control objectives will result in a more thorough audit. His second step is to "obtain a familiarity with and working knowledge of the audit area" (p. 47). The principal goal in this stage is risk assessment, yet while he discusses the traditional familiarization tools (interviews and observations, discussions with management, reading prior audit reports), he does not discuss the control objectives and specific control identification of his first step. Thus, Brown does not present an integrated system for linking control objectives, specific controls, evaluation of those controls (and missing controls) and conclusions. Flesher seems to have done a much better job of accomplishing these objectives.

The various approaches and methods discussed above are representative of the trends in Operational Auditing during the last decade. Many of the concepts have been integrated

into Internal Auditing to some degree (some fully, most partially or only on a very limited basis). Even as these techniques were being proposed, however, internal auditors were aware that continued effort was needed to identify a useful methodology (Morris, 1978) and that a fundamental shift in orientation was needed to effectively use the new techniques. While internal auditors have made some progress in adopting new methods, Hyde (1980) states that Internal Auditing's base "is still solidly in financial operations" (p. 66). Hodges notes that, "the traditional audit approach emphasizes evaluation of past performance" (1978, p. 53) and Baggett (1982) is even more critical, stating

> internal auditors tend to be oriented toward ascertaining the existence of records and testing their accuracy...The logical consequence of this is operational audits that concentrate on a review of detailed records and procedures. Typical of this, Operational Auditing guides list specific functions. For each function, a 'best' or typical set of procedures is prescribed. The auditor is expected to find or recommend these procedures (p. 44).

Morris' (1981) comments on the reporting stage are similar to Hodges' and Baggett's:

> Internal auditors have been led to believe that in order to upgrade their image and the professional status of their audits, modern tools should be applied. They lose sight of the fact that these [sic] tools are only as good as their interpretation and, thus, are no more than what they make of them. Professional internal auditing requires more than the mere application of audit techniques, it requires the sound interpretation of the facts and figures of the findings into terms audiences - management and the audit committee - can understand and use. (p. 52)

Continuing along these lines, a 1984 study by Mautz,

Tiessen, and Colson found, in a survey of those who work with internal auditors, that two reasons why Internal Auditing has not achieved its full potential are "lack of managerial perspective on the part of internal auditors" and "narrow point of view of internal auditors" (p. 38). The latter is also related to methodology - the transactional orientation traditionally followed simply leads to inappropriate or insufficient methodologies in the Operational Auditing setting. Mautz, et al., conclude that the two areas (Financial and Operational) are "substantively different" (p. 41) and that different techniques are appropriate.

Nich, Gift, and Zeb (1987) discussed the state of the art and the future of Internal Auditing. They concluded that Internal Auditing has been playing a reactive role, and that attempts at role shifting have not been successful because "internal auditors are neither organizationally positioned nor particularly competent to play a broader role" (p. 4). They also felt that the idea encompassed within Operational Auditing, to audit for effectiveness, efficiency, and economy (the three E's), was basically sound but that Internal Auditing was "not perceived by senior management as particularly competent to do an effective job of judging [the three E's] within a larger organizational context" (p. 5). Again, this lack of competence was due to an emphasis on transactions and inadequate methods. They note that both management and much of the Internal Auditing profession see Internal Auditing "as primarily an accounting function, employing essentially the methods of the public

accountant." More specifically, Fletcher and Verschoor (1984) note that

> Auditors seldom addressed the question of whether or how effectively the manager had achieved the goals or primary performance objectives of the unit because it was usually very difficult to measure with precision the degree of importance management functions had played in that success or failure (pp. 29-30).

In addition, Dittenhofer (1985) states, in regards to governmental auditing, that

> Internal auditors perform some efficiency type audits and few effectiveness audits. These audits are often not performed because of ... [a] lack of knowledge about the methodology for performing this type of auditing (p. 55).

In light of the conclusions of other authors cited above, it seems reasonable to generalize Dittenhofer's comments to operational auditors in the private sector as well.

The dissatisfaction with extant methodology persists even to the present time. One result of the lack of appropriate methods is the tendency of internal auditors to consistently reinvent an Operational Audit approach for each different audit scenario (Goyer, 1976). This tendency is apparent in the appearance of numerous "how to" articles appearing in Internal Auditing journals lately. Nich, et al, (1987) analyzed three 1986 issues of The Internal Auditor and found 50% of the articles concerned with practice, or "how to," (p. 6) and another 23% with information systems auditing. They concluded that internal auditors are overwhelmingly concerned with transactions, and that "larger issues, such as results, function, and human relations get scant attention" (p. 7). This analysis was extended to

include eleven issues of The Internal Auditor including all of 1986 and the first four issues of 1987 (through October), with somewhat different results (see Figure 5). In this analysis, 40% of the articles dealt with either methods (practice) or defining controls. Another 24% were concerned with Internal Auditing's organizational role or function. While these results support the conclusions of Nich, et al., they also lead to the conclusion that internal auditors may be having trouble using the basic methodologies already available to them: the articles dealing with methods were, for example, "An Effective Approach to EDP Auditing," (February 1986), "Improving Audits of Government Contracts," (August 1986), and "Practical Audit Risk Analysis" (August 1987).

Part of the problem in the search for appropriate methodologies for Operational Auditing seems to lie with its different goal set (from that of Financial Auditing). This different goal set may not be served adequately by methodology adopted almost intact from public auditing. Indeed, Nich, et. al., would like to see Internal Auditing branch out and adopt methodologies from different fields.

One of the disciplines from which Nich, et al. propose adopting methodologies is Information Systems Design. This is not a new proposal, having been promulgated at least as early as 1976.[2] Persuading internal auditors to adopt a systems methodology is not without its problems, however. Marvin (1977) points out that while a systems model is a powerful tool, internal auditors may not embrace systems

FIGURE 5. ANALYSIS OF ARTICLES IN THE INTERNAL AUDITOR (JANUARY 1986 THROUGH OCTOBER 1987)

Category	Number of Articles	Percentage
Practice/Methods	25	30%
Results	4	5
Organizational Role/Function	20	24
Human Relations	5	6
Systems	3	4
Defining Controls	8	10
Other (Prof. Stds., Legal Liab., etc)	18	21
	--	--
	83	100%

methodology completely because they realize that "they may lose some of their independence by getting involved in recommendations about how to better achieve the objectives of programs." Marvin explains that this realization stems from the knowledge of the differing backgrounds of internal auditors and systems analysts. Systems analysts traditionally are involved in the decision-making process and have a more direct influence on management behavior. The internal auditor who wishes to possess systems analysis skills may be expected to incorporate into his or her world view a similar expectation of direct involvement in the decision making process, and yet in the Financial Auditing realm internal auditors have always been prohibited from performing management functions in order to maintain their independence and objectivity. Marvin's proposed solution to this dilemma is that internal auditors utilize technical assistance staffs of specialists. However, it seems that such specialists are being integrated into the Internal Audit staff (Fritzemeyer, 1976) and especially within the realm of Operational Auditing a more active involvement in the decision-making process is inevitable.

In 1977, Knighton proposed a systems approach based on evaluating information inputs into the decision-making process and "identifying and evaluating each policy, procedure, or other element of operational control designed to promote improved performance of the tasks required" (p. 44). Knighton did not propose exclusive use of the systems approach, but rather included it in a list of appropriate

methodologies such as the walk-through audit, flowcharting, and the program audit. Ridel (1982), alternatively, advocates the systems approach and notes that consideration of the methodology should reveal that the omission of any aspect of his approach would result in a less-than-comprehensive audit. He notes that the systems approach is a reaction to increasing complexity in the environment and that auditors can no longer "examine each function or activity on our audit schedules as an independent entity because functions are not independent" (p. 24). Ridel also states that most of the concepts of the systems approach are incorporated in Sawyer's The Practice of Modern Internal Auditing, but that Sawyer did not present an "organized attempt to define and analyze a function and recognize the environment in which this function operates" (p. 25). Ridel proposes five criteria with which to define the function being audited:

- the system objectives and performance measurements;
- the system environment and fixed constraints;
- the resources of the system;
- the elements or organization of the system;
- the management or control of the system.

His discussion of these criteria primarily encompasses the Familiarization stage, with some explanation of the other stages and how the information gathered during Familiarization will influence the subsequent audit work. Ridel does

not propose a particular systems methodology.

In 1987, Miller did propose a particular systems methodology - a Socio-Technical approach. The basic premise of the Socio-Technical Systems Analysis (STSA) approach is that not only policies, structure, controls and tasks are important, but that the "people" or social system's functioning is "critical to the organization's performance" (p. 96). Miller notes that traditional Internal Auditing is concerned only with the technical system (policies, procedures, controls, tasks, etc.) and that STSA will not only involve auditors with the social system but will also enable them to "improve the quality of work life for employees" (p. 96). These concepts, fundamental to STSA, will be discussed in more depth in the next chapter.

Miller's discussion extends primarily to the planning phase of Operational Audit administration - deciding which audits are to be performed over some planning horizon. He notes that during planning both social and technical factors must be considered. The technical factors Miller lists are internal controls, organizational structure, technology and tools, management information systems, the physical environment, and work process or flow. He lists sociological factors as team effectiveness, interpersonal relations, communications, intergroup relations, organizational climate, and employee development. The technical factors seem to have dominated most of the Internal Auditing literature in the last decade. Miller notes that in order to truly be involved with the social system, the plans made using STSA

must be implemented using a Socio-Technical audit methodology, and that such a methodology "is far more powerful than the traditional financial and/or operational approaches" (p. 100). Miller does not, however, discuss how to implement a STSA methodology in an actual audit. This paper will attempt to do so.

Conclusion

Operational Auditing has different goals than traditional Financial Auditing (either external or internal). Methodologies adopted primarily from Financial Auditing, and in particular public (external) auditing, are not sufficient for the needs of Operational Auditing. Many solutions to the methodological insufficiency created by adopting Financial Auditing methods have been proposed, but a new paradigm has yet to emerge. One particularly promising development is the proposed adoption of systems analysis/development methodology by internal auditors. An inexhorable trend toward incorporating systems methodology has culminated in the proposal, by Miller, that internal auditors adopt Socio-Technical Systems Analysis as an appropriate methodology. However, Miller did not operationalize the STSA approach for the Operational Audit scenario.

The next chapter will discuss the applicability of Socio-Technical Systems Analysis (STSA) Internal Auditing. The chapter will discuss the theoretical basis of STSA, how STSA can help meet the goals and objectives of Operational Auditing, and some benefits of STSA not fully recognized yet

in the Internal Auditing literature.

ENDNOTES

1. See for example John O. Davies, "Vital Questions You Need to Ask", The Internal Auditor, June, 1987, pp. 54-58, which deals with the entire audit but concentrates on questionnaires as a data collection device; Spencer E. Hodges, "A 'Listening' Approach to Operational Auditing", The Internal Auditor, December, 1978, pp. 53-55, which treats interviewing as an evidence gathering technique; Norman Morris, "How Does Your Audit Department Rate?," The Internal Auditor, October, 1978, p. 77, for a list of "tools and techniques of auditing"; and Fletcher and Verschoor, "Managing Innovation: The Internal Auditor's Challenge," The Internal Auditor, August, 1984, pp. 29-32, for a discussion of CERT (control evaluation review technique), a methodology for evaluating a control system, primarily through the use of ratios.

2. See, for example, Fritzmeyer, "Should Internal Auditing be Performed by a Staff of Generalists or by a Specialized Staff?" The Internal Auditor, August, 1976, pp. 41-47; George and Palmer, "Systems Auditability and Control," The Internal Auditor, April 1977, pp. 11-15; and Harmeyer, "Acceptance Demands Credibility," The Internal Auditor, October, 1978, pp. 35-52.

CHAPTER III

SOCIO-TECHNICAL SYSTEMS ANALYSIS THEORY AND JUSTIFICATION

Introduction

The previous chapter culminated in Miller's (1987) proposal that Socio-Technical Systems Analysis (STSA) is an appropriate methodology for Operational Auditing (OA). However, he presented little theoretical support for this conclusion. What Miller must have known, but did not explicitly state, is that the development of STSA is a reaction to: (1) the Scientific Management based organizational design perspectives prevalent in many business applications today, and (2) to the increasing turbulence of the internal and external environments in which businesses must operate. This chapter discusses each of these factors and how they relate to OA. Then, problems previously identified in Organizational Design (OD), Management Information Systems (MIS), and Management Accounting Systems (MAS) which result from these two factors will be discussed and related to extant OA problems. There is growing support for STSA on these higher organizational levels of control as an acceptable methodology to solve problems arising from both the implicit reliance on the Scientific Management paradigm in newly emerging

organizational designs, and from their interactively designed environments. This leads to the belief that STSA could be adopted in OA with good results.

Scientific Management Paradigm

A paradigm is a world view, and one of the most pervasive paradigms in business, since early in the Twentieth Century, has been Scientific Management. This world view is based upon a Closed Cybernetic Systems model, though, leading to perceptions of closed systems (with little departmental interdependence recognized either within the organization or with the external environment) and the need for a Theory X management styles (Thomas, 1985). According to Thomas, "Frederick Taylor saw control as the central idea of Scientific Management, and cost accounting systems as crucial to the achievement of this scientific control theory" (1985, p. 47).

Operational Auditing is also a crucial element of scientific control theory because it is a control function which examines and evaluates other controls (Thornhill, 1981). As stated in Chapter 1, Brink (1982) notes that "internal auditors who do their jobs effectively become experts in what makes for the best possible design and implementation of all types of control" (p.4). Three basic issues in OA are whether controls have been devised and implemented that will help management attain the organization's goals and objectives, whether these controls are complied with. and assessing and improving performance

quality. A problem in OA is considered to be a deviation from the accepted standard. Types of problems are the lack of a needed control, a control that is not complied with, a control that is not cost effective, or a general lack of efficiency and effectiveness in operations.

Operational auditors are overwhelmingly concerned with controls within the parameters defined by Scientific Management. The propensity to break tasks down into their smallest component tasks, coupled with a Division-of-Labor philosophy, leads to a focus on Financial Accounting controls and to the use of methods designed for auditing those controls. However, as has been previously noted, Financial Auditing goals and Operational Auditing goals are not always equal. The use of primarily Financial Accounting oriented checklists will thus not enable operational auditors to accomplish their goals.

Furthermore, the closed systems perspective leads to a failure to recognize interdependencies between various organizational subsystems. Coupled with the lack of systematic procedures to identify critical boundary conditions, this leads to an inability to achieve global productivity improvements, especially in modern designed production environments (such as those utilizing CAM and JIT).[1] This internal interdependence and global suboptimization is a form of Environmental Turbulence. The following sections discuss how the Scientific Management perspective merely compounds the problems created by the turbulent environment.

The Turbulent Environment

The idea of a turbulent environment can be summed up in one idea from Elton Mayo (Bell, 1956): "The characteristic fact about the modern scene is the presence of constant, disruptive change" (p. 24). Trist (1980) notes that the turbulent environment is characterized by "large competing organizations, all acting independently, in many diverse directions, [to] produce unanticipated and dissonant consequences in the overall environment which they share" (p. 117). In such an environment, experience is no longer the only important factor, because situations change so rapidly that experiences are not directly applicable to current situations (Ackoff, 1972).

This view is inconsistent with the concept of continuity long relied upon by financial (external) auditors as illustrated in Mautz and Sharaf's (1986) "Sixth Postulate of Auditing." "In the absence of clear evidence to the contrary, what has held true in the past for the enterprise under examination will hold true in the future" (p. 42). If operational auditors also rely upon this postulate (and it seems that they do) then the implications of turbulence in the organization are not being incorporated into OA methodology.[2] Furthermore, environmental influences can cause changes within the organization. Odiorne (1980) states

> Internal audits looks back at what has already taken place and is more often an agent of review than an agent of change, yet the major problem of accounting as a profession and of managing organizations in general is to learn to cope with change...Good program audits should seek out areas

> where people are overly enmeshed in day-to-day internal business and, accordingly, are too lenient in attending to those changes in the outside world which may be threats to the organization. (p. 60)

Odiorne's solution to the turbulence problem is better planning for the future, including an assessment of the organization's strengths and weaknesses. In support of Odiorne, Trist (1980) notes that the proper response to a turbulent environment is an interactive planning mode where parties cooperate to make the future happen. This interactive planning mode can be quite difficult to accomplish, however, because employees may not possess the necessary skills to respond to environmental threats and opportunities. According to Ashby's "Law of Requisite Variety" (Trist, 1980), "when a system's response repertoire cannot match increases in variety emanating from the environment, that system's survival is endangered" (p. 115). Inflexible, bureaucratic systems fostered under the Scientific Management paradigm fail to recognize this need, leading to incomplete job designs and insufficient training resulting in role occupants lacking a requisite variety of responses.

More specifically, recent factors to which the social system must respond have been identified by Davis (1980, pp. 9-11):

- the "school socialization process": people experience a longer period during which the individual is most important;
- depression era workers are leaving the workforce, which results in a workforce composed of individuals who do not remember worrying about starvation;

- welfare lowers the cost of refusing to work;
- economic opportunity laws place the burden of social change on the work organizations;
- the increasing rate of technological change causes environmental turbulence through the technical subsystem;
- the changing role of management control: employees exercise more judgement and discretion, management may have to trust employees to perform tasks about which management knows very little.

Brink and Witt (1982) recognize this turbulence, noting that "[these] environmental forces are a part of the generally accelerated rate of social expectations in such areas as protection of natural resources, pollution, minority groups, higher levels or business responsibility, and moral standards" (p. 7). Glenn (1977) also seems to recognize turbulence in his comment that "Internal auditors should be looking at what is happening today and endeavoring to determine and report its likely effect in the future so that management can take action before the event and thus avoid unnecessary expense and loss" (p. 19). Finally, Thornhill (1981) lists four factors that create a riskier (more turbulent) environment in which operational auditors must currently operate: business and government continue to grow bigger and more complex; products and services are more diverse and complex than ever; underdeveloped countries are becoming more industrialized and developed countries are becoming more technologically advanced and information oriented; and erosion of ethical standards - respect for authority, managerial competence, honesty, and reliability (pp. 28-29). Thornhill's solution includes better reporting

and controls for operations, reduction of risks, and better controls to prevent fraud. More importantly, he also advocates better communications with managers and a more active (rather than reactive) role in organizational policy setting.

Organizational Design

Davis (1971) identified four organizational requirements for improved performance, cooperation, and commitment in the face of turbulent environments: individual and group autonomy in planning and controlling their tasks; ability to adapt to, and learn from, the environment; a requisite variety of responses (Ashby's Law of Requisite Variety); and the individual's or group's ability to participate in the development of jobs, roles, and the planning of changes. Rather than providing these requirements, Scientific Management results in fractionalization of processes into "simple, routine" jobs leading to employee dissatisfaction, absenteeism, turnover, and difficulties in managing employees (Thomas, 1985). These are some of the problems OA seeks to solve, yet it seeks to do so by imposing more controls, more "separation of duties" (task fractionalization), and by discouraging employee discretion. Within the Scientific Managemente paradigm, OA cannot adequately address these problems because they are a product of the paradigm.

Management Information Systems Design

The problems created by the Scientific Management para-

digm in Organization Design carry over to the Management Information Systems (MIS) designed for organizations. Thomas (1985) states

> As environmental turbulence increases, traditionally designed organizations have had limited success in adapting due to structural rigidities and lack of employee motivation. Similar problems exist with the MIS; an inability to adapt information systems to changing organizational needs, and a lack of user motivations to accept, maintain, and improve them (p. 21).

In terms of OA, MIS designers also exhibit an inability to adapt control systems to changing needs, producing information systems that actually foster a lack of user motivation to accept, maintain, and improve controls.

Thomas also notes that information processing, as the primary means of adaptation to the environment, is done within and by the social system, and that the social system is thus the primary determinant of the effectiveness of information processing potential. Similarly, the social system can be seen as the determinant in control effectiveness. Lack of user involvement is one of the most serious problems in Systems Analysis/Systems Design (Bostrom and Heinen, 1977a). Similarly, the OA literature includes a number of discussions on auditee acceptance of audit findings,[3] with the general conclusions that auditees do not feel that findings are always relevant, and that the auditors, rather than the auditees, are responsible for the control system.

In many cases, the lack of user acceptance and maintenance of control systems may stem from different perceptions

among auditors and auditees. In Argyris' 1970 study, "MIS users saw the designers as secretive, while the designers saw themselves as rational reformers who design efficient systems for an inadequate line management. User participation was encouraged for MIS acceptance, rather than for collaborative problem-solving and design [emphasis added]" (in Thomas, 1985, p. 381). The same misconceptions may occur between auditors and auditees - the auditor, despite his/her intentions, may be perceived as an externally imposed "watch-dog" who is interested in fault-finding rather than cooperative problem-solving.

Consistent with the Scientific Management paradigm, systems analysts encourage "... structured systems with well-defined job descriptions and hierarchical [sic] lines of authority ... emphasizing order, stability and technical efficiency" (Thomas, 1985, p. 27). This is true of internal auditors as well. In MIS, one result of such systems is that feedback on performance goes to managers rather than to workers. Managers, however, may not be in a position to act on the information in a timely manner, or the information itself may not be received when it is needed. This results in a duplication of the formal MIS in the form of an informal information system, resulting in wasted resources and suboptimal performance. An audit that ignores the social subsystem within an organization will not discover these informal information systems, will not develop a true picture of the entity under audit, and therefore cannot fully address any existing problems in the control or

information systems.

In MIS, this interaction between the social and the technical systems has been ignored, with the result that tasks lack interest (resulting in unmotivated employees) and decision-making is moved further and further up the management hierarchy. Other effects are less communication at the lowest operational levels and increasingly centralized controls.

Management Accounting Systems

One result of the Scientific Management paradigm that has plagued Management Accounting Systems (MAS) is a goal orientation toward detective controls. Reports tell management what went wrong in the past, long after any corrective action can be taken, unless the situation is an ongoing one. In many cases, Operational Audits also function as detective controls. Audits conducted long after the fact may disclose operating problems that have since been resolved. Furthermore, since operational auditors look to management for the standards against which they audit, the auditors may not be any better than management at identifying emerging threats and opportunities that would require new responses.

In most audits, changes in operating procedures promulgated by management will be considered and, if justified, new standards are adopted as the criteria against which to evaluate findings. Seldom does the auditor consider whether management's response was timely or whether new circumstances are emerging which would necessitate another change.

This viewpoint is illustrated in Crosby's (1986) statement that "corrective action involves a system designed to resolve problems forever by identifying, communicating, and documenting work processes that prevent those problems from happening again" (p. 35). In a turbulent environment, the same problem may recur, but due to a different cause, or due to an external cause beyond the control of the company. Eliminating the cause may thus be impossible. It therefore becomes paramount to develop a variety of appropriate responses to the problem.

A second problem in MAS resulting from the Scientific Management paradigm is the emphasis on upper management as the focal or key recipient of management accounting information (Thomas, 1985), which is used for performance appraisal purposes. This encourages competition among departments which results in local optimization rather than global optimization. The information that upper management receives includes performance variances resulting from both internal (controllable) and external (uncontrollable) sources. The manager's defense, again, is to maintain his or her own informal information system with which to keep track of uncontrollable events. The resulting lack of motivation to maintain and support the formal MAS on the part of the Operations Managers responsible for its data input, integrity, and relevance, is an internal control problem (Thomas, 1985) which brings it within the realm of Operational Auditing[4].

In summary, then, an organization operating under the

Scientific Management paradigm may not possess the requisite responses necessary to cope with increased environmental turbulence. The most salient feature of the Scientific Management perspective is the lack of consideration of the social subsystem of an organization, stemming from a Theory X management style. Numerous problems resulting from this perspective have been identified in OD, MIS, and MAS. Operational Auditing has been shown to originate with and rely upon the Scientific Management/Theory X perspective, and the resulting problems apply to OA as well. Furthermore, because OA directly influences the tenor of workers' tasks and interactions between organizational subsystems, OA can be said to be concerned with organizational design and information system design. Thus, it is reasonable to propose that STSA, a process-methodology that has been shown to overcome these problems on these higher control system levels, be applied to OA in order to solve similar problems. The remainder of this chapter is a discussion of STSA theory.

Socio-Technical Systems Analysis (STSA)

The basic premise of STSA, set forth by Bostrom and Heinen (1977a) is that "technology is essentially neutral: whether its application succeeds or fails depends entirely on the decisions that are made on how it shall be used" (p. 18). An implication of this (Miller and Rice, 1967) is that the "work organization is not uniquely determined by the technical system and that alternative organizational models

are often available" (p. 31). As Davis (1981) notes "the technical system defines the tasks to be performed and the social system prescribes the way in which they are performed" (p. 25). A needed shift from a focus on jobs and tasks to a focus on the roles and sub-systems operating within the organization, should result in these sub-systems being able to control variances through self-regulation and adaptation to the environment (Thomas, 1985). According to STSA theory, this shift contributes to joint optimization of both technical and social systems, recognition of work system boundaries that consider interdependencies, and a role content emphasis rather than a job content emphasis (Davis and Taylor, 1979).

STS theory depends on two basic concepts. The first is that "organizations are artifacts, purposively created to serve man's needs" (Thomas, 1985, p. 14). Organizations are a mechanism through which man adapts to the environment, and so must be adaptable and flexible (Simon, 1969). The second concept is that "every socio-technical system is embedded in an environment influenced by cultures and values" (Thomas, 1985, p. 14). Understanding of an organization (or part thereof) cannot be achieved without understanding of the environment within which it operates (Davis and Trist, 1974).

Contrary to Scientific Management, "which considers humans as unreliable machine components fitted to a normative technical design," (Thomas, 1985, p. 14), STSA theory requires that workers have both the discretion and ability

to respond to a variety of circumstances, as well as the commitment to perform necessary tasks on their own initiative. An organizational Control Chain of Causation, then, might look as follows[5]:

1. For the economic goals of the organization to be satisfied, the production process must function efficiently, economically, and effectively.

2. If appropriate responses are not taken to random events as they occur, the production process will not function as specified in (1).

3. If the organizational members are not committed to their roles, or they lack the necessary control skills, they will not respond appropriately.

4. Commitment cannot be forced or bought: it must be designed into the jobs and roles assigned to people.

5. Appropriate information and training are necessary in order that people have the control skills required to identify and perform necessary control actions when needed.

An open, Socio-Technical system design fosters consideration of these characteristics. The properties of an open Socio-Technical system have been identified by Davis (1981, pp. 28-29) as follows:

- equi-finality: the ability to follow different suitable paths to achieve accepted outcomes;

- requisite response capability: members possess the repertoire of knowledge, skills, and authorities to match the variety of demands faced by the organization;

- self-regulation: the organizational unit decides how and when it will apply its response capability;
- relevant boundaries: requires that the boundaries around each organizational unit be

> so located as to include all the means necessary to achieve the desired organizational outcomes.

Achieving these properties requires the development of new strategies to cope with change. These new strategies include considering policy-making as a learning process, building research capabilities into the organization, utilization of professionals in collaborative research projects, and predominantly project and research oriented training (Herbst, 1974). The key ingredient for success in developing these new policies is user involvement, achieved through a methodology which considers the social subsystem to be a primary component of the total organization.

Bostrom and Heinen (1977b) define three phases of STSA: the Strategic Design Process (the "Scan"), the Socio-Technical System Design Process (including Technical and Social System Analysis), and an Ongoing Management Process (kAnalysis, Design, Redesign phase). The change process should be managed by the users. People should have the opportunity to ask questions and discuss problems. Retraining should be provided where workers are deficient in the skills necessary to cope with the system (Bostrom and Heinen, 1977b). The most effective point at which the user can participate is in the Strategic Design Process: formulating and reformulating the goals and policies which guide the systems design activities (Bostrom and Heinen, 1977a). Having users focus on this stage can facilitate dealing with issues of user participation and responsibility in the actual analysis, design, and maintenance of specific inter-

nal controls.

The purpose of the Strategic Design Process is "to combine relevant MIS and user personnel into a steering group in order to define the values and goals which direct the project" (Bostrom and Heinen, 1977b, p.15). After the Steering Committee develops a policy document and identifies system boundaries, interactions, and problems, a Design Team is selected to carry out the actual modifications of the system. The operational auditor functions as a design engineer, working with the auditees, within the Steering Committee. The auditor together with key users (auditees) would form the Design Team, with expert assistance as needed from EDP, Finance, and other personnel.

Once the Strategic Design Process is complete and this policy document is produced, the Steering Committee should translate the output of the process into technically operational solutions. During the Design/Redesign phase, the alternatives should be developed from the data collected about the goals for the redesign. The design engineer, then, must "present the widest range of techno-economically feasible alternatives" (Herbst, 1974, p.8) in order to develop an organization that is both more satisfying to its members and more effective in meeting task requirements (Bostrom and Heinen, 1977a).

In addition to analyzing the social system, the technical system must be analyzed. Drucker (1970) proposes that work may provide the focal role for understanding the system of technology. The Technical System, then, is the proces-

ses, tasks, and technology needed to transform inputs into outputs (Bostrom and Heinen, 1977b). The Technical System Analysis is conducted as follows:

1. Identify the unit operations (the physical product transformations). Think about and list every single step that must take place to produce acceptable output. Now group these steps together into larger units representing significant transformations in the production process.

2. List all the individual operations or steps required within each unit operations.

3. Identify the production variances within each unit operations. Think about and list all the things that could be defective or substandard about the ingredients or raw materials, and could go wrong with the tools, procedures, methods, or equipment. Under each unit operations, list the variances caused by the ingredients, the machinery, the procedures, or the methods used that could cause that particular unit operations to either fail to produce acceptable output or make it difficult for the employees to produce it easily, smoothly, and inexpensively.

4. Identify the key variances. Construct a variance analysis matrix by listing the unit operations down the left hand margin and then placing the appropriate variances on the diagonal of the blank matrix. Start at the top of the variance matrix with the first variance of the first unit operation and determine if this variance causes or exacerbates any of the other variances in the matrix. Go through the entire matrix in this fashion, one column (variance) at a time. If two variances do interact with each other, place an "X" in the box where the two variances intersect.

5. Construct a Key Variance Control Table by placing the key variances in the left hand column and answering the questions that appear across the top of the table for each key variance.

One of the tools available to assist in the Technical

System Analysis is the Variance Analysis Matrix (Ansari, 1979). This is an "A x B" matrix where dimension A is the nature or significance of the variance (expected versus unexpected) and dimension B is the source of origin of the variance: internal (within a department), external (within some other department), or exogenous (from outside the company).

The Variance Control Table lists, for each key variance, the unit operation where the variance originates, the point at which the variance is observed, the point at which the variance is controlled, who or what controls the variance, what actions are taken to control the variance, and what information is used, and from which sources, to control the variance.

STSA considers both the social and the technical subsystems. The social system is concerned with the attributes of people (attitudes, skills, values), the relationships among people, and the reward systems and authority structures (Bostrom and Heinen, 1977a). Two potential improvement in satisfying social system needs are improved task accomplishment and increased worker satisfaction (higher quality of working life, or QWL). Systems designers must consider the needs of all users of the system, otherwise, the system will create dysfunctional behavior in organizational members/users who are not served by the system (such as maintenance of private information systems). As an ongoing policy, Herbst (1974) advocates the use of "Social Monitoring - The development of capacities for the rapid

recognition and evaluation of emerging and evolving social, psychological, and technological trends" (p. 62). According to Bostrom and Heinen (1977b), "STS tends toward Theory Y... The individual is viewed as someone who wants to contribute to organizational goals and wants to use not only his/her skills and abilities, but also to become increasingly competent in mastering his/her environment" (p. 14).

According to STS theory, then, the social system is an important component of the total organization, and must therefore be analyzed in detail. Four areas are included in the Social System Analysis (Bostrom and Heinen, 1977b): the individual needs, characteristics, and abilities of people in the work system; the internal work system characteristics; the external environment of the work system; and the support systems available for that work system. This analysis encompasses six factors (Bostrom and Heinen, 1977b):

1. Initial scan of the social system problems, conducted as general, open-ended questions to the workers.

2. Map the communication role network - focus on task-based interaction with people.

3. Individual role analysis - consideration of the psychological characteristics of jobs.

4. Analysis of existing work group, including attitudes about the existing work group performance.

5. Analysis of the work system's external environment, including interactions with other departments.

6. Analysis of support systems, including payroll, performance evaluation, training, budgeting and promotion.

The map in factor 2 includes such information as who each

person works for, the nature of interactions between a worker and others, the importance of each interaction, and the frequency of communications. Factor 3 may include having employees rate job characteristics for variety, challenge, decision making, learning, relevance, contribution, and future. It may utilize a Job Diagnosis Survey[6].

The Social System Analysis is conducted in three steps:

1. Determine the focal role(s), which are those roles that are essential to the creation of the product (or service).

2. Construct a Role Network showing the closeness and direction of communication between the focal role occupant and other role members of the organization.

3. Complete the Social Systems Grid as an aid to identifying social interactions with the focal role.

The Social System Analysis and the Technical System Analysis will be discussed in more detail in the next chapter.

The Ongoing Management Phase consists of successive iterations of the previous phases. The system is continuously monitored to determine if it is meeting its goals. This would be accomplished through periodic reviews in the same manner that repeat audits of certain systems are now conducted. The same basic systems methodology is used to analyze the redesigned system.

Conclusion

The development of STSA is a reaction to the Scientific Management perspective prevalent in business today, and to the increasing turbulence of the environment in which

businesses must operate. Problems previously identified in Organizational Design (OD), Management Information Systems (MIS), and Management Accounting Systems (MAS) which result from these two factors are also seen or can be deduced in OA. The fact that STSA has been proposed as an acceptable methodology to solve problems arising in other areas from the prevalence of the Scientific Management paradigm and from the turbulent environment leads to the belief that STSA should be adopted in OA and can produce "good results".

STS theory depends on two basic concepts. The first is that organizations are a mechanism through which man adapts to the environment, and so must be adaptable and flexible. Second, every Socio-Technical System is embedded in an environment influenced by cultures and values. The work organization is not uniquely determined by the technical systems: alternative organizational models are often available. Since OA directly influences the tenor of workers' tasks and interactions between organizational subsystems, OA can be considered to be involved in OD, MIS, and MAS designs. Thus, a design methodology is needed that considers the social and technical subsystems as integral components of the organization and that can provide integrated procedures allowing "control" to be viewed, analyzed, and developed consistently on all hierarchical levels within the organization's control structure.

The methodology of Socio-Technical Systems Analysis is fairly well defined but somewhat complex. The next chapter presents this methodology in detail, within the context of

an example, STSA in an interactive and interdependent produc=
tion process Operational Audit.

ENDNOTES

1. Thomas, 1987. (WP #87-19).

2. While the literature has not explicitly dealt with the development of postulates specifically for Operational Auditing, from Mautz and Sharaf's discussion it can be inferred that continuity is assumed in Operational Auditing as well as Financial Auditing: operational auditors assume some continuity of circumstances from one period to the next when engaged in repeat audits of a particular entity. A complete development of postulates for Operational Auditing is beyond the scope of this work.

3. See, for example, Nich, David L., Gift, Robert G. and Zeb, Jahan. "The Future of Operational Auditing," Internal Auditing (Summer, 1987): 3-11.

4. A related problem for EDP auditors is the erosion of data integrity. However, the problems of the specialized sub-field of EDP auditing are outside the relevant considerations of this work.

5. Modified from Thomas' modification of Davis' (1971) organizational chain of causation.

6. See Hackman, J.R. et al., Perspectives on Behavior in Organizations. New York: McGraw-Hill, 1977.

CHAPTER IV

AN EXAMPLE OF A SOCIO-TECHNICAL SYSTEMS ANALYSIS BASED OPERATIONAL AUDIT

This final chapter presents the Socio-Technical Systems Analysis (STSA) methodology, first in general, and through the use of a specific Operational Auditing (OA) example. The example is an analysis of the Cotter-Cherns Scottish Sandwich Corp., Ltd. (CCSSC), manufacturing process for vending machine of ham and cheese sandwiches[1]. While the example analyzes an entire production process, the methodology is equally well suited to the analysis of any department or function within an organization.

Phases or Steps of a Socio-Technical Analysis

The first phase in the STSA is the Organizational Scan[2]. The purpose of the Scan is the analysis of the organization, its environment, and its products. In OA terms, this is a Familiarization step. The Scan is conducted in four steps:

1. Think about the organization, and identify its goals and objectives.
2. Environmental Analysis. Think about and list any environmental considerations that affect the organization and its products. Specifically identify any important threats and

opportunities that management should be aware of when they plan the objectives and goals.

3. Organizational Analysis. Think about and list those internal factors about the organization itself that influence its strengths and weaknesses. This step should be based upon problems that organizational members have communicated during the Scan, descriptions of the people required to manufacture the product, the development of an organizational chart (Figure 6), and identification of the organization's physical boundaries (Plant Layout in Figure 7).

4. Product Analysis. Think about and list exactly what the finished product should do and look like, and its quality requirements. Specify the output so that the output specifications can be used as detailed finished goods standards. Consider the list of environmental constraints identified in Step 2. Based on the list of detailed finished goods standards that need to be satisfied, think about and list all the raw materials (inputs necessary to produce the output. This specification of the inputs can be used as detailed raw material standards.

The outputs (workpapers) of this first phase, then, are a list of organizational goals and objectives, a list of environmental threats and opportunities, a list of organizational strengths and weaknesses, and detailed output and input specifications for products.

The second phase in the STSA is the Technical Analysis. The purpose of the Technical Analysis is to analyze the production process in order to develop an Input/Output model of the product transformation process. The Technical Analysis is accomplished in five steps:

1. Identify the unit operations (the physical product transformations). Think about and list every single step that must take place to produce acceptable output. Now group these steps together into larger units representing significant transformations in

FIGURE 6. ORGANIZATION CHART FOR C.C.S.S.C., LTD.

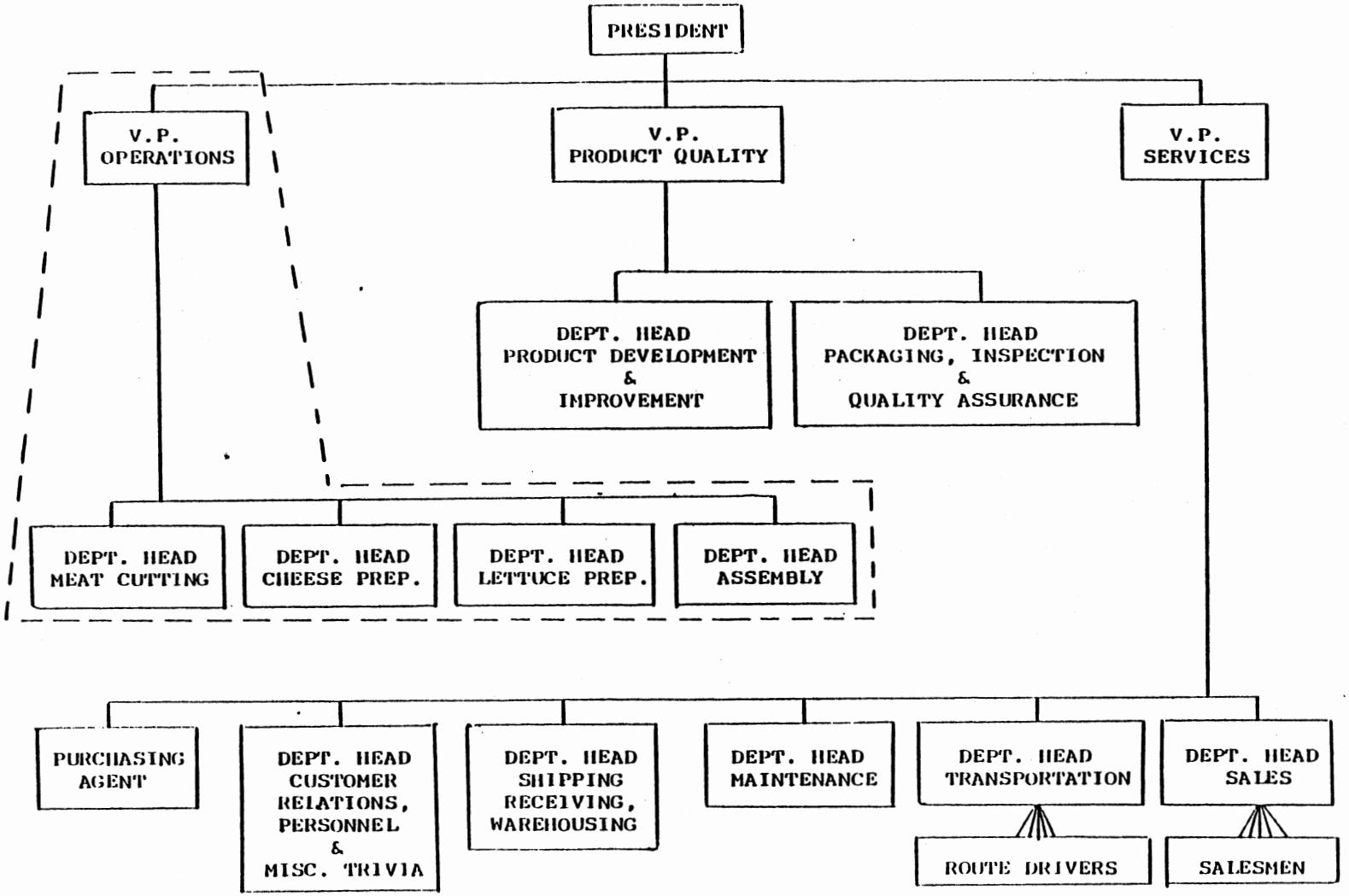
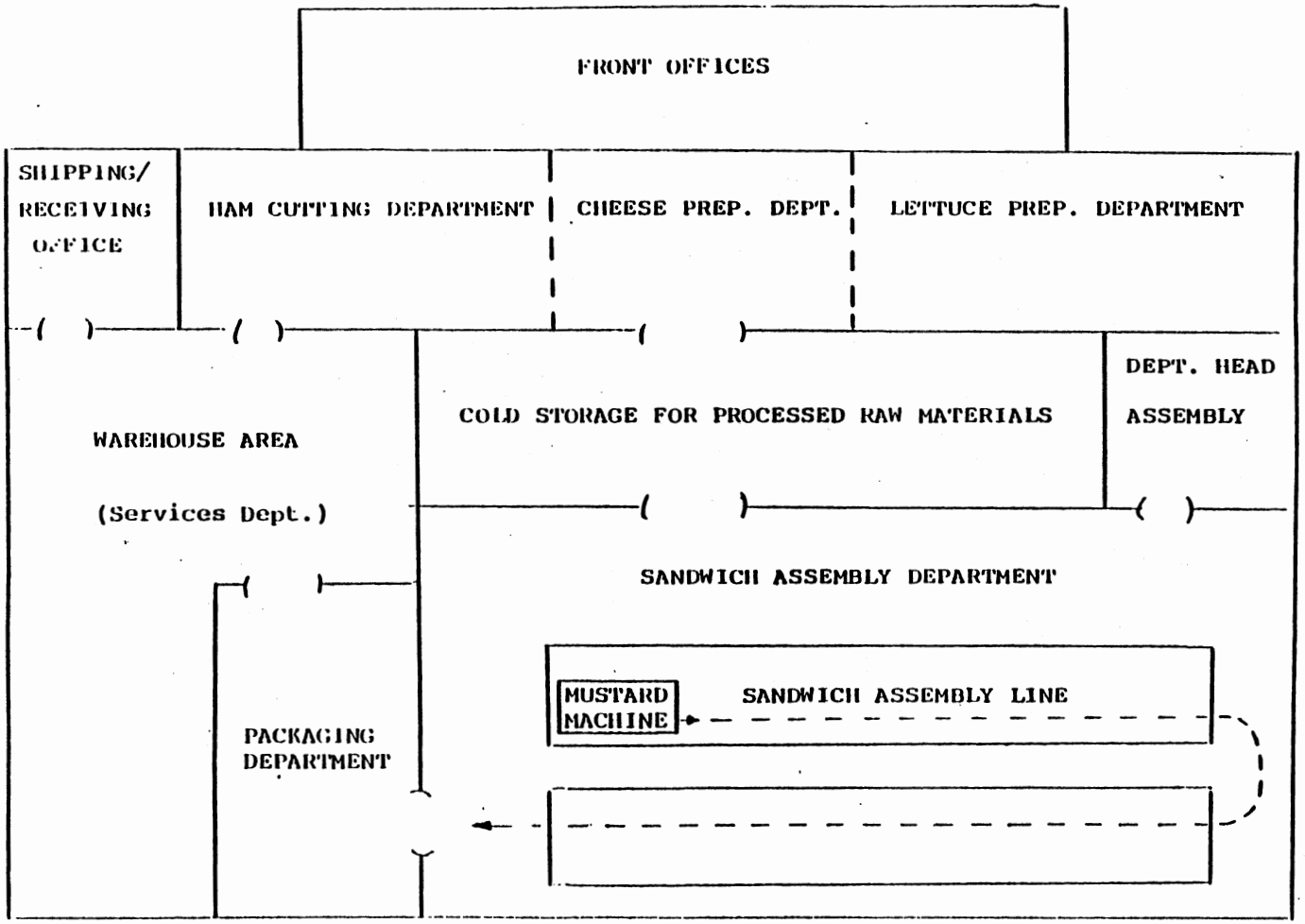

PRESIDENT
V.P. OPERATIONS
V.P. PRODUCT QUALITY
V.P. SERVICES
DEPT. HEAD PRODUCT DEVELOPMENT & IMPROVEMENT
DEPT. HEAD PACKAGING, INSPECTION & QUALITY ASSURANCE
DEPT. HEAD MEAT CUTTING
DEPT. HEAD CHEESE PREP.
DEPT. HEAD LETTUCE PREP.
DEPT. HEAD ASSEMBLY
PURCHASING AGENT
DEPT. HEAD CUSTOMER RELATIONS, PERSONNEL & MISC. TRIVIA
DEPT. HEAD SHIPPING RECEIVING, WAREHOUSING
DEPT. HEAD MAINTENANCE
DEPT. HEAD TRANSPORTATION
DEPT. HEAD SALES
ROUTE DRIVERS
SALESMEN

FIGURE 7. APPROXIMATE PLANT LAYOUT


FRONT OFFICES
SHIPPING/
RECEIVING
OFFICE
HAM CUTTING DEPARTMENT
CHEESE PREP. DEPT.
LETTUCE PREP. DEPARTMENT
DEPT. HEAD
ASSEMBLY
WAREHOUSE AREA
(Services Dept.)
COLD STORAGE FOR PROCESSED RAW MATERIALS
SANDWICH ASSEMBLY DEPARTMENT
MUSTARD
MACHINE
SANDWICH ASSEMBLY LINE
PACKAGING
DEPARTMENT

the production process.

2. List all the individual operations or steps required within each unit operations.

3. Identify the production variances within each unit operations. Think about and list all the things that could be defective or substandard about the ingredients or raw materials, and could go wrong with the tools, procedures, methods, or equipment. Under each unit operation, list the variances caused by the ingredients, the machinery, the procedures, or the methods used that could cause that particular unit operations to either fail to produce acceptable output or make it difficult for the employees to produce it easily, smoothly, and inexpensively.

4. Identify the key variances. Construct a Variance Analysis Matrix by listing the unit operations down the left hand margin and then placing the appropriate variances on the diagonal of the blank matrix. Start at the top of the Variance Matrix with the first variance of the first unit operation and determine if this variance causes or exacerbates any of the other variances in the matrix. Go through the entire matrix in this fashion, one column (variance) at a time. If two variances do interact with each other, place an "X" in the box where the two variances intersect.

5. Construct a Key Variance Control Table by placing the key variances in the left hand column and answering the questions that appear across the top of the table for each key variance.

The outputs for this second phase are a list of unit operations, a list of variances in a Variance Analysis Matrix, and a Key Variance Control Table. At this point, the Design Team (including the auditor) will have a better understanding of the system interdependencies, possible problems, and key information communication points and data needed for control in the system being examined.

The third phase in the STSA is the Social Analysis. The purpose of this phase is to analyze the roles and role networks created within the organization design to satisfy the four basic functions of the social system (Goal Attainment, Adaptation, Integration, and Long-Term Development). The Social Analysis is accomplished in three steps:

1. Determine the focal role(s) in the social system by examining the roles required to create the product (or service) which directly meets the mission of the system.

2. Construct a Role Network showing the closeness and direction of communication between the focal role occupant and other role senders. Identify all the essential social systems functions (G,A,I,L) for each of the network relationships with the focal role.

3. Complete the Social Systems Grid using the information developed for the role network. The grid aids identifying social interactions with the focal role dealing with these four essential functions.

The outputs for this third phase are thus the Role Network and the Social Systems Grid. After this phase, the auditor should have a fairly good idea of possible solutions to the problems facing the organization and specifically, what is needed to motivate the Key Focal Role members.

The last phase in the STSA is the Design, Analysis, or Redesign Effort. The purpose of this phase is an identification and clearer understanding of the issues to be addressed in meeting the organization's goals and objectives. Solutions are identified and implemented for problems discovered during the previous phases of the analysis. The STSA can be used simply to provide a "fresh look" at an existing operations, as a formal procedure in a

re-design project, or to design a new operation, department or organization. It is accomplished in two steps:

1. Integration is achieved throughout the analysis by linking organizational objectives to goals; goals to the organizational design and production process (the technical system); and the technical system to the social system. In the Social System Grid, consider the following three questions:

   a. Think about the entry in each cell of the grid. Does it describe a positive, negative, or neutral condition?
   b. If left unchanged, will organizational effectiveness deteriorate, stay the same, or improve?
   c. Will the continuation of these relationships frustrate or irritate the focal person(s)?

2. Synthesis is achieved through the philosophy of joint optimization. Organizational goals lead to many different possible technologies. But to make the technology work, it must be viewed within the context of its effects on the social system required by it. The social system must, in turn, be considered within the context of individual human needs.

The output of this last phase should be the completed analysis, including a list of problems and proposed solutions to those problems. The rest of this chapter discusses in detail an example of the STSA methodology applied to a ham and cheese manufacturing company[a].

The Organizational Scan

Step 1: Organizational Objectives and Goals.

Objectives are long-run general statements concerning the purposes for the organization. Goals are tangible short-run specific targets that if accomplished will lead to

the organization's objectives. The following are some of the objectives and goals identified for the CCSSC:

A. Objectives:

1. The stockholders are mainly old and want a consistent dividend record.

2. An overriding concern is with consumer preference and expanding the company's market share.

3. A healthy profit margin and the desire to have fun while getting rich and doing the job well are also major concerns.

B. Goals:

1. A 15% ROI is expected from all products and all new investments.

2. Avoid food poisoning incidents at all costs.

3. Strict compliance is required with all applicable laws and regulations.

Step 2: Environmental Analysis.

These are external factors that influence how the company goes about producing and marketing its products. The following are just a few environmental considerations that might be faced by a company planning to produce ham and cheese sandwiches:

A. Environmental Threats:

1. The firm is located in sunny southern California which encourages absenteeism and contains many competitors. See also Opportunity #1.

2. All workers must join the union which has been historically opposed to innovative changes proposed by the company for job design changes.

3. Public health codes are strictly enforced. Since sandwiches are to be sold to the

public, they must be produced under sanitary, government inspected conditions (plastic gloves must be used when handling all consumable raw materials, finished sandwiches must be kept at 44 degrees F. until consumption, etc.).

4. Technology and monetary conventions. The cost and size of the sandwiches will be constrained since they will only be sold through vending machines.

5. Weather and economic conditions. The availability and cost of resources may affect the composition of the final product (a drought in California may make lettuce too costly, or unavailable, etc.).

6. Consumer preferences or conventions of acceptability. In order to survive as a viable concern, the company must provide the public with what they demand (consumers may express preference for the following: lettuce on top, cheese next, ham slices next, mustard on the bottom slice, sandwich cut diagonally, etc.).

B. Environmental Opportunities

1. Competition is for geographic areas and specific businesses, locations, etc. Contracts with businesses, schools, etc, give a company sole distribution rights (i.e., only that company's vending machines and products will be sold within the business, school, etc.).

2. The company is owned by elderly stockholders who can easily supply capital for new investments.

3. There are many local suppliers for the raw materials needed to produce sandwiches.

Step 3: Organizational Analysis.

This is an analysis of the strengths and weaknesses within the company.

A. Internal Strengths:

1. The managers are reasonable men and women who want to get rich and enjoy the good life, but

who also want to be just and benevolent employers.

2. Delivery personnel often talk to customers when restocking vending machines and bring back customer comments to management (See Environmental Threat #6).

3. Management has decided to concentrate all their efforts on making only one product, a quality ham and cheese sandwich.

4. The mustard spreading machine, while very expensive, has a maximum spreading rate of 500 slices/hour. This is well above any projected sales volumes.

B. Internal Weaknesses:

1. Management has decided to limit distribution to vending machines. Some larger firms (hospitals, schools, etc.) have cafeterias which might sell CCSSC sandwiches.

2. The Assembly Department has historically experienced a high employee turnover rate of about 30% annually. This leads to a high number of rejects, not meeting production quotas, and uneven workflows when many workers are absent.

3. Even though managers are friendly, maintain open lines of communication, and coordinate their activities, workers appear basically apathetic, bored, and antagonistic toward workers in other departments. They do seem honest and capable, though.

C. Current Problems in Sandwich Production:

1. There has been some difficulty in meeting scheduled production requirements in recent months.

2. Many sandwiches approved by inspection are at the maximum size limits for the cardboard slips and vending machines.

3. Poor packaging has resulted in penalties for health code violations.

4. Turnover of assembly workers is a chronic problem. Inexperienced workers frequently leave before they are productive.

D. Organization Chart (see Figure 6)

E. Plant Layout and Physical Boundaries of the Company (see Figure 7)

Step 4: Product Analysis.

This includes an analysis of all products made by the company. In this case, only one product is manufactured.

A. Output Specifications: Output specifications for ham and cheese sandwiches might read as follows:

1. Quality

   a. Two slices of equal size bread.
   b. Nutritional content will be specified for the bread, ham and cheese (fat, carbohydrates, vitamins, etc.).
   c. No overlap or mismatching of slices.
   d. Sandwiches should be taste-panel accepted.
   e. Cut should be sharp and on the diagonal.
   f. Total dimensions of sandwiches should not exceed vendor purchased cardboard packing slips.
   g. Each sandwich should be individually wrapped in a cardboard packing slip surrounded by plastic wrap.
   h. Plastic wrap should be heat sealed.
   i. Plastic should not be burned during sealing.
   j. Completed sandwich should be stored at 44 degrees F. until consumption.

2. Quantity

   a. Weekly schedules for production should be posted on the preceding Friday.
   b. Sales department should update production requirements daily on the basis of feedback from route drivers.

B. Input Specifications: Input specifications for ham and cheese sandwiches that might be derived from previous output specifications, and from a list of environmental considerations, could read as follows:

1. Bread: Rye bread, two 15 gram slices, 4" x 4" x 1/4", no heels to be used, no visible mold, no ripped or mangled

slices, freshness will equal predetermined level, etc.

2. Ham: Two one-ounce slices, fat content of ham will equal some predetermined level, visually the slices should have a good marbled texture, no gray or off-color slices should be used, salt content of ham should be equal to some predetermined level, ham should be held at or below 44 degrees F. at all times, workers handling the ham should use plastic sanitary gloves at all times, etc.

3. Cheese: Domestic Swiss, a single one-ounce slice, fat content equal to some predetermined level, aged for three years, no visible mold, no ripped or double slices should be used, preservative content should not exceed some predetermined level, cheese should be palatable, only Kragt brand cheese should be used (because Mr. Kragt is the president's golfing partner), cheese should be held at or below 44 degrees F. at all times, etc.

4. Lettuce: One layer evenly covering entire slice of bread, no visible bug damage, crispness should equal some predetermined level, no lumps or cores should be used -- hence outer leaves only, color should range from dark through light green - no white leaves are to be used , no more than three grams of lettuce to cover bread, no insecticides should have been used during the growing of the lettuce, etc.

5. Mustard: Five cc's, evenly spread on bottom slice, no slop over, yellow color, creamy and smooth, etc.

The Technical System Analysis

Steps 1 & 2: Unit Operations and Production Process.

The Scan should have developed a list of environmental

considerations together with detailed output and input specifications. The next step in the process is to derive a detailed, sequential analysis of every step necessary to produce the product. From this listing it should be possible to summarize or regroup the process into recognizable transformations of the raw materials as they move toward product completion. These larger blocks of activities will be called Unit Operations.

For the example at hand, one "logical" approach to making a ham and cheese sandwich might read as follows:

Unit Operations — Production Tasks

Purchasing

1. Purchase correct amount & size of bread.
2. Purchase correct amount, size and quality of ham.
3. Purchase correct amount, size and quality of cheese.
4. Purchase correct amount and quality of lettuce.
5. Purchase correct amount and quality of mustard.
6. Purchase correct amount of plastic gloves.
7. Purchase correct amount and size of plastic wrap.
8. Purchase correct amount and size of boxes.
9. Purchase correct amount of wax paper.
10. Purchase correct amount and size of labels.

Receiving

1. Receive and store all raw materialsand supplies.
2. Store perishables in cold storage at 44 degrees F.
3. Store bread in dry area.

Ham Preparation

1. Requisition quantity of ham needed for next day's production (2 slices/sandwich).
2. Slice ham into 4" x 4" x 1/4" slices of one ounce weight.
3. Stack sliced ham into containers (250 slices/container).
4. Inspect ham for quality while stacking.
5. Store sealed containers in cold storage.

A similar analysis should be done for lettuce and cheese preparation.

Assembly: Bread Prepared

1. Review daily production quota with Department Head.
2. Get bread and mustard from storage area.
3. Fill mustard machine with mustard.
4. Insert one half of bread quota into machine.
5. Take remaining loaves of bread to work station #5.
6. Set machine speed and turn on machine.
7. As each slice of bread comes out of machine, place it mustard side up on an empty assembly tray (20 slices/tray: 4 x 5 rows).
8. When assembly tray is full slide full tray to work station #2 and replace tray with clean empty tray from rack next to mustard machine.
9. Repeat until scheduled daily quota of slices has been processed.

Assembly: Ham Sub-Assemblies Attached

1. Get container of ham slices from cold storage (slices previously prepared by Ham Cutting Department).
2. Slide full tray of mustard-covered bread into position at work station.
3. Neatly position two slices of ham from the container on top of each mustard-covered slice of bread.
4. Proceed until all 20 slices on tray are covered.
5. Slide ham covered tray to worker at work station #3.
6. Repeat operation until scheduled daily quota of trays is reached.

Assembly: Cheese Sub-Assemblies Attached

1. Get container of sliced cheese from cold storage (previously prepared by Cheese Preparation Department).
2. Slide full tray of ham-covered slices into position at work station.
3. Neatly place one slice of cheese from container on top of each piece of ham-covered bread.
4. Proceed until entire tray of 20 ham-covered slices has been covered with cheese.
5. Slide cheese covered tray to work station #4.
6. Repeat operations until scheduled daily quota of trays is reached.

The analysis should continue through the entire process, including: inserting lettuce, adding the top slice

of bread, cutting, packaging, and inspecting the finished sandwich.

Step 3: Identify the Production Process Variances.

Once the production process has been decomposed into a number of unit operations, think about where and how the process could conceivably go wrong. Generate a list of potential things that could, if they occurred, disrupt the normal, smooth, efficient production of the finished product. Remember that these potential problems (or VARIANCES) could encompass: deviations in raw materials; defective tools and equipment; or incorrect methods and procedures used by management or employees.

Potential variances that might be detected in the unit operations within the Assembly Department are found below. Note that this is only a sampling for the purpose of explaining the variance control technique, thus, there may well be other additional variances to consider. At the same time, some of these variances might not be of any concern if the output specifications were not as detailed (i.e., making a sandwich during a T.V. commercial while the football game is on).

Unit Operations in Assembly Department	Potential Variances
Bread Prepared	Bread soggy. Edges of bread curled. Bread improperly fed into machine. Amount of prepared bread.
Ham Sub-Assemblies Attached	Temperature of ham too high. Slices of ham too thick. Slices of ham in shreds.

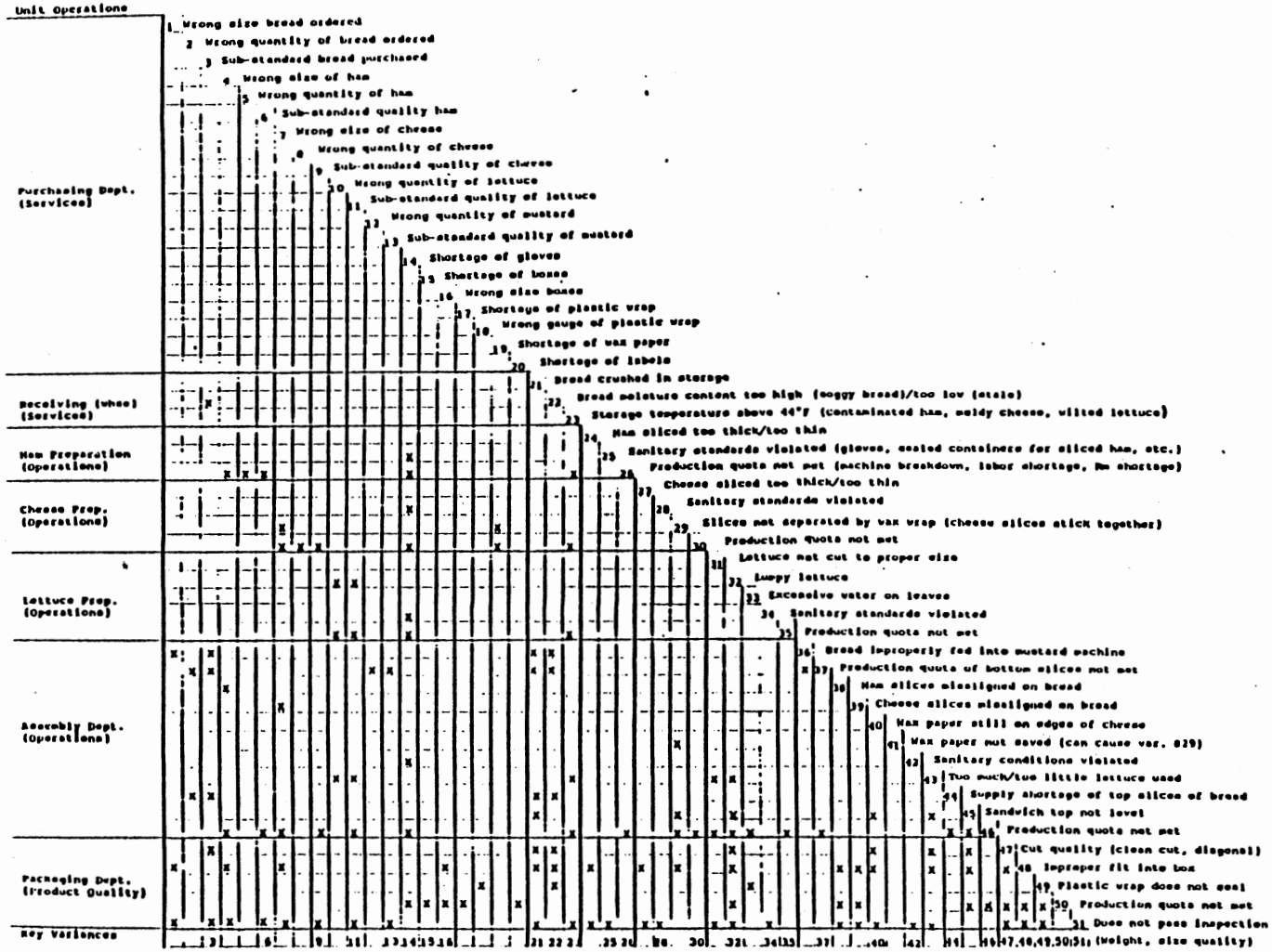
	Ham dirty or contaminated. Ham slices misaligned on bread.
Cheese Sub-Assemblies Attached	Cheese moldy. Wax wrap still on edges. Slices stick together. Cheese misaligned on bread.
Lettuce Inserted	Lettuce lumpy. Excessive water on leaves.
Sandwich Assembled	Inadequate supply of top slices. Size of slices incorrect. Sandwich top not level.

The aim of the technical system analysis is to help identify those variances which significantly affect the capability of the production system to pursue its objectives in one or more unit operations. One way to identify key variances is to look at the interdependencies between them, and the matrix format (Figure 8) helps to do this. The matrix points out relationships among the variances and highlights major clusters or chains of cause-and-effect relationships, thus providing a formalized map of the events that need to be controlled by the social system.

A Variance Control Table (Figure 9) reports the extent to which each key variance is presently controlled by the social system and where important organizational and informational loops exist, or are required. The control table is used to clarify the following data:

1. In what unit operation the variance occurs.
2. Where it is observed for the first time.
3. Where it is controlled and by whom.
4. What control actions are undertaken.
5. What information flow is involved in the diagnosis and control activity.

FIGURE 8. THE VARIANCE MATRIX


Unit Operations
Purchasing Dept. (Services)
Receiving (Whse) (Services)
Ham Preparation (Operations)
Cheese Prep. (Operations)
Lettuce Prep. (Operations)
Assembly Dept. (Operations)
Packaging Dept. (Product Quality)
Key Variances
1 Wrong size bread ordered
2 Wrong quantity of bread ordered
3 Sub-standard bread purchased
4 Wrong size of ham
5 Wrong quantity of ham
6 Sub-standard quality ham
7 Wrong size of cheese
8 Wrong quantity of cheese
9 Sub-standard quality of cheese
10 Wrong quantity of lettuce
11 Sub-standard quality of lettuce
12 Wrong quantity of mustard
13 Sub-standard quality of mustard
14 Shortage of gloves
15 Shortage of boxes
16 Wrong size boxes
17 Shortage of plastic wrap
18 Wrong gauge of plastic wrap
19 Shortage of wax paper
20 Shortage of labels
21 Bread crushed in storage
22 Bread moisture content too high (soggy bread)/too low (stale)
23 Storage temperature above 44°F (contaminated ham, moldy cheese, wilted lettuce)
24 Ham sliced too thick/too thin
25 Sanitary standards violated (gloves, sealed containers for sliced ham, etc.)
26 Production quota not met (machine breakdown, labor shortage, ham shortage)
27 Cheese sliced too thick/too thin
28 Sanitary standards violated
29 Slices not separated by wax wrap (cheese slices stick together)
30 Production quota not met
31 Lettuce not cut to proper size
32 Limpy lettuce
33 Excessive water on leaves
34 Sanitary standards violated
35 Production quota not met
36 Bread improperly fed into mustard machine
37 Production quota of bottom slices not met
38 Ham slices misaligned on bread
39 Cheese slices misaligned on bread
40 Wax paper still on edges of cheese
41 Wax paper not saved (can cause var. 039)
42 Sanitary conditions violated
43 Too much/too little lettuce used
44 Supply shortage of top slices of bread
45 Sandwich top not level
46 Production quota not met
47 Cut quality (clean cut, diagonal)
48 Improper fit into box
49 Plastic wrap does not seal
50 Production quota not met
51 Does not pass inspection
(Weight, size quality)

Note that in the example here, we have not explicitly investigated problems caused by Maintenance, suppliers, or customers. In a full-scale Operational Audit, it is advisable to examine the impact which these systems have on the production department. Thus, the next steps would be to:

1. Identify the maintenance variances.
2. Examine how they are being controlled.
3. Identify variances being passed into the system by those who supply raw materials or those who use the products.
4. Examine how they are being controlled.
5. Examine how their effects could be diminished.

Step 4: Identify the Key Variances.

In Figure 8, 28 variances are considered to be Key Variances. A Key Variance is any variance that, if it occurred during the production process, would seriously disrupt the efficient, production of the sandwiches.

By reviewing the environmental considerations that are faced by the CCSSC sandwich company and the output specifications that have been placed on the production process, it should be possible to generate a list of occurrences that should be avoided at all costs. This list will help to determine the Key Process Variances which need to be carefully controlled. As further explanation, the following are some of the reasons behind giving these 28 variances the special status of Key Variances:

Variance #22 (Soggy Bread):

> Bread with a high moisture content, from whatever source (purchase of low quality bread, improper storage) jams the mustard spreading machine and thus shuts down the line completely until the maintenance department can send someone to unclog the machine. Since the line loses $50/minute when it is down, management wants to avoid this situation.

Variance #32 (Lumpy Lettuce):

> Although at first this may seem like a minor item, it is obvious from the matrix that this variance is worthy of further attention. Looking down the column labeled 32 on Figure 8, note that lumpy lettuce causes or interacts with seven other variances that appear later in the matrix. Lumpy lettuce makes it hard for the operator in Packaging to level and cut the sandwiches with lumpy lettuce in them, and likewise to package and seal sandwiches that contain lumpy lettuce. Hence, because it potentially leads to so many other problems further down the line, lumpy lettuce has been singled out as a Key Variance.

Variance #49 (Plastic Wrap Does Not Seal):

> This is considered a Key Variance because the local health board deems unsealed sandwiches to be in violation of its health codes. Compliance with health codes is a primary goal of this company.

Step 5: Construct the Key Variance Control Table.

Figure 9 is a partial Key Variance Control Table illustrating the information required for each key variance identified in Step 4. Below are brief summaries of three process variances found in Figure 9 together with some preliminary suggestions concerning how they might be controlled in a more effective manner.

Variance #22 (Soggy Bread):

> The cause of this variance is either (a) the purchase of low quality bread with high moisture content, or (b) the improper storage of bread during warehousing. It appears that the variance is being transported across several organizational

KEY PROCESS VARIANCE	WHERE OCCURS	NAME OF UNIT OPERATION		
		WHERE OBSERVED	WHERE CONTROLLED	
			DEPARTMENT	ROLE
22) Soggy Bread	Purchasing or Warehouse	Assembly	Purchasing Department, Warehouse, or Assembly.	Purchasing agent. Warehouse or Assembly workers.
32) Lumpy Lettuce	Lettuce Preparation	Lettuce inserted during Assembly.	Lettuce Preparation or Assembly.	Lettuce workers or Assembly workers.
37) Amount of prepared bread does not meet quota	Purchasing, Warehouse or Assembly	Assembly	Purchasing, Warehouse, or Assembly.	Purchasing agent, Warehouse clerk, or Assembly workers.
49) Plastic wrap does not seal.	Packaging Department	Packaging Department	Throughout production process.	All roles can control causes.

FIGURE 9. KEY VARIANCE CONTROL TABLE

ACTIVITIES REQUIRED TO CONTROL	INFORMATION & SOURCES OF INFORMATION RELATED TO CONTROL VARIANCES	SUGGESTIONS FOR JOB OR ORGANIZATION REDESIGN	SUGGESTIONS FOR CHANGES IN THE TECHNOLOGY
Purchase better quality bread. Keep warehouse dry. Reject soggy slices.	Visual Inspection of slices. Feedback to Purchasing and Warehouse. Increased rejects or jams.	Assembly workers purchase bread and store bread.	Dehumidifier in bread storage. Modify mustard machine to accept soggy bread.
Discard or crush lumps at lettuce prep. Reject lumpy lettuce at Assembly.	Feedback to Lettuce workers. Visual inspection in Lettuce Preparation.	Assembly workers prepare lettuce.	Develop smooth leaf lettuce. Change type of lettuce used.
Obtain more trays. Store slices to retain freshness. Coordinate 3 departments.	Short supply of trays. Low stock levels in Warehouse. Amount of mustard.	Assembly workers obtain trays from supplier.	Replace trays with conbeyor belt.
Closer Tolerances & more accurate sandwich-making. Attempt to reseal.	Feedback to all Assembly workers on critical nature of sealing.	Rotate Assembly jobs between Packaging & the other Assy. stations.	Use continuous roll plastic wrap.

FIGURE 9 (CONTINUED)

boundaries (See Figure 6) and is not being discovered until it reaches the Assembly Department where control of the variance is currently impossible.

The variance is observed in the Assembly Department. Experienced operators sometimes catch the problem before it is too late, because they know what brands of bread will jam their machine. Inexperienced operators do not, however, and as a result slices of bread are mangled, curled, or soggy and jam the equipment. When this happens, the line has to be shut down until maintenance can unclog the machine.

Given the current structure and practices of the organization, this valuable piece of information that experienced production workers hold never seems to find its way back to the purchasing agent or the warehouse foreman. Hence, corrective action is seldom forthcoming. Instead the maintenance department or the vendor of the mustard machine get the complaints -- complaints arise, of course, after the frustrated workers sometimes either force the soggy bread into the equipment so to (hopeful
ly) focus attention on the real source of the variance, or simply keep their mouths shut because they "don't get paid to think."

Potential Suggestions for Improvements:

1. Search for and purchase a new mustard spreading machine that will not jam up as often.

2. Install a humidity tent prior to the mustard machine to ensure that all bread entering the mustard machine has the proper moisture content.

3. Live with the current scrap rate and periodically fire the bread preparers because they cannot make the production quotas.

4. Change the goals and rewards for the Purchasing Department so that they better coincide with the overall organizational mission of making good quality ham and cheese sandwiches as efficiently as possible.

5. Expand the boundary of the Assembly Department so that they have some control over the purchasing of assembly-related inputs, such as bread.

<u>Variance #32 (Lumpy Lettuce)</u>:

Again, here is a variance that occurs in one

organizational unit and is then transported across a boundary to wreak havoc on another department. This problem apparently arises because of conflicting goals in two different organizational units. Since the Lettuce Preparation Department bonus is based upon speed of processing and low scrap rate (weight of raw heads compared to weight of processed lettuce) they often are less than careful about shipping cores and unprocessed lettuce (lumps) to the Assembly Department. In this fashion, the lettuce department looks good because they cut their scrap rate and more than meet their schedule for processing time.

However, the Assembly Department is charged for lettuce containers by weight (so many sandwiches per container of lettuce) and hence looks bad when unscheduled time is required to process the lettuce or discard the cores or make lumpy sandwiches. As the situation is currently structured, the Assembly Department has three alternatives: (a) produce lumpy sandwiches in which case other variances will be caused further down the line, or the sandwich will fail final inspection, (b) stop and process the lettuce (crush the lumps) in which case they will fail to make their time-studied quota, or (c) scrap the lumps in which case they will be penalized for using too little lettuce on each sandwich, or too much lettuce if more is requisitioned.

The Assembly Department appears to be caught in a classic Catch-22 situation. Regardless of what they do, they are going to look bad (at least according to the Cost Variance Reports management receives) while the Lettuce Preparation Department looks great.

Potential Suggestions for Improvements:

1. Change the reward structures of these two departments so as to reduce this clash in goals. As it now stands, performance measures for these two departments are inappropriate for getting the total system to produce a complete, high quality sandwich. Tie the Lettuce Preparation Department's performance to the Assembly Department via some sort of joint reward structure.

2. Install lettuce shredding machinery.

3. Change some of the boundaries inside the organization so that workers inserting the lettuce into the sandwiches actually prepare their own supply of raw materials prior to final assembly.

Variance #49 (Plastic Wrap Does Not Seal):

This variance is internal to the packaging department and therefore does not involve crossing organizational boundaries.

Potential Suggestions for Improvement:

1. Job rotation, so workers could gain a fuller appreciation of the need for meeting production tolerances and output specifications.

2. Introduce a better training program to alert new workers to the potential problems that might arise via their sloppy work.

If these steps do not rectify the problem, then Row 49 of Figure 8 should be re-examined for secondary causes of the variance (such as ham slices too thick, or wax wrap still on cheese).

Social System Analysis

The purpose of the social part of a Socio-Technical System is to provide the control, coordination, adaptability, and flexibility that enables a particular technical system to achieve its goals. Part of this is through social control of key variances, and part is through performing other activities related to adaptability and flexibility.

Assemblages (such as crowds) differ from systems (such as organizations) because systems have structure. Organizations typically contain collections of positions and jobs to which sets of behaviors have been assigned. These assigned behaviors are not completely specified in advance. Individual people occupying a position have expectations about it. Positions also involve legitimate expectations by others which are seldom formally defined.

The techniques of sandwich-making have been analyzed above. The organization positions invented by CCSSC for sandwich-making and for services to production are shown in Figure 6. The people filling the positions in the sandwich-making system have also been briefly described.

Step 1: Identify the Focal Roles.

This is a useful bridging concept between people and positions. A role is a set of expectations and specified behaviors assigned to a position being occupied by someone having relationships with other people in other roles. By its structure, an organization assigns activities to positions, and then assigns positions to specific individuals and/or groups. Individuals holding these positions create roles by exercising their individual needs and wants in the positions. Positions without people are not roles. People without positions are not role-occupants.

People communicate their expectations to other people about the positions they hold in an organization. These people are the role senders. Role senders transmit their own interpretations plus their own expectations. Role occupants hear partly what their role set (i.e., all role senders) interpret and send, and partly what the occupant interprets and expects. So role behavior is a combination of:

1. Influential role senders,
2. The expectations of the role occupant, and
3. The situation the role occupant finds

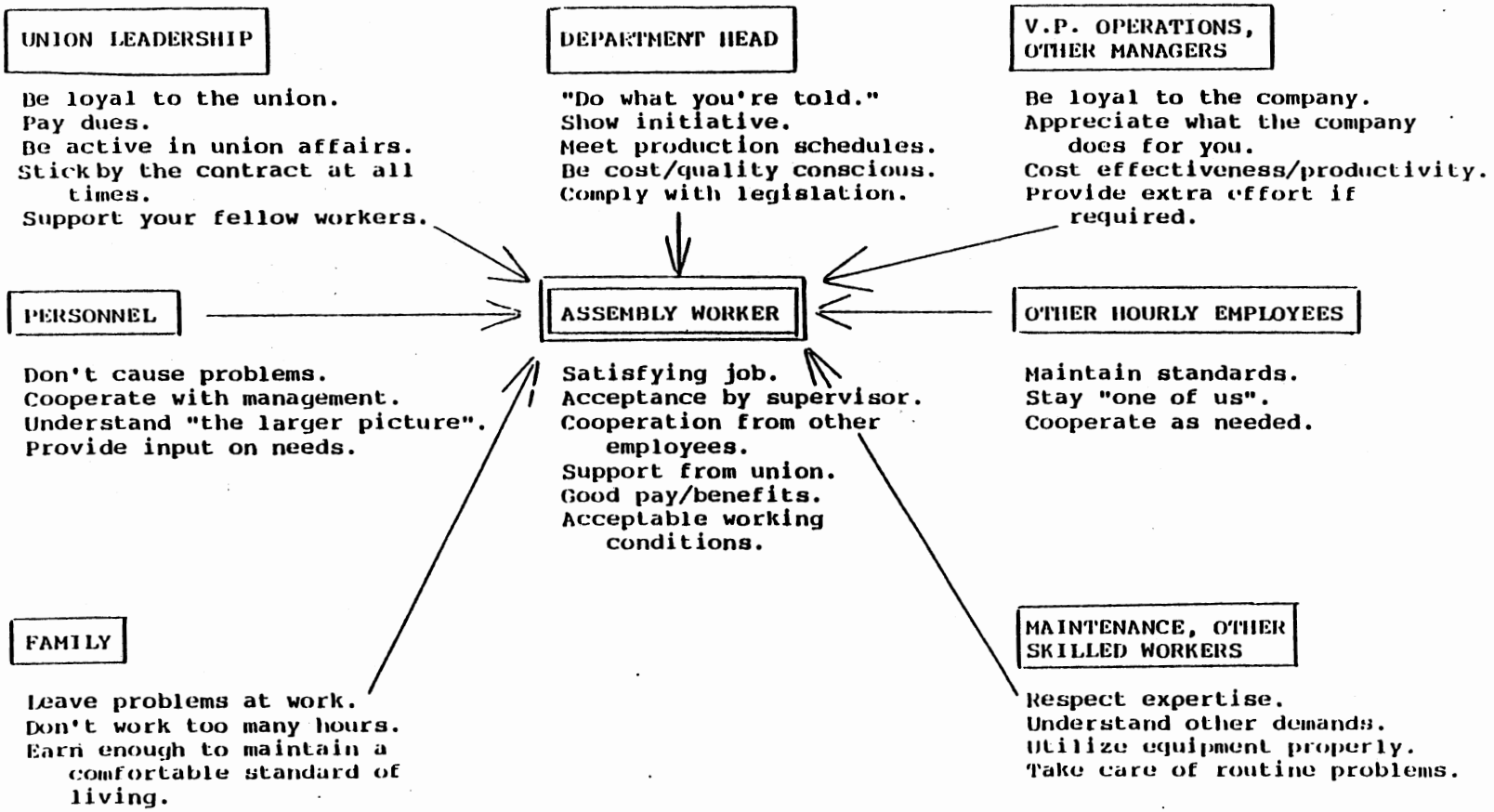
> him/herself in (involves physical, social and psychological constraints).

In other words, individuals have a tendency to act as wholes, and not just simply in terms of their formal assignments. Obviously, there is seldom a perfect fit between individual role expectations and organization role expectations. Some form of accommodation is required between them. So, efforts must be made to clarify and satisfy mutual expectations. Otherwise, dysfunctional behavior will result (often characterized by low productivity, apathy, absenteeism, etc.)

The social analysis attempts to examine this accommodation between roles. Unless unlimited time and money exist to undertake an examination of every organizational role in the social analysis, it is necessary to identify a focal role (or a limited number of such roles) to adequately examine the mutual expectations described above. In a Socio-Technical Analysis, the most important roles are those most closely involved in the control of key variances. These roles should be taken as the focal point.

Figure 10 illustrates some of the formal and informal expectations influencing the Assembly Department worker. Here the assembly worker is viewed as a key focal role, because it is the worker who can best control the relevant factors which produce controllable cost variances. The assembly manager sees that workers follow production schedules, health codes, and job performance standards. He/she checks their performance, and informs them of

FIGURE 10. EXPECTATIONS INFLUENCING THE ROLE OF ASSEMBLY WORKERS


UNION LEADERSHIP
Be loyal to the union.
Pay dues.
Be active in union affairs.
Stick by the contract at all times.
Support your fellow workers.
DEPARTMENT HEAD
"Do what you're told."
Show initiative.
Meet production schedules.
Be cost/quality conscious.
Comply with legislation.
V.P. OPERATIONS, OTHER MANAGERS
Be loyal to the company.
Appreciate what the company does for you.
Cost effectiveness/productivity.
Provide extra effort if required.
PERSONNEL
Don't cause problems.
Cooperate with management.
Understand "the larger picture".
Provide input on needs.
ASSEMBLY WORKER
Satisfying job.
Acceptance by supervisor.
Cooperation from other employees.
Support from union.
Good pay/benefits.
Acceptable working conditions.
OTHER HOURLY EMPLOYEES
Maintain standards.
Stay "one of us".
Cooperate as needed.
FAMILY
Leave problems at work.
Don't work too many hours.
Earn enough to maintain a comfortable standard of living.
MAINTENANCE, OTHER SKILLED WORKERS
Respect expertise.
Understand other demands.
Utilize equipment properly.
Take care of routine problems.

deviations. Other employees send their expectations too. Production workers send expectations about not working too fast. Maintenance workers send expectations about not complaining too much about the machines. Warehouse workers and other operations workers in the food preparation areas send expectations to the assembly worker about not complaining too much about short supplies, or poor quality materials. Assembly workers, if they are disinterested in the job or not easily influenced by others, may disregard many of these sent expectations and behave in the way they wish. This disregard may be seen by the role senders as uncooperative or unfriendly behavior, and the role senders may become aggressive, hostile, or punishing (depending upon their personal attributes). Thus, the focal role occupant may influence his or her own role behavior, and ignore the role senders, or he/she may be changed by the role senders.

Step 2: Construct the Role Network.

Any social system, if it is to survive, is required to perform four basic functions. These are:

(G): Goal Attainment
(A): Adaptation
(I): Integration
(L): Long-Term Development

Every organization exists in order to meet the short-term goal of producing its product (G). However, in doing so it must not adversely impact its capacity to survive as an organization. To survive it must adapt to, and be protected from short term changes and pressures in its immediate

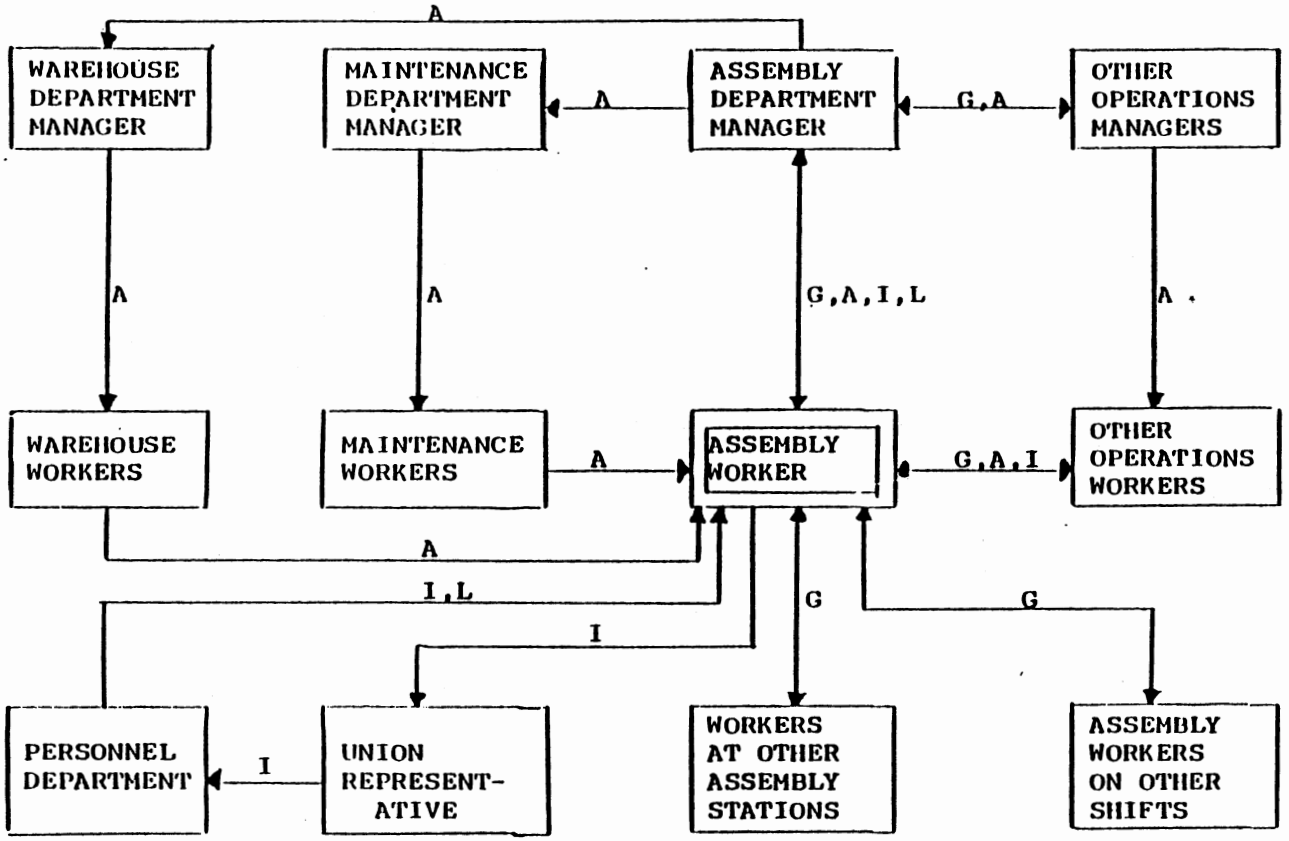
environment (A). It must also combine or integrate activities to manage internal conflict and to promote smooth interactions among people (I). Finally, it must ensure the long-term development of knowledge, skills, and motivation to cope with goal-related, environmental, and systems requirements in the future (L).

Many organizations have departments to perform these functions. For example, Industrial Engineering, Planning, Personnel, and Training departments can have the main responsibilities for one or another of the four basic functions. Yet, we know from experience that not all such activities are handled by special departments. Indeed, informal activities at the level of the Focal Role are often more frequent and more influential in affecting functional behavior than formal methods.

The task for any social system analysis is to map the structures and relationships in which the required social system functions get carried out, and to look at interactive relationships within and between the various subsystems involved. This mapping involves examining the purposes served by existing relationships, as portrayed in the Role Network analysis (Figure 11) and examining the presence or absence of a fixed set of functional relationships in a Social Systems Grid (Figure 12).

Figure 11 shows the Focal Role of Sandwich Assembly Worker in relation to other employees (Role Senders). These role senders include the Assembly Manager, other assembly workers (other stations, other shifts), other operations

FIGURE 11. THE ROLE NETWORK


A
WAREHOUSE DEPARTMENT MANAGER
MAINTENANCE DEPARTMENT MANAGER
A
ASSEMBLY DEPARTMENT MANAGER
G,A
OTHER OPERATIONS MANAGERS
A
A
G,A,I,L
A
WAREHOUSE WORKERS
MAINTENANCE WORKERS
A
ASSEMBLY WORKER
G,A,I
OTHER OPERATIONS WORKERS
A
I,L
I
G
G
PERSONNEL DEPARTMENT
I
UNION REPRESENT-ATIVE
WORKERS AT OTHER ASSEMBLY STATIONS
ASSEMBLY WORKERS ON OTHER SHIFTS

workers (Lettuce Preparation workers, etc.). Figure 11 demonstrates that the concept of a social role becomes more real and less abstract when we think of it in terms of its outcome (Role Activity or performance), such as sandwich-making. Every worker performs his or her role in a different way than any other person in the same position. This is due to the uniqueness of personal attributes such as intelligence, interest, etc. Workers run the packaging operation, or lettuce insertion station, for instance, but differ in how hard they try to make a quality sandwich, or whether they try to coordinate with others on the assembly line, or in other groups.

The Role Network shows the function (G, A, I, or L) that each relationship affects. For instance, sandwich assembly workers have more contact with each other than with any other role, but they are in contact with one another mainly about matters of running the line (G). Their upward relations with their assembly manager are requests for more supplies or requests for machine repair, both of which require changes in the environment (A). The manager initiates contacts with the assembly workers to ensure that the line continues to function and that key variances are controlled (G). The manager also communicates changes in production levels caused by sales (A), and can raise the levels of friction and resentment between assembly workers and management through the tone and content of these instructions (I).

Assembly workers will contact other shifts if they need

to pass on information about the line (G). Assembly workers also contact other operations workers in the food preparation areas when they need additional supplies in order to meet increased production schedules (A). They also contact other operations workers about variances like soggy bread, or lumpy lettuce (G). The relations between assembly workers and these other operations workers are somewhat strained when the latter show little interest or concern in the former's problems (I). Assembly workers are contacted by warehouse and maintenance workers (A), after their needs for supplies or repairs are communicated through their manager (A). Assembly workers contact the Personnel Department through their union to file grievances, especially those relating to management and supervision (I).

Step 3: Construct the Social Systems Grid.

The Social Systems Grid takes the combined focus of the four required social functions (G,A,I,L) and the particular relationships identified in the role network, and adds to it four specific relationships found in most organizations. The resulting grid of 16 cells draws attention to every possible case of relationships fulfilling social functions which affect, or are affected by, the focal role and role senders. The four specific relationships the grid examines are as follows:

1. vertical relationships between superior and subordinate,

2. horizontal relationships between the focal role and similar status members of his/her

work group,

3. cross-group relationships between the focal role and people in adjacent groups within the same Socio-Technical system, and

4. relationships between outsiders and the focal role in the Socio-Technical system under investigation.

In the grid in Figure 12, the use of the sandwich assembly worker is continued as the focal role. In completing the grid, the user should describe behaviors or their absence in each of the 16 cells. For "Goal Attainment" behaviors (Cells G-1, G-2, G-3, G-4) cell entries can be drawn directly from the Table of Variance Control (Figure 9) for all the key variances identified in the technical system analysis. Behaviors for the other three rows (A,I,L) must be obtained from other sources. Some information for the 16 cells of the grid can be drawn directly from the Role Network (as presented in Figure 11) representing present, actual behavior. For example, in Cell G-3 the Assembly workers' attempts to communicate with Lettuce Preparation workers is described under "Variance 32," while Cell I-3 describes the Lettuce Preparation workers' disinterested response to such attempts.

As noted, the grid also permits description of behaviors that are not occurring in the achievement of essential functions by specified relationships. For example, behaviors which are not occurring, but which could be, are noted in Cells A-2, I-2, and L-1. Other such behaviors will be found throughout the grid.

The grid can summarize the social systems analysis in

BASIC ORGANIZATIONAL RELATIONSHIPS / BASIC SOCIAL SYSTEM FUNCTIONS	VERTICAL RELATIONSHIPS 1.	HORIZONTAL RELATIONSHIPS 2.
GOAL ATTAINMENT (G)	Var. 622: Assembly workers are told by their manager "not to worry about soggy bread unless it jams the mustard machine." Var. 632: Assembly workers are told by their assembly manager to use lumpy lettuce rather than to reject it, and to take time to crush it only when absolutely necessary.	Var. 622: Experienced assembly workers have not described the machine effects of soggy bread to inexperienced workers. Var. 633: These assembly workers with experience in both lettuce insert and packaging operations communicate together to keep lumps from impairing sealing quality. They do not share their insight with less experienced assembly workers.
ADAPTATION (A)	Assembly workers inform their manager about machine breakdowns and shortages of raw materials. Assembly managers are sent production schedules each Friday for the following week, and these managers inform their workers of production changes on a daily basis. Health care violations are communicated in a similar way.	Assembly workers do not discuss low volume of prepared bread caused by bottlenecks at the mustard machine and by shortages of bread trays. Assembly workers do not discuss ways of meeting increased sales demands.
INTEGRATION (I)	Managers in operations tell assembly workers that they are "not paid to think." Some worker resentment is created by this.	Assembly workers have little informal contact with one another, which lessens points of potential friction. But this also assures that trust between department workers is not high either.
LONG TERM DEVELOPMENT (L)	Operations managers do little to train or develop their subordinates, and little effort is visible to improve lackluster morale.	Experienced assembly workers share little of their on-the-job learnings with less experienced workers.

FIGURE 12. THE SOCIAL SYSTEMS GRID

CROSS-GROUP RELATIONSHIPS 3.	RELATIONSHIPS WITH OUTSIDE 4.
Ref. 622: The assembly manager has communicated a problem of bread supply and storage to the warehouse manager. Assembly workers do not communicate directly with either warehouse or maintenance workers. Ref. 633: Assembly workers attempt to communicate directly with lettuce preparation workers. The assembly manager discusses lettuce problems with the lettuce preparation manager, with little effect.	Ref. 622: Communications between the buyer and the outside bakeries are not shared with the assembly manager or with his subordinate workers. Ref. 633: No contact noted with outside agents regarding the lumpy lettuce problem.
Assembly workers requirements for maintenance, bread, packaging, and mustard supplies are communicated by their managers to the appropriate service groups. Assembly workers communicate directly with meat, cheese, and lettuce preparation groups for supplies when needed.	There is no contact between assembly workers and customers, salesmen, outside vendors, or suppliers.
Assembly workers' attempts to improve coordination with other operations groups (such as meat preparation, and lettuce preparation) are met with "who cares--that's not my problem."	Worker grievances are handled by the Personnel Department, with significant advice from outside consultants.
No effort is made to share knowledge or skill between groups within operations, or between operations and service departments.	No outside assistance in training assembly workers or managers is employed by C.C.S.S.C.

FIGURE 12 (CONTINUED)

the following ways:

1. Think about the entry in each cell of the grid. Will the continuation of the existing behaviors frustrate or irritate the focal person or others in the Role Network.

2. Will the continuation of the existing behaviors improve or deteriorate organizational performance?

3. Will the introduction of behaviors not presently occurring improve organizational performance or the feelings of the people involved?

4. If the grid remains unchanged, will organizational effectiveness deteriorate, stay the same, or improve?

Design, Analysis, or Redesign Efforts

In this hypothetical example company, the purpose of the Socio-Technical Systems Analysis was to analyze an existing manufacturing environment and its production process, rather than to design or specifically redesign the system. This emphasis is consistent with many Operational Audits after focusing only on analysis of internal controls (as opposed to a formal redesign mission). As a result of examining their current problems of production, quality, and employee turnover, the CCSSC should now be clearer about the issues to be addressed in improving the present situation. However, recommendations for improvement which are developed as a result of this analysis are not likely to be effective unless they also consider the demands of employees with respect to their individual human needs. These demands typically focus around the following desirable job attributes:

1. friendly help from co-workers,
2. work that is interesting,
3. an opportunity to use your mind,
4. work results you can see,
5. good pay and benefits,
6. opportunities to develop skills,
7. participation in decisions about the job,
8. getting help needed to do the job well,
9. respect for the company you work for,
10. recognition for a job well done.

Improvement programs should address technical, social, and individual demands in an integrated way, jointly optimizing all of them rather than maximizing performance in any one area at the expense of the others.

The organization can be considered to be composed of control and information systems, which are then components of the larger system. The audit, then, is concerned with prescribing a control system (and corresponding information system) for global optimization. This is accomplished through analysis of the Variance Matrix.

A close examination of the Matrix highlights the importance of both planning and operations monitoring for corrective actions and, thus, adaptation. If managers cannot foresee production problems, they cannot plan corrective actions, nor can they prevent problems from outside the production process from causing production problems throughout the process. Communication is important because the problems should be controlled at the point at

which controls are the least costly in terms of cost to the entire organization. Similarly, if workers are not aware of anticipated problems and preplanned corrective actions, they will not control variances at the appropriate point, nor will they comprehend the importance of doing so.

The information system, then, must allow managers and workers to anticipate problems and plan corrective actions. It must provide historical information about the costs of various problems in the past. It should also allow workers and management to monitor the production process in order to identify unexpected problems and formulate globally optimal solutions as quickly as possible. This requires managers to have the ability to identify, communicate and cooperate with other departments about potential interdepartmental problems and solutions.

In light of these requirements, the Design Team (and the auditor) in this example might conclude that the control systems (and information system) in this example should possess the following characteristics:

1. Managers in the weekly production planning meetings agree upon how potential problems are to be solved and estimate the costs of the required corrective actions with the help of past reports. This feedforward information is coded by production cause for input into the MAS, and communicated to the workers involved. Thus, the resulting cost variances are anticipated and no further investigation is needed upon receipt of the report.

2. Workers code production variances as they are incurred. Managers, in their daily monitoring, thus have a more efficient search routine, and cost variance explanations are captured within a dynamic mode. Production control is facilitated by capturing this

information as the causes are identified when problems arise.

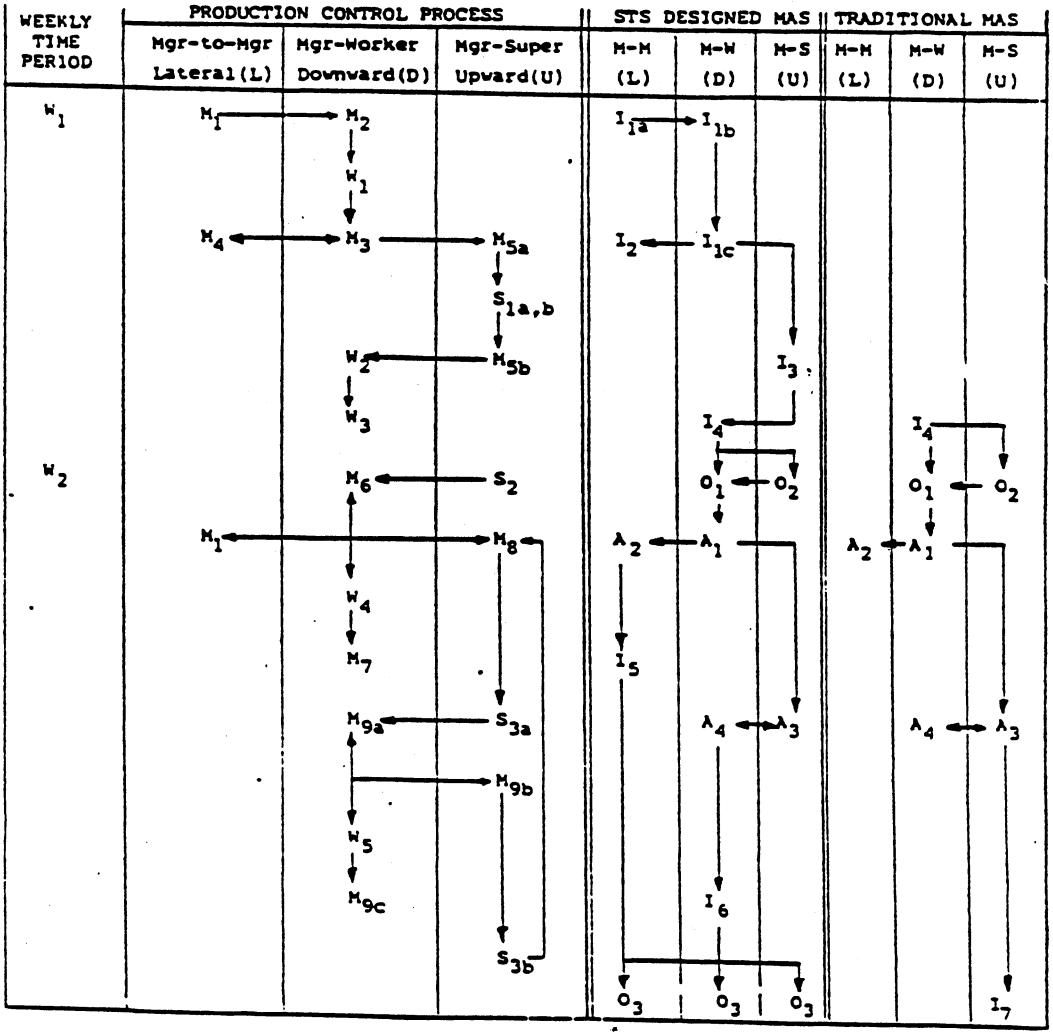
3. The Cost Variance Reports are disaggregated into production causes and this information is reported to all managers. The total costs of transported variances are then available for future planning decisions in subsequent production planning meetings.

4. The managers are required to jointly reconcile the reports within their weekly production planning meetings.

The particulars of this design are captured in the Transformation Flowchart (Figure 13). This flowchart compares the prescribed information system with a traditionally designed management accounting system. Note that in the traditional MAS, there is no communication between the managers - all information concerning controls is passed to the managers and the supervisors, and globally optimal controls seems unlikely[4]. Notice also that in the STSA designed MAS, the supervisor does not have to maintain a separate, informal information system for report interpretation (I_7).

Figure 14 is a conventional flowchart of this system, including relevant documents. Figure 15 is a sample of one of the focal documents - a redesigned Cost Variance Report. Note that with this report, not only are problems identified, but causes as well (so far as is possible before the final investigation). Problems are also coded according to whether they are expected or unexpected, and whether they were preplanned, corrected, or uncorrected. Managers can then focus their attention on those problems which are unexpected and uncorrected.

FIGURE 13. THE TRANSFORMATION FLOWCHART


WEEKLY TIME PERIOD
PRODUCTION CONTROL PROCESS
Mgr-to-Mgr Lateral(L)
Mgr-Worker Downward(D)
Mgr-Super Upward(U)
STS DESIGNED MAS
M-M (L)
M-W (D)
M-S (U)
TRADITIONAL MAS
M-M (L)
M-W (D)
M-S (U)
W1
W2
M1
M2
W1
M4
M3
M5a
S1a,b
W2
M5b
W3
M6
S2
M1
M8
W4
M7
M9a
S3a
M9b
W5
M9c
S3b
I1a
I1b
I2
I1c
I3
I4
O1
O2
A2
A1
I5
A4
A3
I6
O3
O3
O3
I4
O1
O2
A2
A1
A4
A3
I7

CODE*	CONTROL ACTIVITIES
Time = Week 1	
M_1	Managers meet in weekly production planning meeting to discuss previous week's problems and anticipated current week's problems based upon sales forecast, materials and labor availability (preventative, corrective, and detective controls).
M_2	Managers communicate anticipated problems and production schedules to their departmental workers (corrective control).
W_1	Workers identify problems (production variances) as they occur. They communicate variances to manager and correct problems when possible (detective and corrective controls).
M_3	Managers monitor operations at least daily to identify and correct problems (detective and corrective controls).
M_4	Managers communicate with other managers on interdepartmental production problems (corrective and detective controls).
M_{5a}	Managers communicate with supervisor on externally caused problems (detective control).
S_{1a}	Supervisor communicates with other divisions on external problems (detective control).
S_{1b}	Supervisor communicates results of S_1 to managers (corrective and preventative control).
M_{5b}	Manager receives S_{1b} and takes corrective actions by communicating to workers. If the problem will continue in future periods, he plans accordingly (corrective and future preventative control).
W_2	Workers take corrective actions based upon manager's response from M_{5b} (corrective and future preventative control).
W_3	Workers turn in material requisition forms and production reports during the course of operations. Time cards are turned in at the end of the week (detective control).

* Code explanations:

M = Managers' actions	W = Workers' actions.
S = Supervisor's actions.	I = Input coding activities.
O = Output from the MAS.	A = Analysis activities.

FIGURE 13 (CONTINUED)

Time = Week 2

M_6 Manager receives weekly performance report form accounting and investigates unexpected cost variances by communicating with workers (detective control).

S_2 Supervisor receives weekly production reports from accounting and communication with managers for explanations (detective control).

W_4 Workers provide explanations for M_6 (detective control).

M_7 Manager takes corrective actions if needed (future preventative control).

M_1 Manager communicates with other managers during weekly production planning meeting on interdepartmentally caused variances that were charged to him within the accounting report (detective control). They also agree on anticipated costs of interdepartmental corrective actions planned to overcome Week 2's problems (preventative control).

M_8 Manager responds to S_2 and appeals interdepartmentally caused cost variances that he believes are not his responsibility (detective control).

S_{3a} Supervisor communicates with other managers on appealed cost variances from M_8 (detective control).

M_{9a} Manager investigates causes of appealed cost variances from other departments by communicating with workers (detective control).

W_5 Workers provide explanations (detective control).

M_{9b} Manager responds to Supervisor and agrees to backcharges or appeals (detective control).

M_{9c} Manager responds to workers to prevent future problems from same cause (future preventative control).

S_{3b} Supervisor continues his investigation if cost variances are re-appealed and he communicates with managers on results for S_{3a} - M_9 (detective control).

FIGURE 13 CONTINUED

CODES FOR COMPARISON OF INFORMATION SYSTEM NETWORKS

CODE*	EXPLANATION
Time = Week 1	
I_{1a}	Amounts and coding of cost variances created by weekly adaptive production decisions from agreements in weekly production planning meeting (M_1).
I_{1b}	Manager communicates information from I_{1a} to workers (M_2 -W_1).
I_{1c}	Workers code production variances as they occur. Manager reviews codes and amounts on at least a daily basis (W_1 - M_3).
I_2	Managers agree on amounts and codes for unanticipated problems. This information is communicated back to workers for I_{1c} (M_4 - M_3).
I_3	Managers advise workers of correct codes for external problems (M_{5a} - $S_{1a,b}$ - M_{5b} - W_2).
I_4	Workers turn in data for input into MAS (W_3).
Time = Week 2	
$O_{1,2}$	Weekly accounting reports (MAS) produced and distributed to managers (O_1) and Supervisor (O_2).
A_1	Manager investigates all significant cost variances by reconciling the report to other information he may have, and/or by communicating with his workers about causes (M_6 - W_4 - M_7).
A_2	Manager communicates with other managers on interdepartmentally caused cost variances based upon A_1 investigation (M_1 in Week 2).
I_5	Report is modified for unexpected backcharges agreed to by managers in Week 2's production planning meeting (M_6 - W_4 - M_1).
A_3	Supervisor investigates appealed cost variances (M_8 - S_{3a}).
A_4	Managers investigate and respond to A_3 (M_{9a} - W_5 - M_{9b} - M_{9c}).

FIGURE 13 (CONTINUED)

I_6 Report is modified for unexpected backcharges notagreed to in A_2 and appealed to supervisor in A_3 (M_8 - M_{3a} - M_{9a} - W_5 - M_{9b} - S_{3b}).

I_7 Supervisor keeps secondary information for report interpretation and evaluation (M_8 - S_{3a} - $M_{9a,b}$ - S_{3b}).

O_3 Revised Cost Variance Report issued.

FIGURE 13 (CONTINUED)

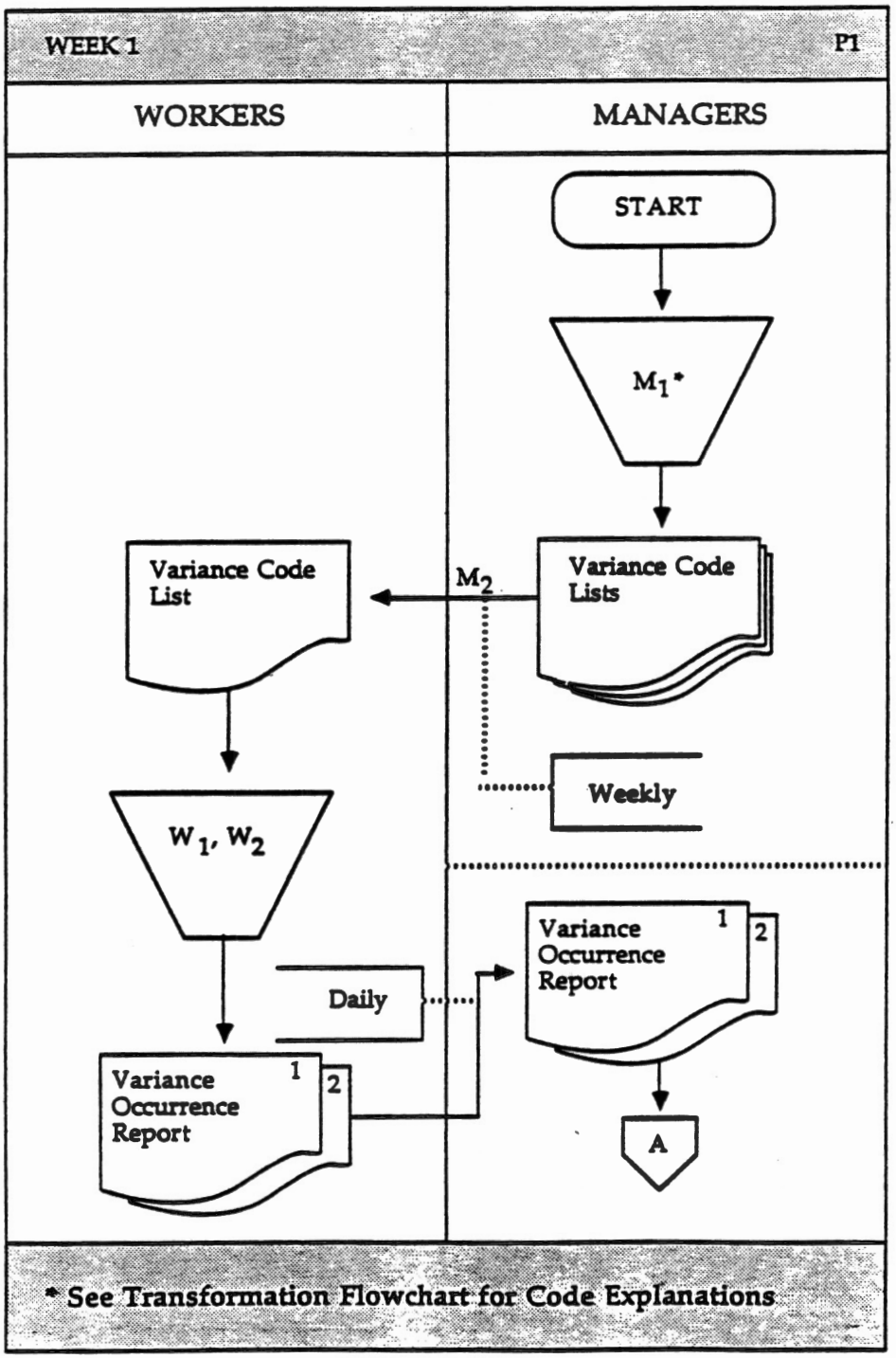


FIGURE 14. DOCUMENT FLOWCHART

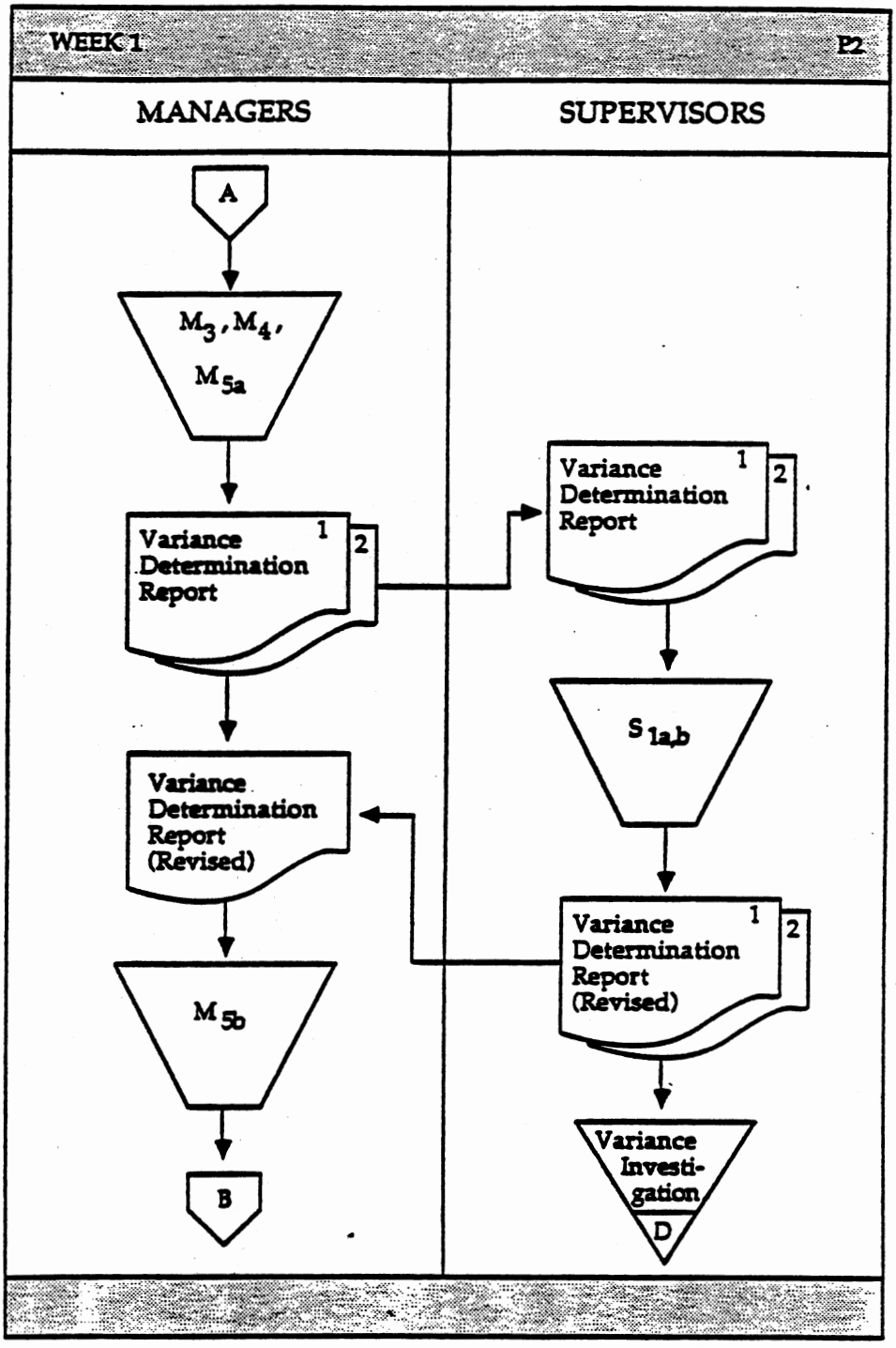


FIGURE 14 (CONTINUED)

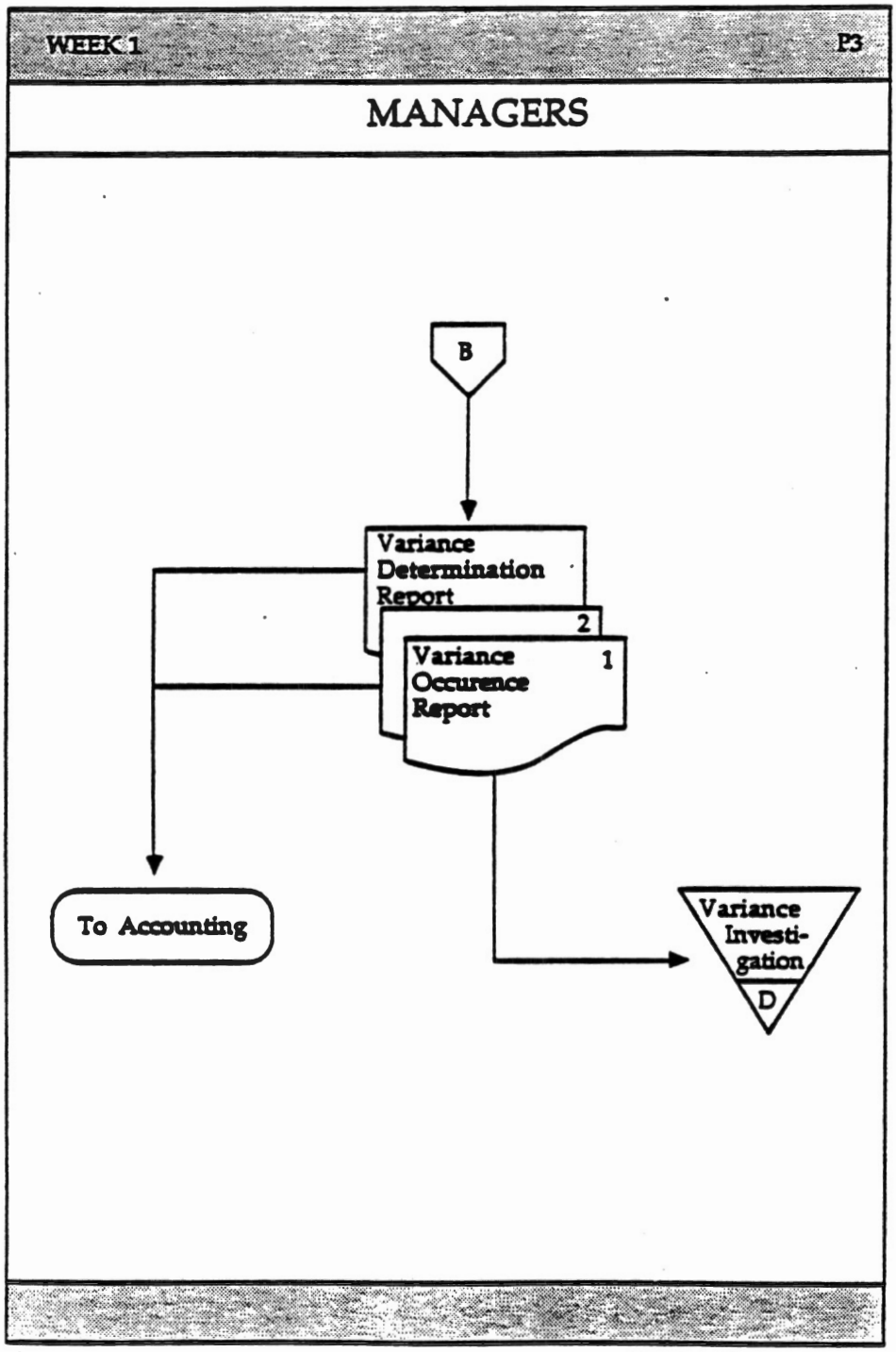


FIGURE 14 (CONTINUED)

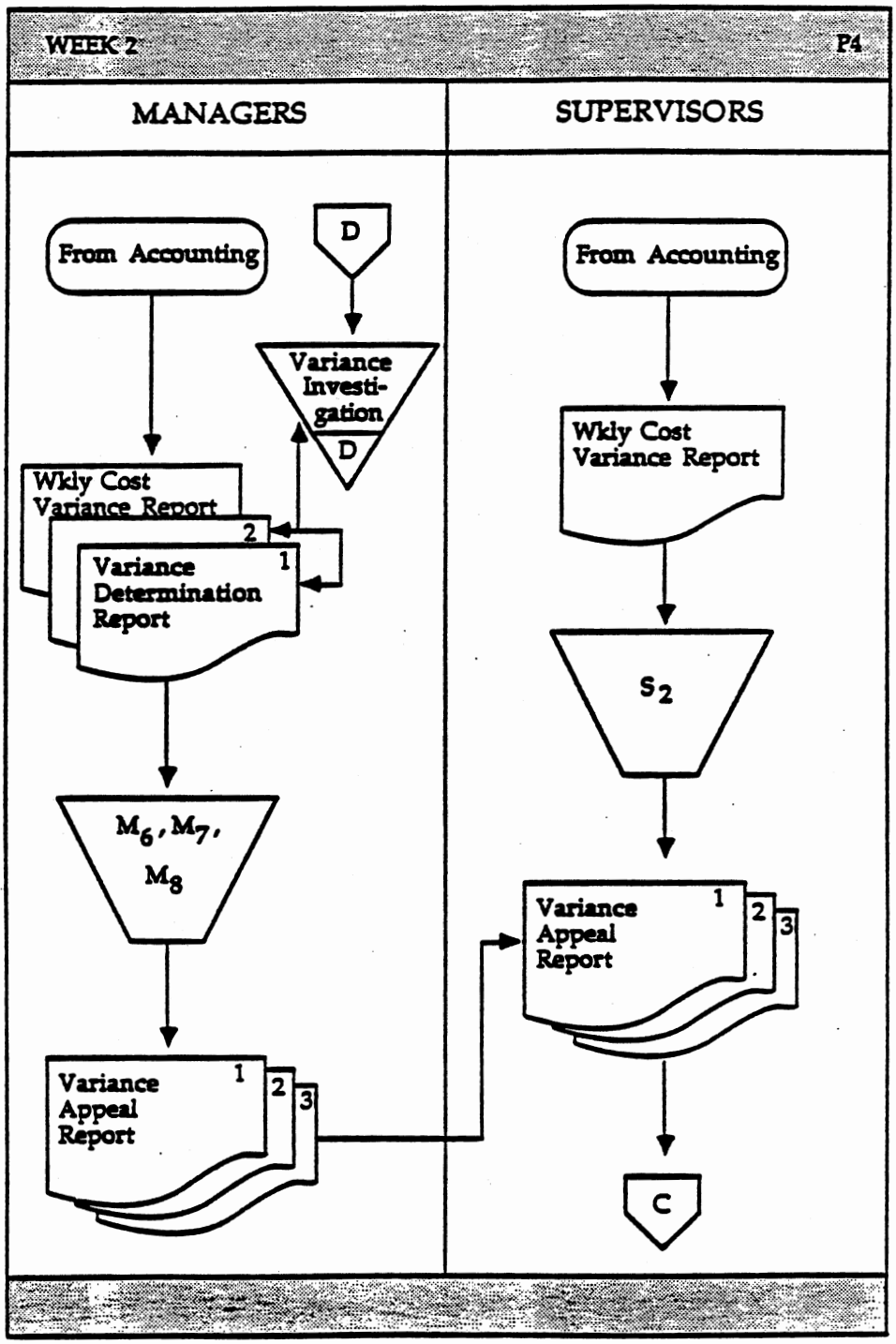


FIGURE 14 (CONTINUED)

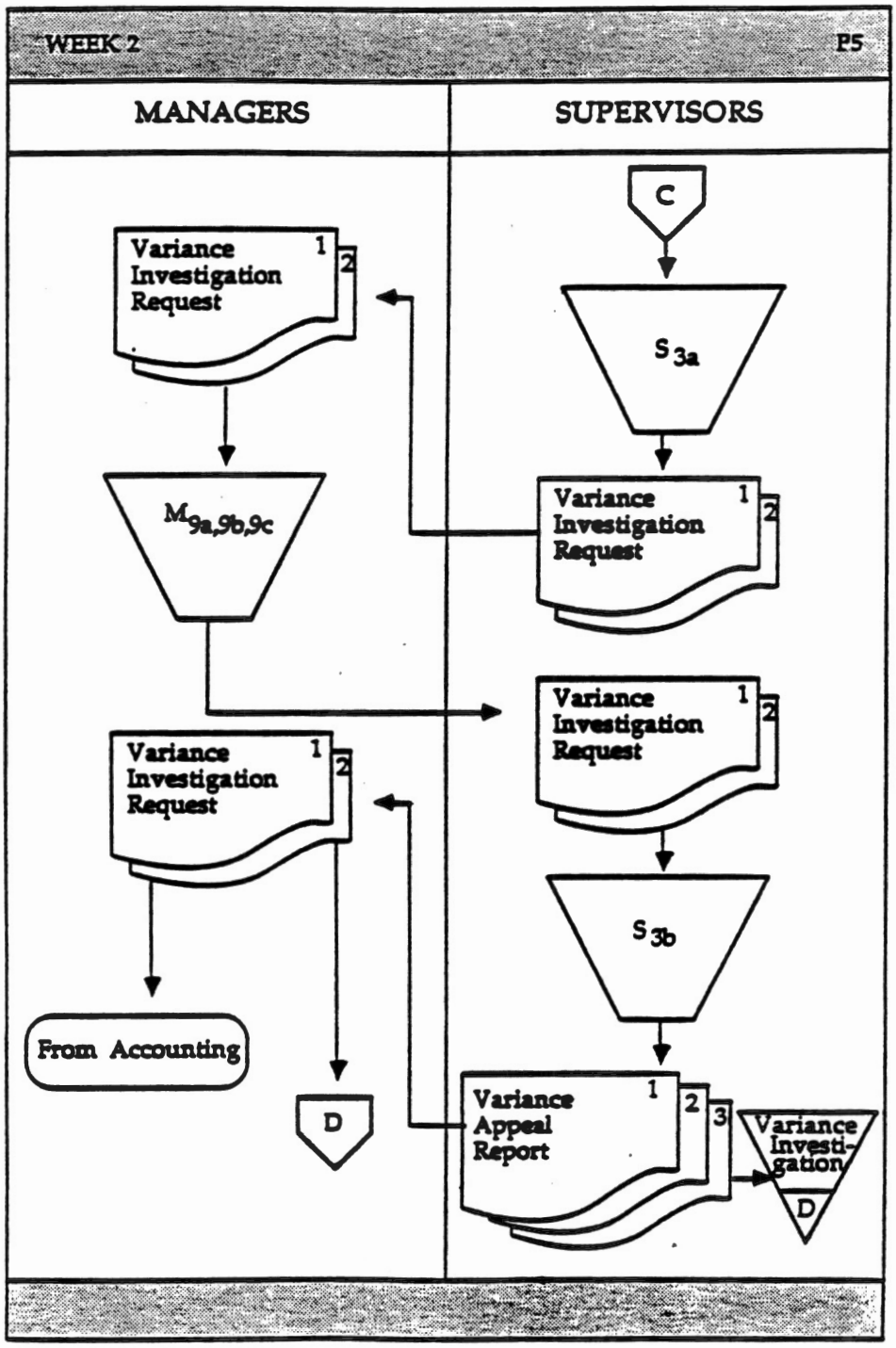


FIGURE 14 (CONTINUED)

DESCRIPTION OF REPORTS

DOCUMENT TITLE	EXPLANATION AND INFORMATION SYSTEM CONTROL CODES (See Figure 13).
Variance Code List	Includes the current week's production schedule, as well as a list of amounts and codes for anticipated variances. ($I_{1a,b}$)
Variance Occurrence Report	Lists all variances (including codes for anticipated problems) which occur in production. Also includes source of problem (if known) and corrective action taken (if any). ($I_{2,3}$)
Variance Determination Report	Lists interdepartmental or external variances and the appropriate codes and amounts as agreed to by managers or specified by supervisor. ($I_{1c,4}$)
Weekly Cost Variance Report	Lists cost variances, amounts, sources of problems, etc. (See Figure 15). ($O_{1,2}$, A_1)
Variance Appeal Report	Manager lists the variances, including codes and amounts, that he does not feel are his responsibility. Also includes reasons the manager does not think he is accountable for the variances, and which department he feels is responsible. (A_2, $I_{5,6}$)
Variance Investigation Request	A list of all variances submitted by other managers that could be the responsibility of a certain department. ($A_{3,4}$)

FIGURE 14 (CONTINUED)

THE SANDWICH COMPANY
ASSEMBLY DEPARTMENT PERFORMANCE REPORT
Week of: SAMPLE

Budget Information

Input Item	SP	• SQ	= SC
Bread	$1.00/loaf	2 slices	$ .08
Ham	$4.00/lb.	2 slices	$ .50
Cheese	$1.92/lb.	1 slice	$ .12
Lettuce	$1.50/lb.	2 leaves	$ .10
Direct Labor	$3.75 per hour	4 minutes	$ .25

Actual Information

Production Quota = 9000 sandwiches
Actual Production = 8000 sandwiches

PRODUCTION VARIANCE (CAUSES)	CODE	BREAD USAGE	HAM USAGE	CHEESE USAGE	LETTUCE USAGE	LABOR USAGE
SCRAP BREAD	36.22B	$10.00 U				
BREAD QUOTA	37.00A	2.00 U				$30.00U
LUMPY LETTUCE	43.32B				$7.50U	
LETTUCE USAGE	43.99C				15.00F	
WAX PAPER SHORTAGE	45.19A					18.75 U
	99.49C			$24.00U		15.00F
TOTALS		$12.00U		$24.00U	$7.50F	$33.75U

TOTAL: $62.25U

FIGURE 15. PRODUCTION VARIANCE REPORT

KEYS TO CODES FOR PRODUCTION VARIANCE REPORT

Budget Information Key:

Usage Variance = SP * (SQA - AQ)

Where: SP = Budgeted input cost per unit of input item.

SQA = SQ * actual production of sandwiches.

SQ = Budgeted amount of an input item per sandwich.

AQ = Total actual amount of an input item used.

SC = Standard cost (budgeted cost of an input item per sandwich).

Key to Performance Report:

CODE: Problems
36.xx = Bread improperly fed into mustard machine.
37.xx = Production quota of bottom slices not met.
99.xx = Unidentified problem.
etc.

Causes
xx.22 = Bread moisture content too high.
xx.19 = Shortage of wax paper.
xx.00 = Unidentified cause.
etc.

A = Expected and preplanned.
B = Unexpected but corrected.
C = Unexpected and not corrected.

FIGURE 15 (CONTINUED)

Conclusion

The Socio-Technical Systems Analysis (STSA) can be used to analyze, design, or redesign an organization or part thereof. In this chapter a hypothetical example is used to illustrate the methodology. The methodology includes an Organizational Scan (which is much like Familiarization in a traditional audit), analyses of the technical and social systems, and an integration and synthesis of both technical and social requirements into a system that allows for global optimization in task performance and control activities.

This methodology, at first glance, may seem quite different from the usual Operational Audit methodology. However, many of the traditional Operational Auditing tools (flowcharts, questionnaires, interviews) can be adapted and extensively used in the STS analysis. The primary difference is not in the methodologies, per se, but in the underlying assumptions of the approach. STSA explicitly recognizes the social subsystem as an integral part of and a major constraint on the operation of the control systems within the organization. By carefully integrating the social requirements into the analysis of the organization, the auditor can prescribe solutions that are more meaningful and that workers and managers are more likely to find relevant and, thus, to support.

ENDNOTES

1. This example is a further revision of Thomas' (1985) revisions and extension of "an Example Socio-Technical Analysis for the Cotter-Cherns Scottish Sandwich Corp., Ltd." developed by E. Lauck Parke, School of Business, University of Vermont. The example was originally revised and expanded by James C. Taylor and John J. Cotter, Center for Quality of Working Life, Institute of Industrial Relations, University of California, Los Angeles (1980).

2. See the "Strategic Design Process" in Robert P. Bostrom and Stephen J. Heinen, "MIS Problems and Failures: A Socio-Technical Perspective. Part I: The Causes," MIS Quarterly (September, 1977), pp. 17-32 and "MIS Problems and Failures: A Socio-Technical Perspective. Part II: The Application of Socio-Technical Theory," MIS Quarterly (December, 1977), pp. 11-28; and in Thomas, Michael F., "An Application of Socio-Technical Systems Analysis to Accounting Variance Control Theory," Ph.D. Dissertation, University of Wisconsin, Madison, 1985, Chapter 3.

3. See note #1.

4. Globally optimal controls seem unlikely in a traditionally designed system due to four factors. First, there is no cooperation between managers because traditional Cost Variance Reports do not recognize the need for cooperation, being based on the traditional idea of division of labor. Second, the closed system view leaves no room for consideration of possible multiple sources and causes of a variance. Third, there is no way to capture information on causes, sources, and corrective actions ex-ante to report receipt, resulting in managers' creating and maintaining private information systems. Finally, traditional information system design **incorrectly** maps the real production control process, because it does not recognize managers' and workers' ex-ante attempts at control (due to Theory X management styles and a Static Systems View).

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VITA 2

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