CRITERIA FOR TRANSFER PRICING OF DATA PROCESSING SERVICES WITHIN BUSINESS FIRMS

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This is to certify that the

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ABSTRACT

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By

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Electronic data processing (EDP) has had a marked effect on virtually all aspects of business. The tremendous growth in the use of EDP in business has caused growing concern over the control and allocation of this expensive resource.

Two primary ways of controlling EDP use are: (1) an EDP priority committee, or (2) an EDP transfer price. There is support for the use of a transfer price for controlling use, but previous research has shown that there is a wide diversity in currently used EDP transfer pricing techniques.[1] Thus, the two hypotheses of this study were:

1. The large number of data processing transfer pricing techniques currently being used are not equally successful in meeting corporate EDP objectives.
2. Given a company's EDP objectives, it should be possible to establish an appropriate set of EDP transfer pricing criteria.

The research included field study interviews, interviews with time sharing firms, interviews with equipment manufacturers, and a survey of the literature. The primary source of data was field study interviews. Fourteen centralized EDP installations were visited. They provided: (1) data on currently used EDP transfer pricing techniques, (2) a better understanding of practical problems in EDP transfer pricing, (3) insight into the advantages and disadvantages of EDP transfer prices, (4) data on the nature of costs in a centralized EDP installation, and (5) additional technical competence in the area of EDP. The following findings were provided by the field study:

The advantages of centralized EDP installations were greater than the disadvantages. There was a trend toward more centralization of EDP facilities by large users.

With the advent of third generation computers has come multiprogramming. In a multiprogramming environment more than one program can be loaded into the central processing unit at one time, and this gives the appearance of more than one job running at the same time. This kind of an environment makes the measurement of a system's capacity very difficult.

Both costs and benefits were sometimes hard to estimate. Errors in cost estimates could be the fault of the user, the systems people or both. Intangible benefits were particularly hard to quantify.

In many firms users did not have a buyer-seller relationship with the EDP installation. Often the job request had to be accepted by an EDP priority committee before it could be run. In other firms users were required to secure approval from their supervisor when the estimated cost of their job reached a certain dollar amount.

All firms had some form of EDP priority committee. In some firms the committee had to approve all EDP jobs. In other firms it only reviewed jobs which required large dollar amounts. The composition of the committee varied with the nature of the decisions the committee made.

Field study EDP managers cited a number of advantages for an EDP transfer pricing system. The primary disadvantage cited was that it took some of the systems resources to administer a charging scheme. Field study respondents favored some form of transfer pricing system for EDP by over a nine to one ratio.

All of the field study firms had some form of EDP transfer pricing system. Four basic methods of transfer pricing were observed: (1) a form of standard cost, (2) a form of full cost, (3) a form of partial cost, and (4) a form of greater than full cost.

Five Corporate EDP objectives were observed:

1. Automate all jobs that can be justified on the basis of cost reduction.

2. Automate jobs which will reduce the amount of peripheral minutiae with which management must deal.
3. Maximize the utilization of EDP resources.
4. Facilitate the creation of change.
5. Give the appearance of being progressive.

The above findings led to the following conclusions: In many cases current transfer pricing techniques were failing in helping to meet corporate EDP objectives, thus confirming the first hypothesis. Four items seemed to cause this situation:

1. Corporated EDP objectives were not always clearly stated or consistently followed.
2. Factors other than EDP objectives influenced computer operations.
3. EDP transfer pricing system objectives were not clearly stated.
4. Criteria were not established for evaluating specific transfer pricing systems.

Corporate EDP objectives are intended to guide the EDP operation in helping to meet corporate goals and objectives. Transfer pricing objectives pertain to the transfer pricing system per se. The primary transfer pricing objective is:

1. The transfer price should alter user behavior to meet corporate EDP objectives.

And in most cases the transfer price should:

2. Get the cost of EDP loaded onto products.
3. Provide data for evaluating responsibility center managers.

In order to operationalize EDP objectives they must be converted into criteria which can then be used in evaluating specific EDP transfer pricing systems. These criteria depend upon the objective(s) of the EDP installation and the transfer pricing objectives.

In establishing criteria four cases were considered. These four cases were based on five corporate EDP objectives as observed in the field study firms. Where appropriate, EDP transfer pricing criteria were established, thus confirming the second hypothesis.

The first case was based on the first two corporate EDP objectives. Cases two through four were based on corporate EDP objectives three through five respectively.

The criteria in case one were:

1. The charge should be based on a predictable rate that is not affected by the volume of activity of the EDP installation.
2. The charge should be based on actual use.
3. The charge should be levied against the person having decision authority over the job.
4. The charging algorithm should be sufficiently detailed to approximate closely the resources used.

5. The elements of the charge should be clearly identified and as understandable as possible, so that the users will be aware of the cost of the resources they are using.
6. The charge should not be expensive to administer.

In case two the criteria were:

1. The pricing scheme should encourage the utilization of unused systems resources.
2. The charge should not result in an incremental loss to the firm.

3-7 were the same as 2-6 in case one.

In case three the EDP objective made the transfer pricing problem indeterminate. In case four no appropriate transfer price could be established in light of the corporate EDP objective and transfer pricing objectives.

An EDP transfer pricing system will function best when there is a buyer-seller relationship between the users and the EDP installation. This relationship should be interfered with as little as possible.

The EDP priority committee should be a high level policy committee. It should review large job requests, priority setting problems, and systems acquisition decisions.

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[1]Harold M. Sollenberger, Management Control of Information Systems Development (New York: National Association of Accountants, 1971), pp. 129-136.

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CHAPTER I

OBJECTIVES, PROBLEM DEVELOPMENT, METHODOLOGY, AND LIMITATIONS

Introduction

This chapter presents a substantial amount of background material. The objectives of the study, the development of the problem, and the need for the study are presented to give the reader an understanding of the current situation. The research methodology section describes the approach that the author took in the study. The limitations are presented so that the reader understands as clearly as possible the parameters of the study. Finally, a brief description is given of the content of each chapter.

Objectives of the Study

The objective of this study was to determine appropriate criteria for establishing transfer prices for data processing services within profit oriented firms. It was hoped that these criteria would be useful to firms in establishing their internal charging systems. A secondary objective of this study was to show that a transfer pricing system for a centralized data processing operation is essential to controlling data processing costs.

Problem Definition

Growth of Electronic Data Processing

Few if any innovations in business have had as profound an effect on business as the computer. Just two decades ago the computer was nonexistent in the business world and only very experimental in scientific applications. Computers started to creep into business in the early 1950's. Early computer utilization was limited to the automation of routine clerical tasks. Often the majority if not all of the data processing work was confined to the accounting area. It has been estimated that by 1960 there were 4,500 computers in use in the United States. A good portion of these, however, were being used by the government or governmental agencies.[1]

As computer manufacturers continued to develop better all purpose machines and businessmen became more comfortable with computers, more and more applications of data processing were found. As more applications were found more computers were acquired. Gradually more and more firms became convinced that they had to acquire their own computer installation. By 1970 there were nearly 90,000 computers in use in the United States. This figure is expected to rise to 160,000 by 1975.[2]

These figures, however, are only a partial indication of the growth of electronic data processing in business. The substantial increase in the number of

computers is primarily due to business utilization. By 1969 the government and governmental agencies accounted for only 22% of the total computer market.[3]

Perhaps even more important is that while the number of computers has grown rapidly the power of computers has grown substantially also. Thus, the growth in computer power in business is much greater than the mere number of computers might indicate.

One might well ask, "Why has there been such rapid growth?" A number of reasons easily come to mind. First, a large number of clerical tasks were easy to automate. The reduction in personnel showed substantial prospective immediate cost savings. Secondly, management sometimes worried that if they did not keep pace with competitors in the area of electronic data processing (hereafter referred to as EDP), they would soon be at a competitive disadvantage. As E. M. Tolliver put it:

> Many top executives are worried because competitors are reportedly using computers to make major breakthroughs in executive level management techniques and effectiveness. These executives tend to have an uneasy feeling that somehow they have failed to exploit the potentials of modern management science, and that the penalty will soon become painfully visible in the profit and loss statement.[4]

The computer helped to generate additional work for itself. As management automated increasing amounts of its own clerical work, new management techniques were tried. Critical path method, linear programming, dynamic programming and simulation are but a few of the new techniques

that were used. Use of these was not even possible in the pre-computer days of business. These new applications often necessitated the accumulation of data that was not previously necessary.

Perhaps one of the greatest incentives to EDP growth was the rumor that the "fingertip management information system" was on the way. In recent years the phrase has been that it is "just around the corner."[5] The implication is that any firm not having the "fingertip information system" will have difficulty competing with those who do.

Management's Disenchantment with Computers

With EDP costs in many large firms currently running at one to three percent of revenue, top management has started to look at the tremendous growth in EDP costs with considerable alarm.[6] With computer costs continuing to rise at a rate faster than costs in general, management is demanding more proof of return on investment.[7]

A closer scrutiny by top management was certain to come in the EDP area, but the belt tightening or cost awareness of 1970 and 1971 has certainly hastened the evaluation. EDP budgets which in the past were almost certain of approval are now getting a very careful look.[8] New terminology such as "justification," "accountability," "de-escalation," and "project costing and killing

techniques" has begun to be used when data processing budgets are evaluated.[9] For the first time EDP seems to have lost its immunity to careful evaluation.

A second cause for scrutiny is that there is growing disenchantment with the computer and computer manufacturers. Many times the computer has not performed to the degree that management expected. Management sometimes feels that the vendor has sold him a "bill of goods."[10] Others are upset at cost estimates that turned out to be substantially below the actual cost figures.[11]

A final disappointment is that the "fingertip information system" that was supposed to be close at hand still appears to be quite far in the future.[12] All of these items go together to make top management very concerned about EDP costs.[13]

Control of EDP Costs

At first glance, controlling EDP costs may not seem any more difficult than controlling any other kind of cost. However, the situation has some characteristics which make it unique:

1. To many managers, computers are new and complex. Even though today's management is more sophisticated in computer utilization than management of a few years ago, the computer is still something of an unknown quantity. Not all of the mystique and romance of the computer has worn off yet.

2. EDP equipment changes quite rapidly. As the central processing unit, the peripheral processors, and the software change, there are often implications for the nature of the costs as well as for cost control.

3. The large increase in the number and kind of users has caused control problems. Accounting and engineering were early users, but many firms find that virtually every facet of the firm is using the computer. Users are spread horizontally across the firm as well as vertically through the various divisions and departments.

4. Data processing installations are often managed by specialists who are not business oriented or who lack experience in managing.[14]

5. EDP costs are often quite large in comparison with other service oriented departments within the firm.

There are two aspects to controlling EDP costs. One is the control of the efficient operation of the installation. The second is the control of the use of the data processing services. Both are quite important but this study will be interested primarily in the latter aspect of controlling EDP costs.

Two primary ways of monitoring the use of computer facilities are the creation of an EDP priority committee and the use of a transfer price for EDP services. An EDP priority committee is usually made up of representatives of each of the various user groups, representatives

from the data processing department, and one or more members of corporate staff. The name of the committee and the exact composition of the committee varied from firm to firm, but the purpose is fundamentally the same. The committee allocates the use of the computer facility among the potential users.

The committee system has the advantage of centralizing the control over this valuable resource. Depending on the composition of the committee, the control can be more or less centralized. One problem is that a good deal of political manuvering may be necessary to get project acceptance. Likewise, a "you vote for me and I will vote for you" sort of system might develop which is not conducive to optimum utilization of the facility. Still the greatest disadvantage of this approach is that it is detrimental to profit center and cost center accounting which is so prevalent in large corporations. This will be discussed in greater length in Chapter II which deals with profit centers and cost centers.

A transfer price (often referred to as a charge-back in industry) is the second way of controlling computer use. Under this sytem the user is charged directly for the services he receives. The idea is that if the user has to justify his data processing charges in his budget, he will not request services which he cannot justify economically. The cost-benefit analysis is

brought down to the user level where the benefit should be clearest.

One of the eight basic conclusions reached by Harold Sollenberger in a recent NAA study is:

> Although there are recognized weaknesses in formal cost-benefit analysis, a strong application of economic evaluation appears needed in order to justify continued large expenditures and to allocate use of scarce systems resources among competing demands for its services.[15]

He goes on to state that:

> Many firms could attest to the fact that the use of systems operations facilities would expand according to capacity provided unless evaluation controls were placed on the users. The charging system's usefulness depends largely on the quality of the charging algorithm. . . . For data processing costs, the most concerned managers were those directly receiving and paying for services.[16]

The existence of an EDP priority committee or an EDP transfer pricing system are not necessarily mutually exclusive. Each may, in fact, play a vital role in achieving a firm's EDP objectives. The role that each should have is considered in this study.

Two approaches to this transfer pricing problem are:

1. Information economics--a careful evaluation of the value of information and the cost of acquiring such information. Such a study would be primarily interested in the possible measurement techniques for both cost and value of information at various points in time.

2. The transfer price per sé--a careful look at the desired objectives of a transfer pricing system. Such a study would be primarily interested in the influence on user behavior of a transfer price. The measurement of value would be left to the user. The user would be required to make an ordinal measure of value but not necessarily a cardinal measure.

This study proceeded along the latter course. The effect of an EDP transfer price on user behavior was a prime consideration. This behavior was considered in the context of a responsibility accounting environment which is so prevalent in business today.

Nature of the EDP Transfer Price

There are two primary types of costs associated with EDP services in centralized EDP installations. They are systems development costs and computer operations costs.

Systems development costs are:

1. The costs of systems analysis and programming for proposed new computer jobs.
2. The costs of systems analysis and programming necessary for updating current programs.

Systems development costs consist primarily of personnel cost. Education, travel, supplies, and

occupancy costs make up most of the remaining budget for systems development.

Computer operations costs are the costs of preparing the data and actually running the computer job. Typically half to two thirds of these costs are equipment costs such as rental of the computer and its peripheral processing units. The major remaining elements are computer operators' salaries, keypunch salaries, systems maintenance costs, occupancy costs, education and supplies.

This dissertation is concerned with transfer prices for computer operations. The discussion of EDP transfer pricing criteria in Chapter V is based upon the special characteristics of computer operations in centralized EDP installations.

Transfer prices for systems development are not directly considered in the study. However, the system development transfer price topic is mentioned in more detail in Chapter VI, "Implications for Further Research."

Need for the Study

To recognize that a transfer price for data processing services could be an effective control is to see only half of the problem. The other half is to determine what that transfer price should be. One approach is merely to observe what other firms are doing and to do the same thing. However, mere description would prove only

partially helpful; prescription of an appropriate charging scheme would be more useful.

Sollenberger's study has shown that there are many different charging schemes currently being used.[17] These range from no charge to several different algorithms charging full cost. It does not seem likely that all of these charging systems could be equally effective in meeting the firms' EDP objectives.

It would be very beneficial to discover whether some or all of the current methods of charging are sub-optimal. However, a more important contribution would be made if the study could present a charging scheme which would meet specified company objectives. Such a charging system would be of substantial benefit to top management in:

1. Controlling the use of the firm's data processing facility.
2. Evaluating managerial performance in cost centers and profit centers.
3. Evaluating the effectiveness of the data processing installation.

Hypotheses

1. The large number of data processing transfer pricing techniques currently being used are not equally successful in meeting specified company EDP objectives.
2. Given a company's EDP objectives, it should be possible to establish an appropriate set or sets of EDP transfer pricing criteria.

Research Methodology

The research was approached along four separate paths. They were a survey of the literature, field studies, interviews with time sharing firms, and correspondence with major equipment manufacturers. The findings represent a blending of the information obtained from each of these sources.

Survey of the Literature

The search of the literature included books, periodicals, and monographs including literature from computer manufacturers. The topics covered included computer equipment, computer peripherals, computer software, managing computer facilities, the economics of computers, microeconomics, cost center accounting, profit center accounting, and transfer pricing. The objectives of this survey were to:

1. Clarify and narrow the problem.
2. Gain additional technical knowledge which would be helpful in the evaluation stage and in maximizing the information derived from the field studies.
3. Determine what pertinent literature had been written on the problem.
4. Review accounting and economic concepts that pertain to the problem.

Field Studies

The field studies included visits to eleven firms. One of these firms had four autonomous data processing installations. Each of these installations operated as a central data processing facility, and each served its own user group. Consequently, the sample of centralized data processing installations consisted of fourteen data processing organizations.

The firms that were visited were all very large firms within their industries. The field study firms could be classified by the following industry or product class:

Classification	Number of Companies
1. Heavy manufacturing and materials conversion	5
2. Chemicals and pharmaceuticals	3
3. Consumer products producers	1
4. Retailers	1
5. Service	1

The field study firms were selected because:

1. They were accessible.
2. They expressed an interest in the problem and were cooperative.
3. Many were thought to be leaders in EDP use.

4. All were relatively large users of EDP. (Annual EDP budgets in the field study firms ranged from $6,000,000 to $72,000,000.)

The field study approach was used because it provided the only access to some of the research data. It was the only way of getting the underlying subjective and organizational flavor of the real world context of an EDP transfer price. The interview atmosphere allowed for immediate reaction to interview responses.

The objectives of the field study were to:

1. Discover what data processing transfer pricing systems are currently being used.
2. Gain a better understanding of the practical problems involved in establishing a transfer pricing system for data processing services.
3. Determine what advantages and disadvantages there are for data processing transfer pricing systems as perceived by those who deal with the problem everyday.
4. Determine the nature of the costs incurred in a typical in-house data processing installation.
5. Gain additional technical competence which would be useful in future interviews and at the evaluation stage.

Additional firms could have been visited, but the resulting additional information would have been slight.

The first few visits generated many new insights. Each successive visit seemed to provide fewer and fewer new ideas. The last several visits primarily added only to the accumulation of statistics. Thus, when fourteen installations had been visited, the field study objectives had been achieved.

The field study interviews lasted from one-half day to two and one-half days. At each installation the installation manager was interviewed. During most visits the computer operations manager was also interviewed. In addition at some installations systems analysts, systems maintenance people, and computer operators were interviewed. A total of forty-eight people were interviewed at the fourteen installations.

The following interview guide was used:

1. Introduction
    a. Brief statement of the purpose of the study.
    b. Brief statement of the purpose of the field interviews.
    c. Outline of the topics to be covered.
    d. Reaffirm the confidential nature of the interview.
2. General nature of the firms data processing operation.
    a. Organization of the firm.

b. Organization of the data processing facility.

c. Type of equipment used.

d. Type of users of data processing services.

3. Charging scheme

a. What if any charging scheme is currently being used.

b. Logic behind current charging scheme.

c. Are any changes being considered?

4. What advantages and disadvantages are there for any transfer pricing scheme for data processing?

5. Nature of the costs incurred in the data processing department.

As soon as possible after each interview the author would write a summary of the interview. This summary was an amplification of the author's notes. The summaries included some items that were not in the notes but which were remembered from the interview.

Interviews with Time-Sharing Firms

Two time sharing firms were visited in connection with the study. Four kinds of information were requested.

1. What is the current pricing system for services?

2. What technical and practical problems arise in the present pricing system?
3. What criteria were considered when the pricing system was established?
4. What is the composition of the installation's costs?

Correspondence with Major Equipment Manufacturers

Two major equipment manufacturers were asked to answer several technical questions in connection with the expansion of core memory and the internal accounting programs available on the various machines. These contacts were made after all of the field visitations.

Limitations of the Study

The following limitations are presented so that the reader understands the parameters of this study as clearly as possible.

1. This study is limited to profit oriented firms. Appropriate transfer pricing criteria for data processing services of non-profit oriented organizations may be quite different. Organizations such as universities which sell services to profit oriented firms are excluded from this study.

2. Firms that have major government contracts requiring substantial data processing services will not be considered. The United States Government requires certain

internal pricing techniques which may at least restrain if not eliminate a firm's internal pricing policies.[18]

3. The firm visits were not meant to be a random sample. Therefore, the reader should be very careful in making inferences directly from the data obtained in the interviews.

Organization of the Report

The report is organized into six chapters:

Chapter I introduces the study and discusses the development of the problem. The problem is defined and the need for the study is discussed. The two hypotheses are then presented. The research methodology is discussed and the study limitations are noted.

Chapter II is devoted to a brief summary of the accounting and economic concepts which are pertinent to the topic. Profit centers, cost centers, and transfer pricing are discussed. The importance of the transfer price is emphasized.

Chapter III is a survey of the literature pertaining to the problem. It includes a discussion of the literature on transfer pricing of EDP services and full costing of EDP services.

Chapter IV is the findings chapter. It presents the findings of the field study phase of the research. The nature of centralized EDP installations is carefully discussed. This is followed by a discussion of some

practical EDP measurement problems. The chapter continues with interview responses to the advantages and disadvantages of EDP transfer prices. Finally, current EDP transfer pricing techniques are presented.

Chapter V starts with additional discussion of the need for EDP transfer prices. This is followed by the presentation of EDP transfer pricing criteria designed to achieve corporate EDP objectives. The role of the EDP priority committee is discussed.

Chapter VI deals with the implications for further research. The importance of transfer pricing for systems development work is discussed. Several other possible research topics are suggested.

Chapter Summary

Electronic data processing has had a marked effect on virtually all aspects of business. The tremendous growth of the use of data processing in business has caused growing concern about the control of this expensive element in business. A primary concern is the control of the use of data processing facilities within the firm.

Two primary methods of controlling EDP use are: (1) an EDP priority committee, and (2) direct charging of users for data processing services. There is support that the latter of these may be quite beneficial in controlling EDP use. It is possible that these two control techniques may not be mutually exclusive.

There are two basic elements to EDP costs in most centralized EDP installations. They are systems development costs and computer operations costs. This study is concerned with transfer prices for computer operations.

Current practice shows a variety of charging schemes ranging from no charge to charging full costs. An appropriate transfer price could be very beneficial in controlling the use of EDP facilities and in appraising managers relative to their use of services. The objectives of the study are to show that a transfer price for centralized data processing operation is essential to cost control and to determine appropriate criteria for establishing transfer prices for data processing services within profit oriented firms.

The study was approached along four paths. They were a survey of the literature, field interviews, interviews with time sharing firms, and correspondence with major equipment manufacturers.

CHAPTER I--FOOTNOTES

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[6]"Problem Solver; Problem Maker," Business Week, October 17, 1970, p. 185.

[7]"Business Takes a Second Look at Computers," Business Week, June 5, 1971, p. 60.

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[14]J. O. Weltzin, "Why Leave EDP in the Hands of Specialists," Management Accounting, LII (October, 1970), 9-10.

[15]Harold M. Sollenberger, Management Control of Information Systems Development (New York: National Association of Accountants, 1971), p. 9.

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[17]Ibid., pp. 129-136.

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CHAPTER II

RESPONSIBILITY ACCOUNTING AND TRANSFER PRICING

Introduction

The purpose of this chapter is to provide the reader with a brief description of the concepts of responsibility accounting and transfer pricing. These concepts are presented because they are essential to the understanding of the analysis of this study. As noted in Chapter I, the study considers the effect of transfer prices on user behavior in a responsibility accounting environment.

The introduction to responsibility accounting is followed by brief discussions of cost centers, profit centers, and investment centers. The importance of transfer pricing to responsibility accounting is discussed. Finally, the major transfer pricing methods are presented.

Responsibility Accounting

The term responsibility accounting has been used in connection with cost centers, profit centers, and investment centers. Each of these is based on the concept that one person or a group of persons should be held

responsible for the performance of a given segment of the business.

Responsibility accounting rests on the premise that individuals should be held accountable for their performance. This concept results in the accumulation of reports of operating results by areas of responsibility.

For very small firms responsibility accounting has little importance, but as firms get larger, control and evaluation become difficult. Top management has found that the responsibility accounting concept is beneficial because:

1. It breaks the firm up into manageable units.
2. Each unit manager is uniquely familiar with his own area.
3. It is simple: far less paperwork, etc.
4. Managers are motivated to make decisions that will maximize corporate profits.[1]

Cost Centers

A cost center is the simplest form of responsibility accounting. Managers are held responsible for the costs incurred in their segments of the firm. Cost centers may be established for both large and small segments of the business.

It seems reasonable to expect cost center managers to accept responsibility for the costs that they or their subordinates control. However, it is not always easy to

identify costs with individual cost centers. Horngren comments on the problem as follows:

> Responsibility accounting has a natural appeal because it specifies a boundary of operations and distinguishes between controllable and uncontrollable costs. It is easy to say that a manager's performance should be judged on the basis of only those items subject to his control. But experienced cost accountants and managers will testify that it is far from easy to decide whether an item is controllable or uncontrollable. Moreover, there are shades of influence: an item may be controllable in whole or in part. Therefore, do not expect to get a crystal-clear, practical concept of a controllable cost. It does not exist. . . . The distinction between controllability and uncontrollability also has a time dimension. . . . In the long run, all costs are subject to at least some degree of managerial control. Long-run costs are usually incurred with special care because they are generally large and irrevocable.[2]

The problem of determining what costs should be charged to cost centers is not an easy one. It is a critical problem in evaluating cost center managers, and it certainly influences the control of corporate costs in general. The importance of this topic is underlined by the consideration that it has been given by scholarly groups. The Committee on Cost Concepts and Standards of the American Accounting Association considered this problem and formulated the following guides for deciding what costs should appropriately be charged to responsibility center managers:

1. If the person has authority over both the acquisition and the use of the service, he should be charged with the cost of such services.

2. If the person can significantly influence the amount of cost through his own action, he may be charged with such costs.

3. Even if the person cannot significantly influence the amount of cost through his own direct action, he may be charged with those elements with which the management desires him to be concerned, so that he will help to influence those who are responsible.[3]

It is important to remember that the prime reason for creating a cost center, or any other form of responsibility accounting center, is to motivate managers to act in a way which will be most beneficial to the firm as a whole. Thus, costs should be identified and assigned accordingly. The American Accounting Association Committee on Costs and Standards commented on this problem:

> The basis of measurement used in providing cost data for control is often a matter of management discretion and an important consideration in motivation. Different bases may significantly affect the way in which different individuals are motivated. For this reason, the basis of measurement selected should be consistent with the type of motivation desired. For example, different types of motivation may result when maintenance costs are charged to a responsibility center on the basis of: (1) a rate per maintenance labor hour, (2) a rate per job, or (3) a single amount per month.[4]

Profit Centers

If a manager is held responsible for both costs and revenues, it is referred to as a profit center. Profit centers have the characteristic of being a business within a business. The chief aim of the business as a whole, earning a profit, is also the main concern of each

profit center manager. The idea is that if each of the profit centers optimizes its profits, then the firm as a whole will optimize its profits.

Many cost centers do not have the necessary characteristics to become profit centers. John Mauriel and Robert N. Anthony set forth three criteria which they say must be present for a company to have decentralized profit responsibility:

1. It must have two or more units for which separable measures of revenue and expense are obtained.

2. The management of these units must have considerable control over the units' expense and revenue. (Presumably, authority to influence profit must accompany any true responsibility for the size of the profit.)

3. Each unit's profit must be calculated and reported regularly to top management, and the results of this calculation must be considered by top management as part of its evaluation of the unit's performance.[5]

The calculation of a profit center's profit is much the same as the calculation of profit for an individual firm. The primary difference is that there are often some costs which are difficult to identify with individual profit centers. Horngren comments on these costs as follows:

> A separable cost is directly identifiable with a particular segment: a joint cost is common to all the segments in question and is not clearly or practically allocable except on some questionable basis. Examples of typical separable costs are advertising, product research and development, sales promotion, specific management consulting, and some supervisory costs. Examples of joint costs are the salaries of the president and other

> top officers, basic research and development, and some central corporate costs like public relations or corporate image advertising.[6]

While the profit figure is very important, many firms choose to look at the elements of that profit figure in evaluating division management. Horngren has devised an income statement from several different perspectives (see Figure 1).

Note that Horngren does not continue the divisional income statements beyond the segment margin level (i.e., divisional net income will not total to the corporate net income figure). No attempt is made to allocate the joint fixed costs which by definition could only be allocated by using "some questionable base." Most firms do make an allocation of all corporate overhead so that the divisional income statements total to the corporate income figure.

The question is what importance does Horngren's segmented income statement have in evaluating profit center management? Horngren answers this way:

> What version of income is most appropriate for judging performance by division managers or product managers? The short-run performance margin should be helpful, especially when it is interpreted in conjunction with the contribution margin. This is because most top managers can influence certain fixed costs, particularly discretionary costs.[8] . . . Segment margin is computed after deducting the directly identifiable fixed costs, which are generally considered uncontrollable in the short run. Although this figure may be helpful as a crude indicator of long-run segment profitability, it should definitely not influence appraisals of current performance.[9]

	Company As A Whole	Two Divisions	
		Division A	Division B
Net Sales	1,500	500	1,000
Variable Manufacturing Cost of Sales	780	200	580
Manufacturing Contribution Margin	720	300	420
Variable Selling and Administration Expense	220	100	120
1. Contribution Margin	500	200	300
Fixed expenses directly identifiable with divisions: Discretionary fixed costs (certain advertising, sales promotions, salesmen's salaries, engineering, research, management consulting, and supervision costs.)	190	110	80
2. Short-run Performance Margin	310	90	220
Other fixed costs (generally uncontrollable, such as depreciation, property taxes, insurance, and perhaps the division manager's salary.	70	20	50
3. Segment Margin	240	70	170
Joint fixed costs (not clearly or practically allocable to any segment except by some questionable allocation base.)	135		
4. Net Income Before Income Taxes	$ 105		

Figure 1.--The Contribution Approach: Model Income Statement by Segments[7].

One final note of caution; it is easy to call a cost a joint cost and allocate it on some arbitrary basis or not allocate it at all as Horngern would suggest. However, if a cost can be identified, within reasonable cost limits, then it should be assigned to the appropriate business segment. The larger the cost is, the greater the necessity for identifying it. The remaining bundle of joint costs should contain only those costs that are truly joint costs (as defined by Horngren) or are so hard to identify that the cost would be prohibitive.

Investment Centers

Many firms feel that a profit figure alone is not a good measure of a division's performance. The profit figure should be put into a better perspective. As an example if Division A reports an annual profit of $100,000 and Division B reports a profit of $50,000 for the same year, it appears that the management of A is better than the management of B. However, if Division A employs $1,000,000 in assets and Division B employs $200,000 in assets, the picture is changed. Division A has a return on assets employed of 10% while Division B's return is 25%. The kind of situation just described gives rise to the extension of profit centers to investment centers.

Mauriel and Anthony say that a responsibility center must meet three criteria before it can be considered an investment center:

1. Some measure of the profit center's investment base is obtained regularly.

2. The measure of the investment base is related to the profit figure, and this relationship is reported regularly to top management, which uses it in evaluating the unit's performance.

3. The profit center manager to some significant extent can influence the size of the investment base.[10]

In an investment center the emphasis in the evaluation shifts from the profit figure per sé to some calculation of rate of return. However, it is important to note that the division's profit figure is one of the two critical elements in calculating the investment center's rate of return. Thus, the problems of isolating revenues and expenses, as discussed earlier in connection with profit centers, is still of great importance.

The other critical element in calculating an investment center's rate of return is the investment base. Fundamentally there are four different investment bases that could be used in the evaluation:

1. Total assets available. This base includes all business assets, regardless of their individual purpose.

2. Total assets employed. This base excludes excess or idle assets, such as vacent land or construction in progress.

3. Stockholders' equity plus long-term debt. This base is really the same as in (1), except that

current liabilities are deducted from the total assets available. In a sense, this represents an exclusion of that portion of current assets which is supplied by short-term creditors. Some companies feel that management should not be expected to earn a return on such current assets.

4. Stockholders' equity. This base centers attention on the rate of return that will be earned by the business owners.[11]

Each of these bases can itself give a different result depending on the method of valuation. As an example total assets employed can be valued at net book value, gross book value, or replacement cost in arriving at the rate of return on assets employed.

This problem will be ignored since it does not have any direct bearing in considering the problems of this study. Likewise, the exact calculation techniques for rate of return will not be discussed. The investment bases were presented so that the reader would understand the composition of the two critical elements in investment center evaluation. For purposes of this study the critical element is the determination of profit.

Transfer Pricing

A transfer price is the basis for recording an exchange of goods or services between segments of a

decentralized firm. Some authors would argue that a transfer price only has reference to exchanges between profit centers or investment centers. In this study a slightly more liberal interpretation will be employed which will include the price at which goods and services are transferred between cost centers.

James Fremgen lists four objectives for establishing a transfer price:

1. Profit maximization (for the firm as a whole).
2. Divisional profit measurement.
3. Evaluation of divisional managers' performance.
4. Motivation of divisional managers.[12]

The importance of transfer prices for a given firm will depend substantially on the importance of the transactions between the segments of the firm. As David Solomons puts it:

> If a divisionalized company could arrange its affairs so that its divisions had no dealings of any kind with each other it would have removed one of the principal complexities of divisional profit measurement. It would also, however, have lost a valuable feature of decentralization, namely, the capacity to enjoy the fruits of division of labor and of specialization while simultaneously benefiting from integration to a greater or less degree. The fact that a divisionalized company is more than the sum of its parts is evidenced through the intricate pattern of interdivisional relationships which can establish itself within a large decentralized company.[13]

Any method of transfer pricing must be devised in light of the fact that there may be points of conflict between the various transfer pricing objectives. A number of transfer pricing methods have been suggested. Each of

these has certain characteristics which must be considered when applying the transfer pricing technique. The following is a brief description of the most commonly used methods of transfer pricing.

Market Price

Market price is often considered to be the "ideal" transfer price. This is because decentralized profit centers are firms within a firm. The market price is considered to be the one that would prevail if these profit centers were in fact separate firms. It is the price that the selling division would receive if it sold to external customers, and it is the price the buying division would have to pay if it bought from external suppliers.

A major problem is that many goods and services which are transferred do not have a ready market price. The product or service may be specially made or have special characteristics which make outside market prices only a rough estimate of true market price. Similarly the supplying division may provide a more personalized service than the buying division could expect from an external supplier. This kind of service differentiates products which would have otherwise been identical.

Modified Market Price

Even when there is an appropriate outside market, the market price is sometimes reduced to make allowance

for the reduced selling effort and/or transportation expense that often characterizes an intrafirm sale. The feeling is that if the seller incurs less cost in making a sale to another division, some of that saving should be passed on to the buying division.

Historical Cost

Historical cost is certainly basic to the accounting profession. It is sometimes suggested as a basis for transfer pricing because it is definitely determinable and readily available.

Historical cost suffers from the fact that a profit center could not be evaluated on a profit basis if its revenue was merely a recovery of cost. Even as a cost center it would be hard to make an evaluation because all inefficiencies would be passed on to the buying segments of the firm.

Cost Plus a Markup

This method is the same as historical cost except the problem of "no profit" is eliminated by adding a profit margin. The new problem is how does one determine what the markup should be? Likewise, how can an evaluation be made? Even the most inefficient manager would show a profit because, again all inefficiencies would be passed on to the buying division. As a matter of fact, if the markup was based on a percentage of cost, the more

inefficient the supplying division operated the larger its profits would be.

Standard Cost

Standard costs can eliminate the problems of measuring inefficiency and passing it on to the buying divisions. There is, of course, the problem of setting the standards. Again any cost basis for transfer pricing precludes the use of profit centers for the supplying divisions unless some markup approach is used.

Marginal Cost

Marginal cost is sometimes referred to as the economically correct transfer price. Microeconomic theory states that a firm will maximize its profits by selling up to the point where marginal cost equals marginal revenue. There has been some confusion about which marginal cost is to be used as a transfer price. Since marginal cost may be different at each level of output it is important to know which marginal cost is appropriate.

The appropriate marginal cost is the one that is equal to the firm's marginal revenue for that particular product. If there is only one buying division then the firm's marginal revenue is the buying division's marginal revenue.

This approach has some practical problems. It is very difficult to measure the firm's marginal revenue

curve for a given product. This is particularly true if there are several buying divisions for a given product. Likewise, it is very difficult to measure the marginal cost at varying levels of production for a given product. In lieu of marginal cost other concepts are sometimes substituted. Finally, if a supplying division had a constant marginal cost over the relevant range of activity, the division would incur a loss equal to its fixed cost.

Negotiated Price

A negotiated price is one that is determined by the arms-length bargaining of the two divisions in question. This, of course, is a natural way of doing business. However, it presupposes that the bargaining entities have complete freedom to bargain. If an agreement is not reached there is the ability to enter external markets.

In the absence of such power, the negotiation approach breaks down. If the buying and selling divisions had to deal with each other a bilateral monopoly would exist. Microeconomic analysis describes such a situation as "indeterminate."[14] The negotiating skills of the managers will determine the outcome, and top management must be ready to step in if negotiations reach an impasse.

Chapter Summary

Responsibility accounting is the concept that managers should be held responsible for their segment of

the business. The evaluation may be made on a cost center, profit center, or investment center basis. The validity of any evaluations rests substantially on the manager's ability to control those items on which he is being evaluated.

Transfer pricing may play an important role in evaluating managers of responsibility accounting centers. It may also have a large impact on the performance of the firm as a whole.

Company objectives should be considered when establishing transfer prices. A number of transfer pricing methods have been advocated. Each has characteristics which should be carefully considered before implementing the method.

CHAPTER II--FOOTNOTES

[1]G. J. Berkwitt, "Do Profit Centers Really Work," Duns Review, XCIII (May, 1969), 30.

[2]Charles Horngren, Cost Accounting: A Managerial Emphasis (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967), p. 273.

[3]"Committee on Cost Concepts and Standards," Accounting Review (April, 1956), 189.

[4]Ibid.

[5]John Mauriel and Robert Anthony, "Misevaluation of Investment Center Performance," Harvard Business Review, XLIV (March, 1966), 99.

[6]Horngren, op. cit., p. 303.

[7]Ibid., p. 301.

[8]Ibid., p. 303.

[9]Ibid., p. 304.

[10]Mauriel and Anthony, op. cit., p. 99.

[11]Horngren, op. cit., pp. 340-341.

[12]James M. Fremgen, "Transfer Pricing and Management Goals," Management Accounting, LII (December, 1970), 26.

[13]David Solomons, Divisional Performance: Measurement and Control (New York: Financial Executives Research Foundation, 1965), p. 160.

[14]C. E. Ferguson, Microeconomic Theory (Homewood, Illinois: Richard D. Irwin, Inc., 1969), p. 281.

CHAPTER III

SURVEY OF THE LITERATURE

Introduction

A review of the literature was an essential part of this study. This review provided a substantial amount of background material and supported the belief that the study was needed.

A tremendous amount of literature is devoted to computers and computer related topics. However, only a small portion pertains to the economics of computers. The majority of the literature pertains to how to use the computer, new uses of the computer, or technical problems of the computer.

Much of the literature dealing with the economics of computers is devoted to the acquisition decision. Only a small amount relates to controlling the use of computers and/or transfer pricing of computer services.

This chapter will present a survey of the literature which directly pertains to the topic of this study. A National Association of Accountants' study by Harold Sollenberger will be discussed. William F. Sharpe's book, The Economics of Computers, will be noted. Finally, a

number of articles will be presented that deal with transfer pricing of EDP services.

Books

Much of the impetus for this study was provided by Harold M. Sollenberger's study, Management Control of Information Systems Development.[1] It is the second in a series of National Association of Accountants research studies dealing with management planning and control. The study dealt with the general problem of controlling information systems development.

Sollenberger interviewed people in eighteen different firms. The firms had characteristics very similar to the firms in my study. The purpose of these interviews was to gain a complete picture of each firm's computer-based information systems activities.[2]

The findings of the study shed substantial light on the problems in this relatively new area. Several of those findings had particular importance to my study.

There were eight basic conclusions presented in the NAA report. One of these conclusions, number seven, stated:

> 7. Although there are recognized weaknesses in formal cost-benefit analysis, a strong application of economic evaluation appears needed in order to justify continued large expenditures and to allocate use of scarce systems resources among competing demands for its services.[3]

This conclusion does not specifically advocate internal direct charging for electronic data processing services.

Nor does it say who should be making the economic evaluation. Nonetheless, the point is made that the allocation process should be based on some sort of economic basis.

Later in the study the topic of charging for systems services is discussed. A list of beneficial effects of a pricing system is presented. This is followed by a list of undesirable effects.

> The pricing system can be beneficial to the systems area. Support among the firms in the study usually was related to several of the following points:
>
> 1. The need for user involvement cannot be overemphasized since these people must function with the system. By charges directly to their budgets, their interest and support may be easier to obtain and maintain.
> 2. Allocation of computer resources throughout the firm might be aided if each user has to have the support of his superiors before systems and data processing costs are incurred for his benefit.
> 3. As part of internal control, the matching of men and machine hours to a budget can help control performance in areas which have had budget and schedule problems.
> 4. The charging system can also provide a means of justifying substantial increases in personnel and dollars. If user areas are able to show the need for additional services and are willing to pay for these items, budgetary approval for more men and equipment may be more easily obtained.
> 5. It forces the information services manager to provide quality services, which will generate demand in other units of the firm at the prices indicated.
>
> Dependence on the transfer pricing device can also have some undesirable ramifications on systems development and computer services. Criticism of charging schemes were typified by one or several of the following points:
>
> 1. The use of a pricing device as the sole allocating tool in this area of high demand for computerization is not effective. In

some cases managers of these services have failed to meet the responsibility of allocating the scarce resources which were assigned to them and have used the charging mechanism as a poor substitute.

2. The user departments may use a narrow outlook when examining their data handling problems and fail to see the company-wide view of the value of information. Thus, it is more difficult to obtain broad support of the concept of integrated systems if charges for their work are absorbed by individual units.
3. The pricing system may force those areas in greatest need and least able to buy the services to forego the services and use less desirable alternatives.
4. Certain specialized services and capacity to meet peak needs may become unavailable due to the undesirability of high rates compared to external suppliers if a full cost transfer price is used.
5. As a side effect, the implied precision of cost figures common in many project justifications gives rise to the desire for precise benefit measures for return-on-investment analysis, which have not been proven.
6. The problems of cost assignment and allocation may be so severe that the worth of the billing system may be impaired by arbitrary allocations, may be made meaningless because of noncontrollability of costs or may be too expensive to justify its existence.[4]

These lists which were collected from the interviews indicate that considerable thought has been given to the possibility of controlling EDP use by using direct charging for services. Sollenberger lends support to this concept in a related article when he says:

> If the user management is allowed by his approval authority to commit systems resources, then it seems that a necessary following step is to charge project costs to the project budget under his responsibility. Not only will this reporting system allow him to keep a close control over the service he is purchasing, but he will have a

> definite interest in the impact these expenses have on the performance of his profit or cost center.[5]

Thus, while no specific recommendations are made about transfer pricing of EDP services, the problem is certainly considered. And it seems that there is some sympathy toward the reasonableness of creating an EDP transfer pricing system.

A second publication of major interest is a book by William F. Sharpe, The Economics of Computers.[6] This book is a microeconomic look at computers. The first five chapters are devoted to providing the reader with enough background in microeconomics, accounting and finance to be able to understand the analysis that follows.

The chapters that follow deal with a history of the computer, sale and lease terms and conditions, legal constraints and economic issues in sale and lease of computers, cost and effectiveness of computer systems, cost and effectiveness of memory, the computer industry services, markets, and costs, and pricing computer services. Each of these topics is covered in considerable detail.

But the book has two practical deficiencies. First the book was started in 1965 and finished in 1969. It is devoted almost entirely to second generation computers. While the economic analysis is still valid, many of the technical constraints have changed.

A second limitation relates to the fact that Sharpe has taken a careful look at computers from a micro-economic point of view. In doing so he has made many assumptions which are necessary for the analysis but which make the results highly questionable. Computer installations just do not fit into the carefully described boxes that Sharpe has prepared for them.

One chapter is of particular interest. Titled, "Pricing Computer Services," it presents a fundamental microeconomic analysis of external and internal pricing policies.[7] The primary emphasis is on internal pricing. Sharpe maintains that any internal pricing scheme is merely an allocation process for computer resources. He also says that the key to the use of internal prices is the profit center concept, and he notes some practical problems of implementation.[8]

He envisions that the major problem is that divisional profit maximization may work to the detriment of corporate profit maximization. In order to circumvent the problem he suggests that managers be "instructed to set prices to maximize the value of the firm as a whole." This is accomplished by assuming that the demand (marginal value) curve of each buying division indicates the value to the firm as a whole.[9] This is a basic assumption of the chapter.

Sharpe then goes on to evaluate several possible situations. He calls the first situation fixed capacity. The proposed transfer price is at marginal cost (assuming it is defined over the range of utilization) if the facility is operating with excess capacity. At full capacity the appropriate transfer price "may be more or less than average cost."[10] This section does not identify what the "more or less than average cost" figure should be. Nor does the reader receive any hint of which way to proceed.

Perhaps the solution is intended in the section titled "Value-Based Allocation." This approach is an attempt to maximize the value of the computer installation to the firm by allocating resources to those uses that yield the highest values to the firm. The two implicit assumptions are:

1. Each user must be willing and able to describe the value (to him) associated with the completion of a job at various times of the day, and that such values are expressed in dollar units.
2. The value to the user is equal to the value to the total organization.[11]

Sharpe solves the problem by using linear programming. Inherent in this solution are all of the assumptions which must typically be made in a linear programming problem. Two of particular interest are that each job requires the entire computer facility for one unit of time and that the job mix is sufficiently small to be described in a linear programming format.

Another situation referred to as variable capacity relates to the ability to acquire different size computer and/or add additional computer equipment. The computer facility is thought of as a modular installation. Conversion costs are not considered, and it is assumed that the total value curve and the marginal value curves are given. The solution is to maximize the difference between the total value curve and the total cost curve.[12]

In each of the above situations Sharpe has assumed that a job had complete use of the computer while it was in the central processor. This is not true in a multiprogramming environment. Multiprogramming allows two or more jobs to execute simultaneously. (Technically only one job is being executed at a time. But the central processing unit is so fast that a number of jobs may be switched in and out while the central processing unit is waiting for slower input-ouput operations. The result is that a number of jobs appear to be executing at the same time.)

This additional complexity makes Sharpe's analysis that much more difficult. However, he does comment on the multiprogramming environment:

> How should a system with some or all of these features be priced? As indicated earlier, this type of question cannot be answered without posing another: how should such a system be used? The answer is obvious--the components should be allocated among jobs so as to maximize total value, where the value of each job is related

> to the time of its completion. Any real problem is, of course, very complex, primarily because complementarities must be taken into account in detail, that is, it will be possible to run more than one job in a time period; but only if the right kinds of jobs are selected. In any event, there is some best allocation, and some set of prices that will lead to the appropriate use of the system.[13]

Without a doubt this book contains the most complete discussion of EDP transfer pricing available. It makes a substantial contribution in presenting many important considerations in evaluating data processing transfer prices. The economic analysis cannot be faulted. Yet, the findings have little practical application.

Many firms that face the EDP transfer pricing problem have a multiprogramming environment. Few if any come close to meeting the strict assumptions that Sharpe found necessary in making his analysis. Total value curves and marginal cost curves are often very hard to calculate in an individual business situation. Finally, an internal charge may be used in many ways other than merely for allocating EDP resources.

Articles

Transfer Pricing of EDP Services

Considering the large volume of computer related literature, surprisingly few articles have been written on transfer pricing of EDP services. However, there are a few articles that should be considered.

In a 1967 article J. T. Wormley suggested that an EDP center should be handled as a cost center. He states that operating divisions set sub-goals in an attempt to meet the corporate goal of profit maximization. The device which best coordinates these goals is a transfer pricing system.[14]

Wormley discusses three possible transfer pricing methods for EDP services. The first, marginal cost, is discarded for the following reasons:

--The marginal cost of each division and the company as a whole must be known.

--Most EDP costs are fixed and variable costs are hard to tie down in EDP.

--A constant marginal cost recovers no fixed costs.

--Marginal cost pricing will drive a system to capacity very quickly.

--User divisions will rid themselves of costs at the expense of the EDP center and company profits.

--Any method that fails to force an economic utilization of an incremental investment such as an increase in capacity is, indeed, a faulty method for management use.[15]

The second method, actual cost, is said to overcome the difficulties of the marginal cost approach, because the full cost of any increase in capacity will be

allocated to the users. Thus, any utilization must consider the total cost to the company. The actual cost is computed at the end of the period when total departmental costs are known.[16]

It is noted that actual cost has three deficiencies:

a. The per hour cost to be transferred is not known at the time when the user can control his utilization.

b. When budgets are prepared the unit cost is not known.

c. The EDP center is not encouraged to control its own costs.[17]

The suggested method is standard cost. Wormley defines the standard cost rate as:

$$\frac{\text{Estimated EDP Department Expenses}}{\text{Estimated Capacity to be Utilized}}.$$

To this method he attributes four benefits:

a. It allows for budgeting.

b. It allows for better decision making.

c. It directs the actions of users toward company goals.

d. It is relevant and simple.[18]

It should be noted that the standard is determined on the basis of expected utilization rate and expected departmental costs. Thus, with sizeable fixed costs the standard unit price will fall as utilization increases. In this case the difference between standard cost and

full cost is that one is a predetermined rate and one is not. Both are aimed at full recovery of costs at the current level of operations.

Also, worth noting is that the author does not mention what measure of utilization will be used. Apparently one measure of utilization will be used such as CPU time.

An interesting variation of standard cost is advocated in an article by Melvin Krasney.[19] It is suggested that the typical EDP service center structure is detrimental to efficient operations. A pseudo-profit center approach is presented as a solution.

Since an outside market price is often not available, the center's revenue is determined by a standard cost plus a markup. The standard cost is based upon total cost using expected activity levels. The profit margin can be the corporation's average or expected rate of return, or the average rate of return of comparable independent computer service firms.[20]

Job requests are submitted to the EDP department. The user includes an estimate of the monetary benefits to be derived from each job. The EDP department will accept the job if the benefits exceed the estimated variable cost of the job.

The revenue to the EDP department is calculated by multiplying the actual quantity of computer services used

by the standard cost plus markup rate. The expense recorded by the user division is some portion of the revenue recorded by the EDP department. The exact amount is equal to the ratio of the estimated benefits to the EDP department's revenue for that job. However, the expense that is recorded will never exceed the revenue for the job. Any difference between the expense recorded by the user division and the revenue recognized by the EDP department is charged to a general and administrative account of the corporation.[21]

This approach raises some interesting questions:

1. Can a profit figure with so many arbitrarily determined elements be used for departmental motivation and evaluation?

2. If there is no outside market price, how can one use "the average rate of return realized by comparable independent outside service firms" as a basis for the internal EDP department's rate of return?

3. If the EDP department accepts all jobs which have estimated benefits greater than variable cost, what rational motive would induce a user to put a benefit estimate significantly greater than variable cost on his job? Instead he would value his job at just greater than variable cost. This would cause him to be charged the lowest possible expense and give him higher profits. This

would lead to a substantial weakening of the evaluation process in profit centers.

4. In light of the preceding comment, is it not likely that the EDP facility will soon be operating at full capacity? The users will be requesting jobs on the basis of marginal cost and soon there will be no excess capacity.

5. Considering the preceding four comments, does this approach encourage the kind of employee behavior which will lead to the corporate objectives of long-run profit maximization?

Several articles have assumed that the appropriate transfer price is a standard cost based on full cost at the expected level of operations for the period. With this assumption, the articles then proceeded to discuss the most appropriate way of arriving at the cost of computer jobs.

One author, Anthony Diguglielmo suggests an "internal" and an "external" approach to charging EDP services.[22] The internal approach necessitates the accumulation of use data for the central processor as well as all the peripheral equipment for each EDP job. The amount of use is multiplied by the standard rates to arrive at a job cost figure. The standards are calculated by using full cost and expected levels of operation. The author points out that the accumulation of such use data

is not possible on some systems, and when possible it adds to the systems overhead.[23]

The external approach necessitates the accumulation of elapsed time on each job. The elapsed time is multiplied times the standard rate which is based on expected full cost and expected utilization rate. The resulting charge is adjusted by a "configuration factor" which is an estimate of the percent of the system that the job used. Thus, if it is estimated that a job only used fifty percent of the system, it will be charged only half of the standard rate. A final adjustment is made with a "distortion factor." This factor attempts to adjust for distortion in elapsed time due to the nature of the job, its priority, and the job mix in which it runs. The exact nature or impact of the distortion factor is not clear. Apparently each job will have its own distortion factor after being run in a variety of job mixes.[24]

In another article Joseph Sass is concerned with small users getting charged higher rates than large users.[25] This occurs because the charge is typically based on one variable such as CPU time. Thus, when a large job is run, utilizing much of the core and most of the peripheral processing equipment, it is charged at the same rate per CPU minute as a small job that utilizes only a small portion of the system. This is of great importance in a multiprogramming environment.

Sass suggests that jobs should be charged on an element by element basis. This would result in a charge based only on that portion of the system that the job used. The suggested charge would be based on a standard cost at the expected level of operations.[26]

An article titled "Job Costing a Multiprogramming Computer" is concerned with the problem of determining a base for charging computer jobs in a multiprogramming environment.[27] The solution arrived at is really quite simple. Take the total elapsed time of each job, during a given period of time, and add it up. Divide this sum by total clock time (i.e. the time the machine is being used) to get a fraction. Then multiply each job by this fraction to get "net time." The net time is then multiplied times the standard cost per unit of time.[28]

This relatively simple approach does not take into consideration the proportion of the system that each job uses. It also assumes that the objective of the charge is merely to allocate the cost of the computer facility.

One final article that deserves mention is primarily a transfer pricing article, but it uses a data processing installation as its example. In this article Billy E. Goetz states that incremental cost is the unique transfer price that will allow goal congruence, and secondly that this invalidates any concept of financial responsibility centers. Market price and average cost

(the other two transfer prices discussed) are said to be "irrelevant and lead to lack of goal congruence."[29]

While corporate goals are never defined in this article, presumably Goetz is thinking of profit maximization. He assumes that there is an outside market for the firm's computer services, but the computer department apparently cannot sell to outsiders. When the computer facility operates at less than full capacity he says the marginal cost is zero. Goetz recognized the problem of putting new jobs on the computer and subsequently removing them, but he assumes the problem away.[30]

The article assumes the EDP installation to be extremely simple. It implies a single corporate goal. It assumes away all practical problems. It negates the benefits of the responsibility center concept. In general the analysis is too oversimplified to be of substantial importance to the topic.

Chapter Summary

Though there is a substantial quantity of computer-related literature, very little of it deals with the economics of EDP. And only a small portion of this relates to transfer pricing of EDP services. This chapter reviews two books and six articles which represent the primary sources of literature directly related to the topic of this dissertation.

The NAA study by Harold Sollenberger provided much of the impetus for this dissertation. It suggested the nature of the problem and suggested that transfer prices may be the solution.

William Sharpe's book provided a careful evaluation of computers in general. While a portion of the book is now outdated it still provides the most complete evaluation of transfer pricing of computer services.

The majority of the articles suggest some form of standard cost transfer price. Typically the standard cost is based on expected levels of operation. One author suggests that an EDP department should be a pseudo-profit center with revenue being determined on a standard cost plus markup basis. Another suggestion was that incremental cost should be the transfer price and all forms of responsibility centers be abandoned.

In general the literature search provided some interesting insights. It also provided support for the need for the study. A topic as important as this should certainly have a more comprehensive evaluation than the literature showed.

CHAPTER III--FOOTNOTES

[1]Harold W. Sollenberger, Management Control of Information Systems Development (New York: National Association of Accountants, 1971).

[2]Ibid., pp. 4-5.

[3]Ibid., p. 9.

[4]Ibid., pp. 129-130.

[5]Harold M. Sollenberger, "Management Information Systems: A Charge to Users and Cost Control," Management Accounting (November, 1970), 27.

[6]William F. Sharpe, The Economics of Computers (New York: Columbia University Press, 1969).

[7]Ibid., pp. 442-493.

[8]Ibid., pp. 442-443.

[9]Ibid., pp. 443-444.

[10]Ibid., pp. 453-455.

[11]Ibid., pp. 469-480.

[12]Ibid., pp. 455-459.

[13]Ibid., p. 481.

[14]J. T. Wormley, "Ensuring the Profit Contribution of a Corporate Data Processing Department," Management Accounting, XLVIII (January, 1967), 3-4.

[15]Ibid., p. 4.

[16]Ibid., p. 5.

[17]Ibid.

[18]Ibid., p. 6.

[19]Melvin Krasney, "Accounting Controls for Corporate EDP Costs," Management Accounting, VII (March, 1971), 17-18+.

[20]Ibid., p. 18.

[21]Ibid., pp. 18, 26.

[22]Anthony Diguglielmo, "Two Approaches to Calculating Cost of Simultaneous Computer Jobs," Banking, LXIII (April, 1971), 43+.

[23]Ibid., p. 43.

[24]Ibid., pp. 43-44.

[25]Joseph Sass, "Benefits of Equitable Charges for a Batch Processing Computer," Data Management, IX (March, 1971), 23-25.

[26]Ibid., pp. 23-25.

[27]M. Snyderman and R. A. Kline, "Job Costing a Multiprogramming Computer," Journal of Data Management, VII (January, 1969), 12, 20, 42.

[28]Ibid., pp. 20, 42.

[29]Billy E. Goetz, "Transfer Prices: An Exercise in Goal Congruence," Accounting Review, LXII (July, 1967), 435-440.

[30]Ibid., pp. 437-440.

CHAPTER IV

FINDINGS--CENTRALIZED EDP INSTALLATIONS

Introduction

The first three chapters presented the problem, noted the current literature about it, and mapped the research methodology for the study. Chapter IV presents the findings of the study.

Chapter IV is devoted to a discussion of the current environment of centralized EDP installations. This presentation is made so that the reader will be aware of the elements that must be considered in creating criteria for an EDP transfer pricing system. This chapter is based on the information received in the field studies.

The chapter starts with a brief discussion of the advantages and disadvantages of centralized EDP installations. This is followed by a description of the basic characteristics of a large centralized installation and the relationship of such an installation to the organization as a whole.

Three practical problems are mentioned. They are: assigning costs and benefits, adding and deleting computer jobs, and user control of accept-reject decisions.

Field study support is presented for EDP transfer pricing; a brief survey of the current transfer pricing techniques of field study firms concludes the chapter.

Centralized EDP Installations

Centralized EDP installations which were visited were characterized by the fact that they provide computer services for a variety of users within the firm. The alternative was to have a number of smaller installations, each serving different segments of the firm. Each of the alternatives has some advantages, however, the trend seems to be toward centralization.[1]

It is difficult to say what advantage of centralization is most important. Discussion with EDP managers in the field study disclosed varying opinions. The following advantages were cited by the field study EDP managers. The number in parentheses represents the number of EDP managers (out of 14 interviewed) citing each advantage.

1. (12) Centralizing EDP facilities allowed the firm to provide more computer power per dollar. This characteristic, which computer vendors liked to refer to as "more bang per buck," allowed the firm to provide the same computer services for less money or more computer services for the same money. If a firm used a full cost

charging scheme, this would usually mean that the user got charged less per job.

2. (8) Highly skilled operators, supervisors, programmers, and systems analysts were hard to find. Centralization minimized duplication of effort (as one EDP manager put it "we got tired of inventing the wheel over and over again"). It also reduced the total amount of required staff in most cases.

3. (7) It allowed for a central data base. As information systems got larger and more integrated, a common data base became more important. A centralized data processing organization was very important in developing large complex information systems.

4. (6) Centralized EDP operations provided more security against systems breakdowns. Typically, a centralized operation could handle systems "crashes" more smoothly than if the firm had a number of smaller operations.

5. (6) A centralized system permitted the acquisition of specialized equipment. Sometimes decentralized EDP shops could not justify the acquisition of new or specialized

equipment, but with centralization there were enough users to justify the equipment. Two firms supported this point with the example of a scanner which was used to read hand written documents rather than machine prepared input.

6. (4) Centralizing EDP made costs more visible. The idea was that the concentration of costs made them easier to control.

These benefits were not the only characteristics of a centralized EDP installation. Other characteristics were not so attractive.

Like all valuable resources, computer services must be rationed to the various potential users. EDP managers stated that with centralization came the problem of allocating computer resources.

A second problem dealt with managerial evaluation. When a number of responsibility center managers were being evaluated on their cost or profit performance, the question arose of what to do about their costs for computer services used. When a computer served only one responsibility center the costs could be isolated. But with centralized EDP many responsibility centers were being served by one installation. The problem of cost distribution was complicated by the fact that different responsibility centers used different amounts of computer resources.

A third problem of EDP centralization dealt with communications. As the EDP department moved away from the users, communications became more difficult. One type of communications problem was physical: namely, getting the data into the computer system. Sometimes this necessitated new equipment such as remote batch entry and/or time-sharing consoles. The second kind of communications problem was the inability of central EDP staff to understand the needs of each of its users. As EDP operations were further removed from users, the ability to respond to user needs sometimes diminished. This problem could only be solved by both the user and the EDP department making a concerted effort to understand each others problems and to cooperate in overcoming these problems. To this end some centralized EDP operations had personnel who functioned solely as liaisons between the user and the computer facility.

The Nature of Centralized EDP Installations

Basically EDP installations were tailor made. The larger the installation the more accurate this statement became. This is not to deny that computer vendors have basic packages of equipment. Each installation was usually built around some standard type of system. But the purchaser can devise an almost infinite variety of installations by varying the mix of peripheral equipment and

software packages. Hopefully each system when complete would best meet the user's needs.

Yet even if centralized data processing installations were somewhat unique, there was still a certain uniformity between them. An understanding of these basic characteristics should prove useful to understanding the topic as a whole. The illustration that follows describes a typical centralized EDP installation.

A given centralized data processing department may have one, two, or more central processing units. Connected to each of these central processing units will be core memory, secondary storage (usually in the form of disk storage), tape drives, card readers, printers, and perhaps other peripheral equipment. A central processing unit along with the attached peripheral equipment is usually referred to as a system. Thus, a centralized EDP shop may have several systems in operation.

The central processing unit is the heart of any computer system. The core memory is also vital to the operation of the central processing unit. The program that runs the central processing unit is stored in core memory.

Core memory is very fast. It is also very expensive. Disk storage is less expensive but it is slower than core memory. Slower yet but still cheaper is tape storage.

Other peripheral devices are printers, readers, and scanners. These are input-output devices. The scanner is a relatively new device that reads hand prepared input. Card readers can recognize only machine prepared cards.

The computer hardward just described is supported by an operations staff. Typically this staff includes:

--Computer operators who run the various jobs that have been submitted and scheduled.

--Data preparation people who prepare the data in the various required forms for the jobs to be run. This group may also convert data from one form to another when necessary.

--Tape librarian who maintains the tape library and pulls the appropriate tapes for running and conversion.

--Secretaries who perform the necessary secretarial and clerical work for the data processing operations department.

--Systems maintenance people who provide the systems support to keep the systems operating effectively and efficiently.

--Supervisory people including floor supervisors, and other managerial personnel in the area of EDP operations.

This operations staff along with the computer hardware comprise the computer operations segment of a firm's EDP

operation. The other segment, systems development, was discussed briefly in Chapter I and will be discussed at greater length in Chapter VI. This study is primarily concerned with computer operations.

Figure 2 is presented as "an illustration of a typical large EDP installation." It does not represent any particular installation. Instead it is intended to have the characteristics of the majority of the installations visited in the field study.

Figure 3 is an organization chart for a typical firm with centralized computer facilities. Again it does not represent any given firm. It is presented to give the reader an understanding of the typical kind of organization in which a centralized computer facility functions.

The centralized EDP facility performs services for corporate headquarters, the other staff functions, and each of the divisions at various levels throughout the divisions. In most firms the centralized computer installation was not the only source of computer equipment. Often firms had one or more computers dispersed throughout the divisions. These computers were usually smaller and served some specific function(s). Common examples were quality control and scheduling. The computer installations shown in divisions A and C of Figure 3 represent this situation.

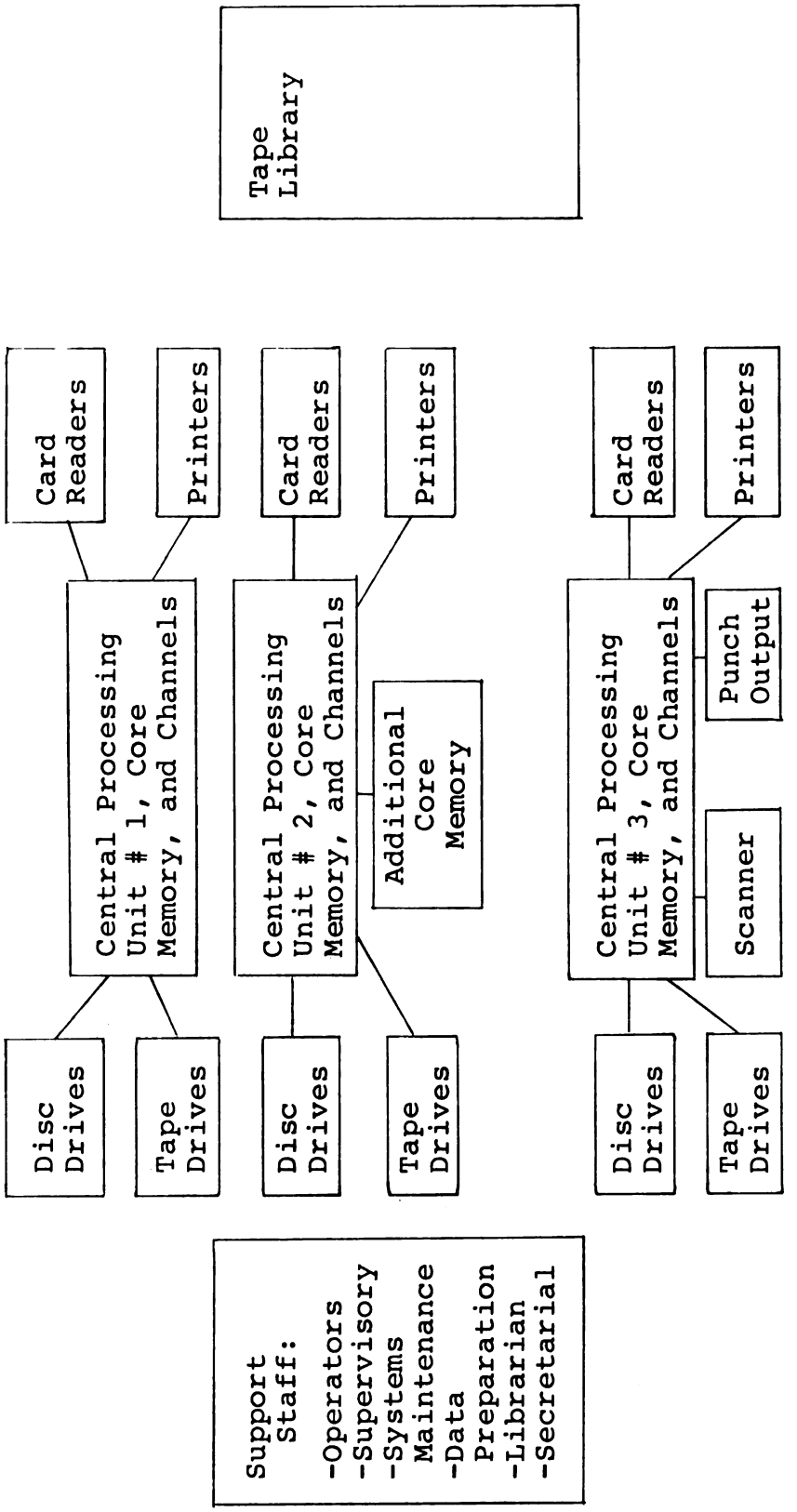

Figure 2.--A Typical Large EDP Installation.

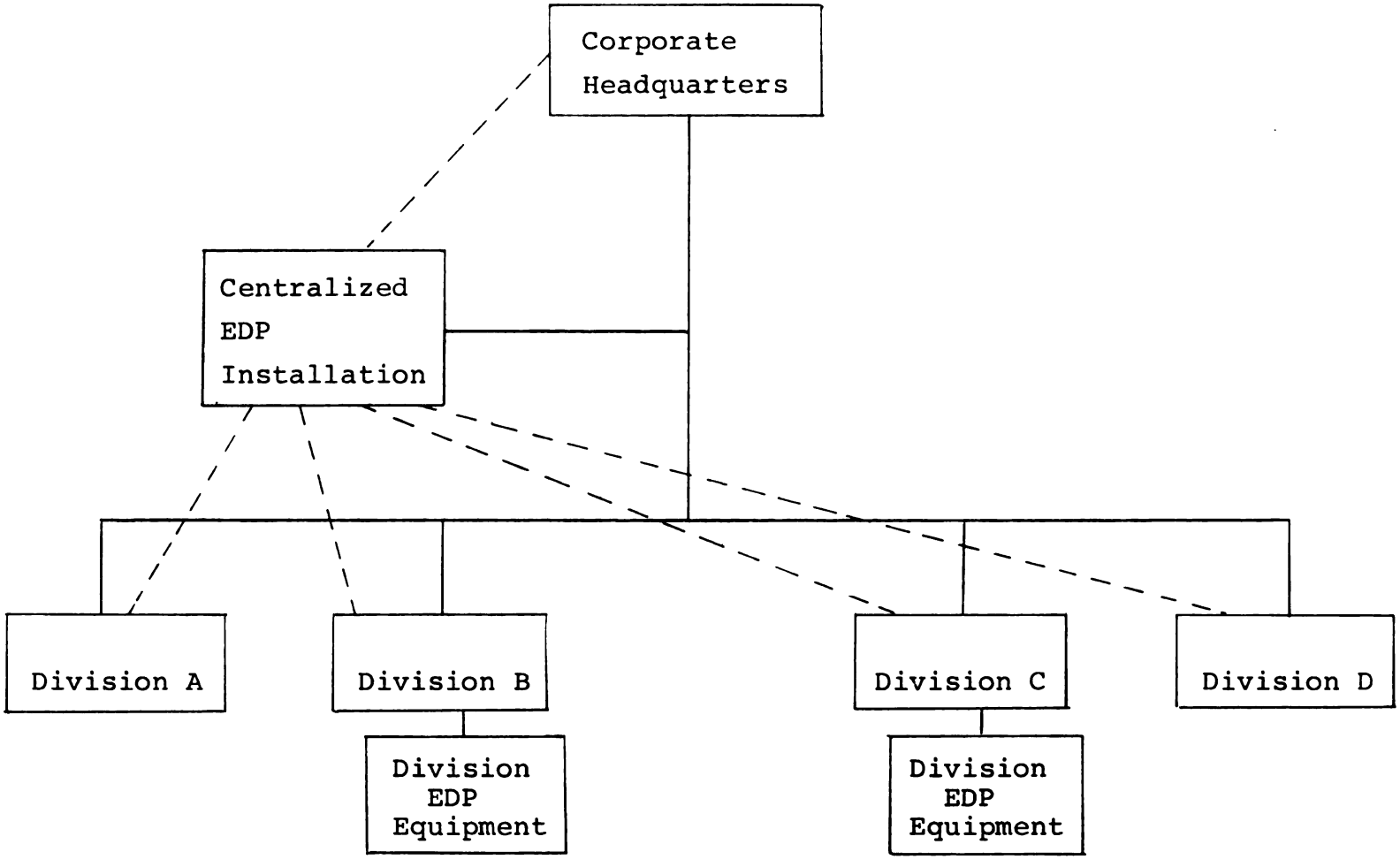

Figure 3.--Organization Chart for a Typical Firm With a Centralized EDP Installation.

In many cases these small installations required no transfer price, because they served such a specific use. Their costs were directly assigned to the responsibility center that was using them.

Figure 4 is an organization structure for a typical centralized corporate information processing center. It was taken from Harold Sollenberger's Management Control of Information Systems Development. It is presented to give the reader some idea of the organization structure that a centralized information processing operation may take. This structure will vary with the nature of the particular data processing installation.

This study is primarily concerned with the central computer installation as presented in Figure 3 and with systems operations costs. If a smaller installation has a sufficient number of characteristics of a centralized EDP center, then it may be necessary to handle it as such. It is important to note that requests for services can come from many different levels of the organization. While the full range varied somewhat among the firms visited, some installations had job requests from corporate headquarters down to requests from line managers in operating departments.

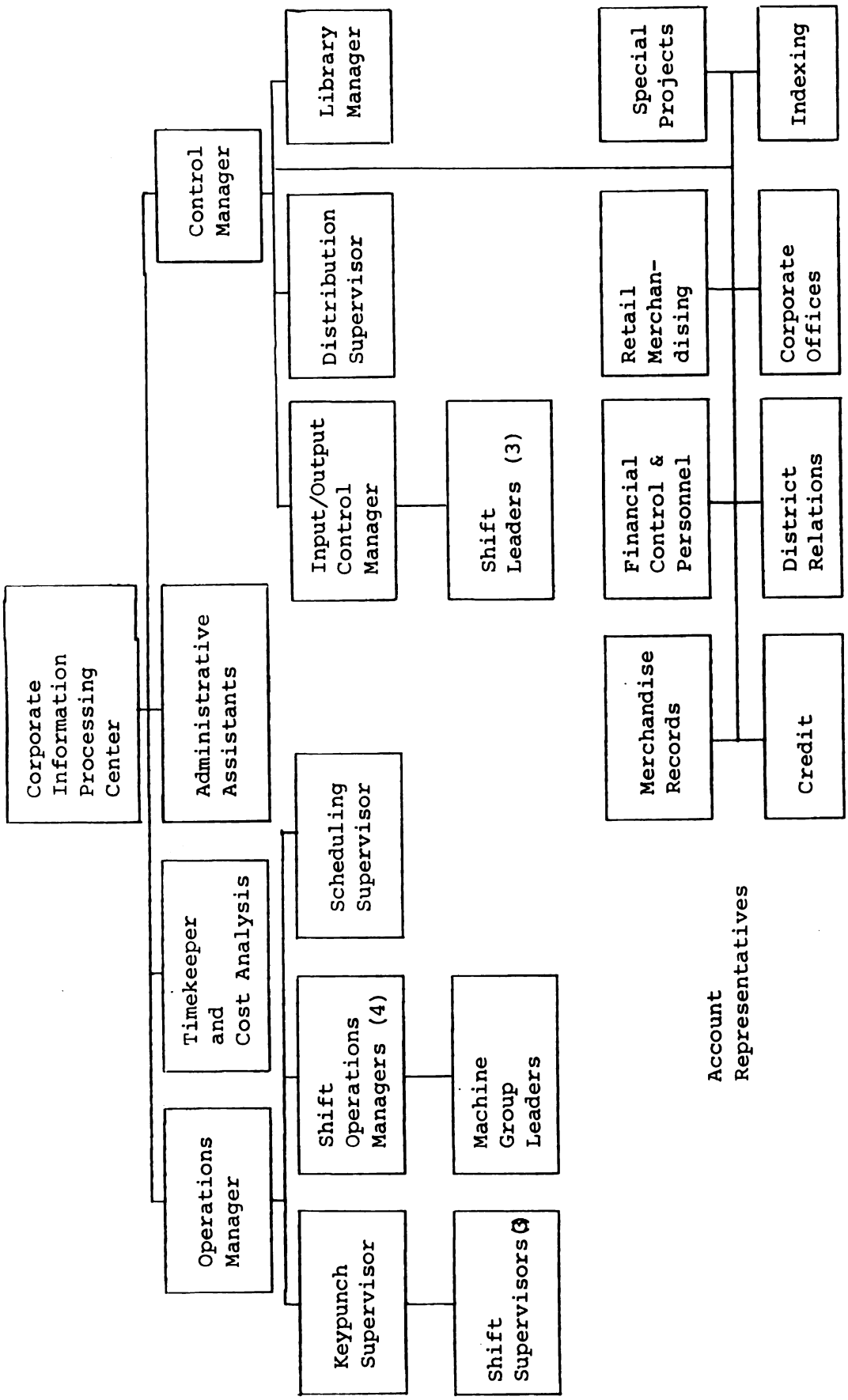

Figure 4.--Organization Structure of a Typical Corporate Information Processing Center.[2]

The Effect of Multiprogramming on Controlling EDP Use

It was relatively easy to determine the amount of systems resources being used by each job with second generation equipment. Each job tied up the entire system as long as it was in the machine. It made no difference if only a small portion of the total system was being used by a job or if the entire system was being tied up, because no other job could use the unused portion of the system resources. So the best measure of resources utilized was merely clock hours, the amount of time the job was in the machine.

With third generation computers, came the ability to use multiprogramming. This feature allowed more than one job to use the system's resources at the same time. The central processing unit actually only processed one job at any given moment in time, but there were numerous interrupts when the central processing unit (CPU) was waiting on the relatively slow peripheral processing units. At such times another job could be executing in the central processing unit. This gave the appearance of several jobs all running at the same time.

The size of the system, the software package being used, and the kind of jobs being run determined the number of jobs that could be multiprogrammed at one time. The number varied from only a few to more than fifteen on the very large new machines.

In order for a job to execute in a multiprogramming environment there had to be enough core memory available for the program, and the required peripheral units had to be available. As an example, if the required core memory was available but only two of the required four tape drives were available the job would not execute. On the other hand if the required amount of core was not available the job could not execute. Thus, a job that used only ten percent of the core memory but required a substantial amount of peripheral equipment could conceivably tie up all of the systems resources while it was running. The same would be true of a job that used substantial core and very few peripherals.

Both of the above examples were, of course, extremes. Most jobs fall somewhere between. When tailoring a new system, primary considerations were the kind of jobs that will be run on the system and the kind of service that will be required. The systems configuration was one that could best meet the service requirements without having either the central processing unit or the peripherals remaining idle for great periods of time.

Several EDP managers noted that many people would guess that if the choice had to be one or the other, it would be better to have peripherals idle and the central processor working most of the time. However, the cost of peripherals were very important. Of the firms visited in

the field study, the central processor and core memory made up about sixty percent of equipment costs and peripherals forty percent. This proportion, of course, varied from firm to firm. The percentage ranged from 75% for the central processor and core memory and 25% peripheral units to 50% for each.

With the advent of multiprogramming came the problem of determining what portion of total resources was being used by each job. Compounding the problem was the diversity of new uses for systems resources. Different jobs used markedly different equipment configurations. For this reason a single indicator of resources used such as clock hours or CPU time was often a very poor indicator of usage.

Measuring Capacity in a Multiprogramming Environment

In most business situations excess capacity is the difference between the current level of activity and full capacity. Field study results showed that in a multiprogramming environment full capacity and excess capacity are difficult concepts.

No multiprogramming computer system operated at near 100% capacity if that is defined as all elements of the system being used 100% of the time. Several EDP managers indicated that they operated "somewhere between 60% and 70% of full capacity," but upon further questioning

they all admitted that this was merely "a rough guess." Even the most sophisticated EDP users in the field study stated that there was much subjective evaluation in the determination of capacity. (See Appendix A for a more detailed description of measuring capacity in a multi-programming environment.)

Operations at full capacity would only be possible with a perfect job mix. This did not exist in any of the centralized EDP installations that were visited.

Acquiring Systems Resources

Typically systems resources were acquired only after lengthy consideration by members of top management. The exact composition of the group making this decision varied. Sometimes it was all the corporate vice presidents plus some experts from the systems area. Other times it was a select group of higher level management who had particular expertise in the systems area. Or it was a specially organized corporate staff. Whatever the exact composition, it was a high level policy decision. In most cases this was assured by the mere size of the investment required for centralized EDP installations.

But typically new systems resources were not acquired just to have excess capacity. Over seventy-five percent of the field study installations stated that new resources were acquired to meet the needs of current job

requests. The majority of the new resources were identified with already approved job requests.

When new systems resources were acquired, it usually took a while before the new installation was operating at the expected level of operations. With a full costing scheme users were paying for the excess capacity as long as the installation operated below the anticipated level of operations.

Most firms were able to approximate at what level of operations they reach "practical full capacity." This was the level beyond which an unsatisfactory quality of service resulted. Unsatisfactory was defined by the policy group that made the systems resources decisions. It was usually characterized by job deadlines not being met and individual user dissatisfaction filtering up to the EDP policy group. This level which was labeled practical full capacity depended on the quality of services desired by the EDP policy group, the job mix, and the skill of the EDP department in scheduling jobs.

Assigning Costs and Benefits

Cost-benefit analysis has a natural appeal to businessmen. However, a basic assumption is that both costs and benefits are definitely determinable. In the area of computer based information systems this was sometimes found to be a heroic assumption.

Costs.--Cost estimates for a prospective job were typically made by the systems department. These estimates were based on the firm's charging scheme and the best estimate of the amount of computer resources to be utilized. The use estimate rested on the abilities of the systems people and the job description given by the user.

The estimated charge could have two elements. The one most important to this study was the charge for computer operations. This may include a charge for data preparation, data coordination, and actual processing.

The second charge was for systems development and programming. If the user was directly charged for this item it was of course a cost element that he would consider. If he was not directly charged for it he was usually not very concerned with it. In either case most firms estimated the systems development and programming costs for each prospective job even if it was not used directly by the customer.

The accuracy of cost estimates varied substantially. Comments such as "We sometimes miss by a lot, but we do the best we can," were common. Several firms showed quite a bit of concern about these estimates. Only one firm felt compelled to "live with" their estimate. However, a number of other firms were still deciding whether or not to stick with their cost estimates.

Faulty cost estimates were caused by errors by the systems department, the user, or both. The error of the user was usually one of omission. Some users, particularly new users, failed to clearly define the parameters of their requests. This caused the systems people to underestimate systems development and running costs.

The systems people sometimes made substantial errors in their cost estimates even when the job description was complete and clear. This was particularly true for jobs which were new in nature. Several EDP department managers indicated that cost estimates were not good, but they were getting better. As one put it, "We have only been doing this (estimating costs on a job by job basis) for three years, and we are getting better with practice."

Benefits.--Cost-benefit analysis usually brings to mind the comparison of two quantities expressed in dollar terms. Some benefits can be expressed in terms of dollar cost savings. The automation of certain clerical functions were usually equated to saving so many dollars of wages and fringe benefits.

After a while, however, firms started considering some jobs which had benefits that were hard to quantify. Eventually the benefits shaded into the area of intangible benefits. This included such things as increased customer satisfaction, meeting competitive pressures, and improved managerial decisions.

Most firms had some sort of form on which job requests were submitted. Typically these forms had places for estimating both tangible and intangible benefits of the job. Users were urged to quantify as much as they possibly could.

The degree to which firms considered intangible benefits in accepting or rejecting jobs varied substantially. One firm indicated that over half of their resources were devoted to jobs that could not be justified on tangible benefits alone. On the other hand nearly half of the firms indicated that intangible benefits were very hard to justify in their firm. Jobs were accepted primarily on their quantifiable cost savings. Several installations said that it would be impossible to get operations research type projects accepted. One firm mentioned that before the austerity program in 1969 there were a number of innovative jobs on their system. But in 1969 they were eliminated and they have not been reinstated.

Adding and Deleting Computer Jobs

An interesting problem was pointed out by a number of people in the field study. Once a user automated a particular function he had a tendency to get locked into the system. This means that he could not easily be

removed from the system. There were a number of reasons why this happened.

1. If the function was previously performed manually, most of these employees had moved on to new jobs, new departments or had left.
2. Sometimes the automation provided new information. This information became essential to the user. Sometimes it was input for other systems.
3. Competitive pressures prevented a return to the old system.
4. At times a considerable amount of systems work and programming was necessary to automate a job. Thus, the cost of actually running the job was only a minor consideration if there was a good chance the job would be run only a short time.

Some EDP managers expressed concern over charging less than full cost for EDP operations. They felt that this encouraged users to use EDP resources, and once the user was on the system he was often "locked in."

User Control of Accept-Reject Decisions

There was some diversity among firms in who had decision authority over accepting or rejecting computer jobs. Most field study firms accepted computer job requests from top corporate management on down to line

managers in the user divisions. Yet, there was a substantial difference in who made the accept or reject decision on job requests. Many firms had dollar limits on the amount of systems resources that each level of manager could commit. Anything in excess of this level had to be approved by higher level management. How high typically depended on the dollar cost of the proposed project.

Usually the chain of approval did not go higher than one level above the manager making the request. This was because most managers did not need systems work so sizeable that a much higher level of management had to approve the request. In such a case the cost occupied a large portion of the manager's total budget.

In approximately two-thirds of the installations the final accept-reject decision was left to some form of EDP priority committee. In such case the user was asked to estimate the benefits of the job request. The systems department estimated the costs. Then the EDP priority committee made the decision.

EDP Priority Committee

All of the field study firms had some form of an EDP priority committee. The distinguishing characteristic was the kind of decisions the committee made.

In nine of the fourteen installations some form of EDP priority committee accepted or rejected each job

request. Thus, if a user said, "Yes I want the job," he could still be turned down by the priority committee.

Even in the remaining installations, job requests that were very large (a relative term depending on the size of the firm) had to be approved by some sort of EDP priority committee. Thus, in all of the installations visited not one had a complete buyer-seller relationship.

EDP priority committees served other functions sometimes such as deciding what job should be worked on first. Very large jobs often took months and even years to get on the system. Systems development and programming resources were usually limited. Therefore, systems development resources had to be rationed using some priority scheme.

Nature

The single term "EDP Priority Committee" has been used to describe the committee which has primary responsibility for computer utilization within a firm. The specific responsibility of the committee and the committee's composition varied from firm to firm. However, certain characteristics were noted.

Committees that reviewed all user requests were usually made up of several people from the EDP department, representatives of the major users, and sometimes a representative from corporate staff. Several firms

accepted or rejected job requests solely on the basis of the systems department staff recommendations. One EDP department manager indicated that he was the final word if there was any question about whether or not a job was to be accepted.

Firms that review only those jobs that exceeded a certain dollar limit usually had a priority committee composed of much higher level management. Commonly these were all the vice presidents, the president and the director of systems and data processing.

The initial decision criterion was a cost-benefit analysis. (The problems of this kind of an analysis were discussed earlier in this chapter.) However, other decision criteria were sometimes used. One EDP manager suggested that there was an attempt to balance the amount of computer services among the various users so that "everyone got their fair share" of computer resources. Another EDP manager said "We consider a lot of other things," but he chose not to enumerate what the other things were.

Three installations were governed by an internal EDP priority committee. That is a committee of systems and data processing people made the accept-reject decisions on all but the very large job requests. In each of these installations the committee chairman was the director of systems and data processing. One of these directors indicated that he was in effect the decision maker.

Field Study Support for EDP Transfer Pricing

In Chapter I it was suggested that the best way of controlling EDP use was by charging users for computer services. This assertion was based in part upon the findings of the field study. Each of the installations visited had some sort of charging system for computer services. The methods of charging varied, but each installation thought some form of transfer price for computer services was beneficial.

Each data processing installation manager was asked what he thought the advantages and disadvantages were for charging users for computer services. The responses were varied but all agreed that the advantages outweighed the disadvantages.

The advantages were grouped into seven major categories. The exact phrasing of the responses varied, but these seven main categories include all of the responses. The most frequent advantages were listed first. The number in parentheses is the number of installations listing an advantage in that category.

1. (12) Internal charging reduced the number of requests for services.
    a. Imposing no charge caused a great increase in the number of requests for services.

b. A flat charge or charging a constant percentage of total costs greatly increased the request for services.

All but two of the centralized EDP installations felt that internal direct charging had a substantial effect on the users' requests for services. Users were motivated to request services that were in any way beneficial if there was no direct charge for the services. Consequently, many requests were received which were uneconomical and/or poorly conceived. A transfer price helped to eliminate a good portion of these requests.

2. (10) Internal charging shifted the responsibility for EDP costs to the users.
   a. It made users aware of EDP costs.
   b. Users should pay for the costs that they incur.

There was a strong feeling that if users are receiving the benefits of computer services, they should be held responsible for the costs. Responsibility was best represented by having the costs appear in the user's budget. Most EDP managers felt that if users were unwilling to have their EDP costs included in their budget, then they should not receive the services.

A second concept of responsibility related to the idea that managers would act appropriately if they really

knew what EDP services cost. A transfer pricing system provided this information.

If users were held responsible for EDP costs, they were forced to use a cost-benefit analysis of some sort. Typically users were closer to, and therefore more familiar with, the benefits to be derived from computer services. Thus, in many cases the analysis of benefits were better at the user level.

3. (9) Charging users was beneficial in acquiring new systems resources.
    a. Top management was more receptive to new systems resources requests when it was apparent that users were willing to pay for the resources.
    b. Growth in EDP resources should be backed by users willing to pay for them.

Many EDP department managers felt that internal charging gave them better bargaining power when they went to top management for additional resources. Top management was influenced more by a group of users saying they were willing to pay for new resources, than just the systems management saying new resources were necessary.

Several systems managers said that before users were directly charged for computer services, it was much harder to get the computer center budget approved. Some felt that they were bearing an undue portion of the

whipping for spiraling EDP costs. As one person commented, "We were only trying to provide the services our customers demanded, and we were getting all the blame for increasing costs." With a direct charging system sharp increases in use could be spotted and identified.

It was pointed out that the acquisition decision for large systems resources was not easy. Classical capital butgeting techniques were valid, but they were very difficult to apply in the computer area. And many admitted that in the final analysis, "seat of the pants" decision rules were sometimes used in acquiring systems resources.

Some EDP managers suggested that a better approach was to see if users were willing to pay for a sufficient amount of new services to acquire the new resources. If not then the appropriate decision was to reject the proposal. This was a consensus approach to EDP acquisition decisions.

4. (7) Transfer pricing of EDP services controlled the use of computer resources.

Many jobs such as payroll, production scheduling, and periodic reports were run at predetermined intervals. There was little incentive for the user to run these jobs more often. Other jobs such as operations research programs, simulations, and linear programming production mix problems might be run much more frequently if users were not directly charged for each run.

One manager said that about 70% of resources were being used for this latter category of jobs. In the absence of direct charging their computer costs would skyrocket.

5. (7) Transfer pricing forced the EDP department to evaluate itself.

Half of the EDP managers in the field study felt that direct charging for computer services forced them to continuously evaluate the installation's performance. The managers talked in terms of self evaluation rather than evaluation by superiors.

The cause of the self evaluation varied between firms. Most said that users were very concerned with their charges. Any changes in the charges were quickly questioned. Rate structures were often challenged. In short EDP management had to stay on its toes to keep its users happy.

Also, two people said that internal charges allowed them to compare their charges with the charges of outside suppliers. The comparison was often made with a commercial supplier of EDP services and sometimes with the rates charged internal users in other firms. Most of the managers making these comparisons realized that the services provided would often not be the same, and sometimes the comparison was being made between prices of a profit oriented supplier and a cost oriented internal supplier.

Some EDP managers felt that even considering these limitations, such evaluations were beneficial.

6. (4) Internal charging moved the EDP department out of the priority setting role.

Several installations felt that the charge-back system had taken much of the pressure off of them in accepting jobs and setting priorities. These managers felt that their job was to run the systems area efficiently, and the use decisions should not be theirs.

7. (3) Transfer pricing conforms to company policy.

Three firms said that the computer department was considered a service department in their firm, and all service departments had to charge users for their services. Company policy stated that the charges should be levied in such a way as to reflect the amount of services each user received. This policy was met by using a transfer price for computer services.

All responses were not favorable. Some disadvantages were cited. The most commonly noted disadvantage was that charging schemes used a certain amount of systems resources. This took valuable resources that could have been used for productive purposes.

While the above disadvantage was listed by almost everyone, the remaining list of disadvantages were

mentioned by relatively few. None were cited by more than three installations.

1. Large systems were hard to justify because they usually required a substantial amount of cooperation among many users.
2. Charging systems added another layer of bureaucracy to an already complex organization.
3. A charging system stymied change.
4. If a charging system was too detailed it made users think of the system as individual elements rather than a total system.
5. A detailed charge made it hard to acquire new and specialized equipment.
6. Users were tied into the system and really had no control over it, so they should not have to pay for services.

The consensus of opinion was that the advantages of an EDP transfer pricing system were greater than the disadvantages. This is supported by the fact that each firm had some form of computer service charge. But perhaps one of the strongest supports for the importance of EDP transfer prices was the fact that nine of the fourteen installations took one of the following positions:

1. Had recently changed their charging system to a more sophisticated algorithm.

2. Were in the process of changing their charging system.
3. Felt that their charging system should be improved but had no immediate plans for change.

Corporate EDP Objectives

All firms have one or more major goals or objectives. These goals are typically stated with some degree of formality. The goals may vary somewhat but basically they start with earning a reasonable profit and remaining liquid and continue through such items as providing jobs for the community and performing a public service.

These goals certainly guide management in formulating policy, but most firms create more specific objectives for the various segments of the business. This was true in the area of electronic data processing.

All of the installations in the field study were guided by one or more objectives. These objectives are presented below:

1. Automate all jobs that can be justified on the basis of cost reduction.
2. Automate jobs which will reduce the amount of peripheral minutiae with which management must deal.
3. Maximize the utilization of EDP resources.
4. Facilitate the creation of change.
5. Give the appearance of being progressive.

The first four objectives were explicitly stated by one or more of the installations. Objective number five was implicit in some of the actions and comments at certain installations.

Survey of Current EDP Transfer Pricing Techniques

A survey of current EDP transfer pricing techniques was not an objective of this study. Nonetheless, a brief summary of the transfer pricing techniques currently being used by the field study installations seems in order.

Each installation had at least one element in its transfer pricing scheme which distinguished it from all the others. But each installation could be grouped into one of four major categories having similar characteristics. The currently used EDP transfer pricing techniques are presented in these four categories.

Standard Cost

Six installations used a form of standard cost in charging for computer services. All the firms using standard costs based their standards on the period's expected level of activity. This period was usually a year though one firm "re-evaluated the standards every few months."

Five of the six installations used standard rates and actual use for either a monthly or quarterly charge.

In each case records were kept on an individual job basis. One installation used "this year's standard rate" and "last year's use level adjusted for known changes" in arriving at a monthly charge for users. This was done so that charges would conform to the budget.

Five of the installations charged for more than one element of the computer facility. The usual charging system included elements for core-hours and each of the peripheral units. Each element was a fully loaded cost center. This means that all costs such as occupancy costs were allocated to the various elements. One of the firms used core-hours as the sole approximation of the total resources used.

The problem of identifying the use of each peripheral on a job by job basis was no longer prohibitive. New software packages had been developed by some software vendors, management consulting firms, and large EDP users which made this information fairly easy to secure. The drain on systems resources was not large, measuring only one and a half to three percent of total systems resource for the field study firms that collected such data. As one EDP manager stated, "It is a small cost to pay for the control it gives me." All of the field study EDP managers that gathered this information felt that it was worthwhile.

Full Cost

Four installations used a form of full cost in charging for computer resources. Three of these firms accumulated use data for the month, and then divided the total amount of use by the total cost for the month to get a rate. The amount of use each job required was then multiplied by the rate for the month to get the charge for each job. Each of the three installations described here used CPU time as a basis for measuring use.

One installation had a corporate level meeting of all divisional managers late in the fiscal year to negotiate charges for the next year. The negotiations proceeded on the basis of the current fiscal year's use plus expected changes in the coming year. The end product was a percentage figure assigned to each division totaling to one hundred percent.

At the end of each month the charge for each division was determined by multiplying the total costs for the month by the negotiated percentage. Any marked change in use level did not have an effect on the charge until the next fiscal year.

User requests came from a number of levels within each division but the charge was levied on the division's overhead account. It was then spread to the various elements of the division as overhead.

Partial Costs

Three installations charged only partial cost to users. One firm charged only some of its users (two divisions were charged and the rest were not). The users that were charged, were charged at a rate which was designed "to recapture only the equipment rental and direct costs" of the installation. This particular scheme was arrived at because "the vice president that was responsible for the EDP area wanted it that way."

Two other installations were located in corporate headquarters as a staff function. Users other than corporate headquarters were charged for services. All other costs were absorbed as part of corporate overhead. One installation "tried to charge full cost" for all services to divisions. The other installation had some excess capacity and charged its services at "a bargain rate" in an attempt to secure more divisional users. Both of these installations based their charge on CPU time.

Greater Than Full Cost

One installation claimed that it attempted to operate as a cost center with a zero budget after charging for services. Yet, it had shown a consistent profit for the last three years. The current year showed revenue (charge-backs) running fifteen percent ahead of costs. The projected budget for the coming year had a budgeted twenty percent profit margin.

Chapter Summary

Centralized EDP installations had both advantages and disadvantages. EDP managers thought the advantages outweighed the disadvantages, and there was a trend toward centralization in firms that were large EDP users.

A typical EDP installation was hard to define. Each installation was, to some degree, tailor made. Yet, centralized EDP installations had certain characteristics which made them similar.

Multiprogramming has had a marked effect on the ability to measure systems resource use. Before multiprogramming this was quite easy.

Cost-benefit analysis presupposes that both costs and benefits can be quantified and compared in some meaningful way. Cost estimates were often faulty. This was the fault of both the user and the systems people.

Benefit estimates were usually possible for tangible benefits, but intangible benefits were sometimes hard to quantify. The ease with which intangible benefits could be justified when requesting services varied substantially from firm to firm.

Unlike many other service functions within the firm, EDP services seemed to tie the users to the service center. Many jobs, once automated, were hard to delete. The easy on easy off jobs were rare.

Many users had only a limited say in acquiring systems resources. The accept or reject decision was often left to the firm's EDP priority committee. Otherwise, the choice was often subject to some dollar amount limitation depending on the level of management.

EDP priority committees were still important in one form or another in all of the firms visited. In some cases the committee only looked at large job requests and set priorities. In others virtually all jobs were evaluated by the committee.

Each EDP manager in the field study was asked what he felt the advantages and disadvantages were in charging for computer services. The resulting list of advantages was:

1. Internal charging reduced the number of requests for services.
2. Internal charging shifted the responsibility for EDP costs to the user.
3. Charging users was beneficial in acquiring new systems resources.
4. Transfer pricing of EDP services controlled the use of computer resources.
5. Transfer pricing forced the EDP department to evaluate itself.
6. Internal charging moved the EDP department out of the priority setting role.

7. Transfer pricing conformed to company policy.

The disadvantages were less prevalent. The only one mentioned consistently was that internal charging used valuable systems resources that otherwise could be used for productive services.

Like other segments of the business, most EDP installations were operated in light of one or more objectives. Five major objectives were observed in the field study firms. They were:

1. Automate all jobs that can be justified on the basis of cost reduction.
2. Automate jobs which will reduce the amount of peripheral minutiae with which management must deal.
3. Maximize the utilization of EDP resources.
4. Facilitate the creation of change.
5. Give the appearance of being progressive.

Finally, a brief survey was presented of the current transfer pricing techniques which were being used by the field study installations. These were:

1. A form of standard cost. (six installations)
2. A form of full cost. (four installations)
3. A form of partial cost. (three installations)
4. A form of greater than cost. (one installation)

CHAPTER IV--FOOTNOTES

[1]Bush J. Jones, "Centralizing Computer Facilities," Journal of Systems Management, XXII (June, 1971), 28.

[2]Harold M. Sollenberger, Management Control of Information Systems Development (New York: National Association of Accountants, 1971), p. 80.

CHAPTER V

CONCLUSIONS

Introduction

The purpose of Chapter V is to present the conclusions of the study. These conclusions rest on the field study findings, the survey of the literature, and responsibility accounting concepts.

The four major elements of the conclusions are:

1. Need for EDP transfer prices.
2. The need for top management's participation in an EDP charging system.
3. EDP transfer pricing objectives and criteria.
4. Decision authority over accept-reject decisions.

Need for EDP Transfer Prices

Support for EDP transfer prices was quite strong among the firms interviewed. Of the forty-eight people interviewed in these firms all but three stated that they were in favor of an EDP transfer price of some sort. Their reasons were expressed from an EDP managerial point of view.

A number of reasons for using an EDP transfer pricing system were found:

1. An EDP transfer pricing system can provide data for evaluating responsibility center managers. With centralized computer installations a number of responsibility center managers request computer services from the same installation. If services are provided in markedly different quantities to the various responsibility centers, responsibility center performance comparisons become difficult if the users are not charged.

With a direct charge for services, each responsibility center manager is charged for each job he runs. If he chooses to increase his computer service usage he will be held responsible for the increase through his budget evaluation.

2. EDP transfer prices can influence user behavior to help meet corporate EDP objectives. Transfer prices can go a long way toward allocating valuable systems resources in a manner which will aid in meeting corporate EDP objectives.

3. EDP transfer prices can load the cost of EDP onto products. In a production environment where there is a substantial amount of EDP costs, it is important to get the EDP cost carried into the product cost. This is easily done with an EDP transfer price.

Based on the findings above, one can conclude that there is substantial support for the use of EDP transfer

prices. The question remaining is what transfer pricing system is most appropriate.

Centralized EDP Installations As Service Centers

There has been some question of whether or not an EDP installation should be a profit center. In Chapter III, "Survey of the Literature," several proposals were presented that would allow the EDP center to function as a profit center.

There is reason to believe that centralized EDP installations lack the appropriate characteristics to be evaluated in any meaningful way as a profit center. The two primary limitations in most centralized installations are:

1. EDP services to internal users are sufficiently different from services available from outside vendors that no market price is available to approximate revenue.
2. Most in-house installations have little or no control over the external sale of their services. These sales typically come only after all internal users are satisfied; therefore, they have no market alternatives and no "real" revenues.

Most in-house centralized EDP operations fit a set of characteristics described by David Solomons:

> There is no outside competitive market for the transferred product, transfers constitute a predominate part of the supplying division's business, and it can meet all probable requirements. In these circumstances, the supplying division should operate as a service center.[1]

The Need for Top Management's Participation in an EDP Charging System

Each firm in the field study had one or more objectives for its EDP installation. The degree of formality with which these objectives were stated varied substantially. Some were explicitly stated and provided by top corporate management. In other cases the objectives were less formal. It was clear by the actions of some EDP managers that the stated goals and the effective goals were not always the same. As an example, one firm had the goal of maximizing the utilization of EDP resources, but the charging system established by the EDP manager was a full cost charging scheme, because the manager "did not want to have to turn around and kick the job off the system when full capacity was reached." The idea being that when full capacity was reached the charge would change to a full cost charge, because there was no longer excess capacity that management should encourage customers to use.

Most EDP transfer pricing systems were established by the EDP managers. In some cases the transfer pricing system was created by a committee within the computer department. But typically the only outside influence came

from user complaints. If these complaints were loud enough, top management would sometimes intervene.

Thus, direct pressure was not exerted on the people creating the charging system to be certain that corporate objectives were met. Top management should take a much greater interest in the creation of the EDP transfer pricing system.

This interest should be manifested in the form of explicitly stating corporate EDP objectives, and being certain these objectives compliment overall corporate goals and objectives. Top management should also review any EDP transfer price to be certain that it aids in the attainment of EDP objectives.

This is not to imply that EDP managers are trying to undermine the corporate EDP objectives. But EDP managers are under the same pressures as other managers. It is not easy to create a transfer pricing system that will adhere to corporate objectives. If an EDP transfer pricing system is satisfactory to users and to top management, what incentive is there for the EDP manager to create a system which is better?

The field study data indicates that corporate EDP objectives are not being met by the current transfer pricing systems used by the field study firms. There seem to be four reasons for this situation:

1. In some firms corporate EDP objectives were not clearly stated, or they were not consistently followed. In such cases it would be difficult to establish appropriate EDP transfer prices.

2. Most firms were influenced by factors other than corporate EDP objectives. Data cited in Chapter IV on accept-reject decisions and the EDP priority committee are indicators that other factors influenced the computer charge system. In some situations the charging systems themselves pointed to the fact that EDP objectives were not the only things considered.

3. Most firms did not explicitly state the objectives of their EDP transfer pricing system. Only three firms indicated that the first step in the creation of their transfer pricing system was to state the objectives of the system. Some of the other firms surely had an implicit idea of what the transfer pricing system's objectives should be, but the best approach is to state these objectives explicitly. This is particularly true if a committee is used in creating the transfer pricing objectives.

4. Most firms did not have any criteria for evaluating their charging systems. In order to operationalize transfer pricing objectives it is necessary to establish criteria which may be used in evaluating transfer pricing systems. In the absence of such criteria it is difficult

to evaluate a transfer pricing system. The EDP objectives are often too broad to evaluate specifically the elements of the charging system.

The first two reasons that firms failed to meet corporate EDP objectives with their current transfer pricing system centered around the firms' inability or unwillingness to define corporate EDP goals and to use them in operating the EDP installations.

The establishment of corporate EDP objectives must be considered on a firm by firm basis. These goals should be in congruence with overall corporate goals.

Once corporate EDP objectives have been established, there should be a concerted effort on the part of EDP managers to operate their facility in light of these objectives. Top corporate management should evaluate EDP managers on the basis of how well they have met the EDP objectives.

EDP Transfer Pricing Objectives and Criteria

EDP Transfer Pricing Objectives

Corporate EDP objectives are intended to guide the EDP operation in helping to meet corporate goals and objectives. Transfer pricing objectives pertain to the transfer pricing system per sé. The third reason cited for firms failing to meet corporate EDP objectives with their current transfer pricing system was that firms failed to state

explicitly the objectives of their EDP transfer pricing system. The primary objective of an EDP transfer pricing system should be:

1. To alter user behavior to meet corporate EDP objectives.

And in most cases it should also:

2. Provide data for evaluating responsibility center managers.
3. Get the cost of EDP services loaded onto products.

Each firm should carefully consider which of these objectives pertain to its operations. Then the pertinent objectives should be used in establishing transfer pricing criteria.

EDP Transfer Pricing Criteria

The final reason cited for firms failing to meet corporate EDP objectives with their current transfer prices was that they failed to establish criteria for evaluating transfer pricing systems.

In order to make EDP transfer pricing objectives operational they must be converted into criteria which may be used in evaluating specific transfer pricing systems. The criteria will vary from firm to firm depending on the EDP objectives and the transfer pricing objectives.

Drawing together the field study data, the literature survey, and responsibility accounting concepts, four cases will be considered in establishing transfer pricing criteria for EDP installations. These four cases center around the five corporate EDP objectives discussed in Chapter IV:

1. Automate all jobs that can be justified on the basis of cost reduction.
2. Automate jobs which will reduce the amount of peripheral minutiae with which management must deal.
3. Maximize the utilization of EDP resources.
4. Facilitate the creation of change.
5. Give the appearance of being progressive.

The five corporate EDP objectives were grouped into four cases. These four cases were then evaluated separately. The first two EDP objectives were considered together as case 1. Corporate EDP objectives 3 through 5 were considered separately as cases 2 through 4 respectively.

Case 1

The first set of criteria was created to meet all three transfer pricing objectives for firms that operate their EDP installations under one or both of the first two EDP objectives.

The first objective primarily covers the automation of jobs which have determinable tangible benefits or intangible benefits which can be approximated. Most firms in the field study had this as a major objective.

The second objective, the automation of jobs to reduce the peripheral minutiae with which management must deal, was also important to most field study firms. The degree of importance seemed to vary with the ease of justifying intangible benefits. Typically the decision was still attempted on a cost-benefit relationship, but here the benefit side was much more difficult to define.

Given these two objectives the criteria for an EDP transfer pricing system include:

1. The charge should be based on a predictable rate that is not affected by the volume of activity of the EDP installation.
2. The charge should be based on actual use.
3. The charge should be levied against the person having decision authority over the job.
4. The charging algorithm should be sufficiently detailed to approximate closely the resources used.
5. The elements of the charge should be clearly identified and as understandable as possible, so the users will be aware of the cost of the resources they are using.

6. The charge should not be expensive to administer.

This set of criteria can best be met by establishing a transfer pricing scheme which is based on standard costs at the expected level of operations envisioned by management when acquiring the systems resources currently available.

This level of activity would be "practical capacity" as described in Chapter IV and explained more fully in Appendix A. This activity level would consider job mix and quality of services. The level of activity for the current period of time may well be less than the practical capacity level. The standard cost should be based on the practical capacity level of operations.

A standard cost as just described would eliminate the charging of users for a "policy cost." With a full cost charging system or a standard cost system based on expected levels of operation for the period, users are charged for excess capacity as long as the installation is operating below practical capacity. This is a policy cost. Users should not be held responsible for this policy cost. It is a cost which is incurred because of a policy dicision at a relatively high level. This additional user charge is of no value in evaluating responsnbility center managers, and in fact it may be quite detrimental to the evaluation process.

The charge should be made for the use of each systems element. This means that the central processor and core should be charged as a unit. Likewise, each printer, each tape drive, each disc drive, each reader, each scanner, etc. should have a standard rate as described earlier.

As noted in Appendix A, software packages are available from various sources which provide use data for the various elements of an EDP system. Thus, the amount of each resource used can be identified on a job by job basis.

Each element such as tape drives, printers, card readers, scanners, central processor and core, and disc drives can be identified as a cost center. A standard cost should be developed for each of these cost centers based on the practical capacity level of operations.

Use information should be accumulated by each job for each element. The installation may use whatever indicators it chooses to measure the use of each resource. However, the measure should be indicative of actual resource utilization.

Certain standard use variables seem to be most appropriate in some areas. Examples are: lines of print for printers, disc hours for disc drives and tape hours for tape drives. Core-hours should be used for measuring central processor and core memory use.

The cost of charging each element of the system is no longer very large. The great advantage is that this approach gives a much better approximation of total system's resource utilization than by using one element's utilization as an indicator. As computer uses continue to grow it appears that an element-by-element charging system will become even more important.

The charge should be made on a timely basis. Users should be constantly aware of what their EDP charges are. When marked changes take place in these charges the user should be aware of the changes, so that any necessary action may be taken. If charges are made only quarterly, bi-monthly or even sometimes monthly, a good portion of the control value of the charges is lost.

The charge should be levied against the person who has primary decision authority over the job. Thus, even if a responsibility center manager must get approval for a computer job request from his superior, he should be charged for the job if he is the one initiating the request. This criterion closely adheres to the responsibility accounting concept of controllable costs.

If the standards are to be used in evaluating EDP management, the standards should be set by another group. Several field study firms had EDP experts on the internal audit staff who helped top management evaluate EDP managers. This group could be instrumental in establishing

standards. If internal staff is not available, then there are outside consulting firms which can provide such service.

Case 2

The second set of criteria was created to meet the transfer pricing objectives for firms that operate their EDP installations under the third EDP objective, maximum utilization of EDP resources. The third objective is primarily utilized by firms that have substantial excess capacity.

Since EDP resources are quite expensive and seem to have a step cost function, some firms like to utilize their excess capacity whenever possible. This objective may also be supported somewhat by the notion that everyone should have some involvement with the computer.

Given this objective the criteria for an EDP transfer pricing system include:

1. The pricing scheme should encourage the utilization of unused systems resources.
2. The charge should not result in an incremental loss to the firm.
3. The charge should be based on actual use.
4. The charge should be levied against the person having the decision authority over the job.

5. The charging algorithm should be sufficiently detailed to closely approximate the resources used.
6. The elements should be clearly identified and as understandable as possible so the users will be aware of the cost of the resources they are using.
7. The charge should not be expensive to administer.

It should be noted that criteria 3 through 7 in case 2 are the same as criteria 2 through 6 in case 1.

This set of criteria can best be met by using a marginal cost transfer price. Marginal cost is not always easy to approximate for an EDP job. Often, however, the variable costs can be estimated over a relevant range of operations. This can be converted to a marginal cost approximation which will come close to meeting the above criteria. This rate should be calculated for each element of the system as mentioned in case 1. This approach will encourage the use of resources which have the lowest marginal costs.

It should be pointed out that this objective can only function on a short run basis. How short-run is open to debate, but virtually all of the field study systems managers felt that a marginal cost charge would swamp their installation with job requests in a very short time.

This problem is severely complicated by the fact that most computer jobs cannot easily be removed once they are on the system. (This matter was discussed at greater length in Chapter IV.) Thus, when the system is operating at capacity it is often hard to add more profitable jobs at the expense of jobs that are already running.

Criteria 3 through 7 are the same as in case 1. The importance of these criteria has already been mentioned.

Case 3

The third case relates to the fourth EDP objective, facilitate the creation of change. The criterion is the charging scheme should facilitate the use of EDP resources. The question is how much should the EDP system facilitate change?

The EDP objective can be interpreted in a number of different ways. The range of interpretation can lead to a wide variety of charging schemes. Based solely on this one EDP objective, the transfer pricing problem is indeterminate. In order to solve the problem, it must be viewed in light of other EDP objectives.

Case 4

The fourth case is based on EDP objective five, give the appearance of being progressive. This objective is never explicitly stated and only rarely admitted.

This objective was more important in the early days of business computer utilization. As management has become more sophisticated in its understanding of EDP, this objective has become less apparent. However, it can still be observed as an effective operating objective at times in some firms.

No transfer pricing system can be devised which will aid in meeting this objective. Like case 3, it is hoped that some other objectives will also be present that will allow the creation of transfer pricing criteria.

Decision Authority Over Accept-Reject Decisions

An EDP transfer pricing system will function best when there is a buyer-seller relationship. To achieve this relationship, the user should have the authority to purchase computer resources when he feels that the benefits, tangible and intangible, are great enough to justify the incurrence of the cost.

In Chapter IV it was noted that in many firms if the estimated dollar cost of a job request was greater than the user was allowed to commit, then the user had to secure approval from a superior. This is an acceptable procedure. The delegation of responsibility and authority to responsibility center managers is seldom absolute. If a user wants to commit financial resources in excess of what he is typically authorized to commit, he should be

required to seek higher level approval. This control step should not impair the effectiveness of the transfer pricing system.

Cost Estimates

In Chapter IV there was a brief discussion of the problems in estimating the cost of requested computer jobs. Since cost is an important consideration in the transfer pricing system, it deserves further discussion.

It was pointed out that both systems people and users caused errors in cost estimates. Errors by the systems department should not be part of the user's charge. On the other hand, users should be held responsible for their own errors in describing their job requests.

A corporate staff level function should be created that:

1. Reviews any user complaints about job cost estimates and actual charges. Thus, if a user is told that his job will cost him $300 a run and he is being charged $500 a run, the user has an unbiased place to go to find out why there is a discrepancy. If the cost estimate was poor because the user incorrectly described his job, he will get no relief. However, if the systems people made a poor evaluation the difference in the charge would be charged against the budget of the systems department. The situation could, of course, fall somewhere in between and allow the user a partial recovery of the additional cost.

2. In addition to the arbitration role, the committee should randomly check a certain number of jobs each month to compare cost estimates with actual charges. This control step is to insure that cost estimates are not set arbitrarily high.

This staff function will be filled by people with superior EDP talent. They may come from the senior systems analysts staff or from outside the firm. The latter case may be preferable to eliminate political ties as much as possible.

EDP Priority Committee

The role of the EDP priority committee may be somewhat reduced under the system just suggested. The committee need no longer rule on every job request. Instead it will only consider very large systems requests and set priorities if systems development resources are at peak capacity.

This committee will probably be composed of high level executives. Because of its organizational level it may also make systems acquisition decisions.

Chapter Summary

There is substantial support for the use of an EDP transfer pricing system. This support includes:

1. Comments and actions of field study personnel strongly supported the use of an EDP transfer price.
2. A transfer price can provide support for evaluating responsibility center managers.
3. A transfer price can influence employee behavior toward corporate EDP objectives.
4. A transfer price can effectively load EDP costs onto products.

Some efforts have been made to classify centralized EDP shops as profit centers. However, most installations lack the appropriate characteristics to operate as a profit center. They should be considered as service centers.

Most field study firms were not effectively meeting corporate EDP objectives. The reasons for this include:

1. Corporate EDP objectives were not clearly defined or consistently followed.
2. Factors other than EDP objectives influenced the operation of the computer installations.
3. Firms did not explicitly state the objectives of their EDP transfer pricing system.
4. Criteria were not established for evaluating specific transfer pricing systems.

An important step is the statement of transfer pricing objectives. A transfer pricing system for EDP resources should:

1. Alter user behavior to meet corporate EDP objectives.

And in most cases it should also:

2. Get the cost of EDP services loaded onto products.
3. Provide data for evaluating responsibility center managers.

The next step is to establish criteria which may be used in evaluating specific transfer pricing systems. In establishing criteria for EDP transfer prices, the five corporate EDP objectives mentioned in Chapter IV were broken into four cases for evaluation. The first two objectives were grouped together and the remaining three objectives stood alone.

In case 1 the suggested criteria were listed. The suggested transfer price was standard cost at the level of activity envisioned by the EDP policy committee when the systems resources were acquired.

In case 2 the suggested criteria were presented as was a suggested transfer price. Some of the criteria were the same. The suggested transfer price was marginal cost. It was noted that this can only be a relatively short run policy in most firms.

It was pointed out that cases 3 and 4 do not have a direct transfer pricing solution. Additional information must be available to solve the situations.

An EDP transfer pricing system will function best when a buyer-seller relationship exists. If a user has to secure approval from a superior because of the dollar amount of the job requested, this control step should not impair the effectiveness of the transfer pricing system.

Cost estimates are a critical element in the transfer pricing system. A corporate staff level function should be created which reviews these cost estimates.

The EDP priority committee should be a high level corporate committee. It should consider only very large job requests and it should set priorities when conflicts arise. It also may make systems acquisition decisions.

CHAPTER V--FOOTNOTES

[1]David Solomons, Divisional Performance: Measurement and Control (New York: Financial Executives Research Foundation, 1967), p. 201.

CHAPTER VI

IMPLICATIONS FOR FURTHER RESEARCH

Introduction

Like most research projects this study raised some questions as well as answered some. The purpose of this chapter is to note briefly those areas which seem most in need of additional study.

The primary area of suggested research is a transfer pricing system for systems development work. Also suggested are the areas of EDP capacity measurement and the problems of benefit measurement.

A Systems Development Transfer Pricing System

This dissertation has been devoted to the establishment of transfer pricing criteria for EDP operations. These criteria were established to meet the special characteristics of a centralized EDP installation. The proposed EDP transfer pricing criteria may well not be appropriate for systems development costs.

Systems Development Defined

The term systems development is a broad term including several different types of activity. Typically

three kinds of activity are included under the heading of systems development:

1. New systems development. New systems development is the systems analysis and programming of new jobs. The relative importance of this item depends considerably on the firm in question. Firms that have substantial excess EDP capacity and firms that are relatively new to the area of EDP will usually have more resources devoted to new systems development. The percentage of new systems development costs to total systems development costs ranged from twelve percent to thirty-five percent in the firms interviewed. The majority of the firms fell in the middle (twenty percent) range. For example, the firm having the largest EDP budget had new systems development costs of 29.1 percent of total systems development costs.

2. Maintenance Programming. Maintenance programming is the updating of current programs to meet new requirements. The majority of this updating occurs because users change input or require new or different information. Sometimes program maintenance is required because of changes in the physical operating system itself. This is particularly true when a firm is converting from one operating computer hardware system to another.

This element accounted for between forty and sixty percent of the total systems development costs in the

firms interviewed. In the firm mentioned above this amounted to 51.4 percent.

3. Systems Maintenance. Systems maintenance is the systems analysis and programming that must be performed to keep the operating system or computer executive routines running effectively. In effect this is work performed by the EDP department for the EDP department, though the benefits should accrue to the users in the long run. Often this cost is loaded onto the overhead of the computer facilities operations.

This item accounted for three to eight percent of the total systems development costs in the firms visited. In the example firm, it was 4.2 percent.

The remaining costs in the systems development area are administrative costs. These costs include top management within the systems development area and supervisory and secretarial costs which cannot be specifically identified with any of the functions just mentioned.

Charging for Systems Development Services

Only four of the field study firms charged out one hundred percent of their systems development costs. An additional four firms charged out between sixty and ninety percent of their systems development costs. However, one of these firms was in the process of eliminating this user charge altogether. So approximately half of the

centralized EDP installations interviewed charged for this service and half did not.

Of additional interest is the attitude of those interviewed toward a systems development transfer price. Many who were strong supporters of a transfer price for EDP operations were unsure of their position or even opposed to a charge for systems development services. Only slightly over a third of the people interviewed stated definite approval for a systems development charge.

Some of the reasons cited for the uncertainty in connection with a systems development charge were:

1. There was a substantial diversity in the talents of the systems development people. This difference in skill caused differences in charges for both the development work and later when the job ran.

2. Some systems development and maintenance programming was necessitated by changes in the operating system or requirements of higher level management. Some felt that users should not be charged for these services.

3. Several people stated that each new job was a learning process. So if a user requested a job that was new in nature, he was in effect paying for the education of the systems people. This benefit was then passed on to users who later requested jobs of a similar nature.

4. One individual felt that systems development costs should not be charged because "users were tied into

the system and as such had no control over these costs." Several others seemed to have similar reservations but did not state them as clearly.

5. It was not always easy to keep track of the time of the systems development people. Some felt that this was an unnecessary and expensive additional task of the systems development people. Others noted that some personnel split their time between a large number of jobs, and thus it was hard to identify specifically where their time was spent.

The Research

Since systems development comprises a large portion of the total EDP budget in most firms it certainly must be controlled. Additional study is necessary to determine what method would be most appropriate for controlling systems development resources. This study should include a serious consideration of transfer pricing for systems development services.

EDP Capacity Measurement

As mentioned in Chapter IV, the measurement of the capacity for a given EDP installation was a difficult problem. A great deal of subjective evaluation was necessary in arriving at practical capacity.

Even though there are more and more devices available for measuring resource utilization, the task of

measuring capacity will continue to be quite difficult. Research is necessary in the areas of job scheduling, resource configuration, and levels of user satisfaction; all of which are essential to the measurement of practical capacity.

Benefit Measurement

One of the problems of any computer resource allocation system is the measurement of benefits. Some tangible benefits are easy to measure. But other tangible benefits and many intangible benefits are much harder to estimate.

This problem is important whether an EDP priority committee is used or a transfer price. With an EDP priority committee the job is accepted or rejected primarily on the basis of benefits versus costs. Typically all benefits must be quantified in some way.

With a transfer pricing situation the user would not have to quantify all benefits. He would merely have to satisfy himself that the benefits were greater than the costs. Thus, intangible benefits may not have to be quantified except in a very loose way.

Even here there would surely be some cases where the cost-benefit relationship would be close enough to cause concern in the user's mind. It is in this area of intangible benefit measurement that research could do the most good. Some measurement techniques such as certainty

equivalents may be used in an effort to secure better benefit estimates.

Such a study would be most beneficial by contacting users. Thereby securing much additional useful information.

Chapter Summary

Several EDP areas appear to be prime areas for further research. The first area deals with transfer prices for systems development services. Field study findings indicated that many EDP managers are in favor of a transfer price for computer operations services but not in favor of a transfer price for systems development services.

Some of the reasons for concern about a systems development charge were:

1. Systems development personnel had a wide diversity of talent, so the installation sold a variable product.
2. Some systems development work was not required by the user, and therefore, he should not be charged for it.
3. Jobs which were new in nature made the user pay for the education of the systems development people.
4. Users were tied to the system, so they should not be charged for these costs which they could not control.

5. It was hard to pinpoint the activities of the systems development people.

Systems development costs comprise a large part of most firms' EDP budgets. As such these costs should be carefully controlled. A study should investigate the most appropriate way of controlling systems development costs.

The measurement of capacity in any EDP installation is difficult. Additional research in the areas critical to this measurement process would be very helpful. This area would include job scheduling, resource configuration, and levels of user satisfaction.

Benefit measurement is often difficult. This phase of job evaluation is important in both a transfer pricing situation and an EDP priority committee situation.

Research in the area of measuring intangible benefits would be most helpful. Techniques such as certainty equivalents may be considered. This approach would be particularly appropriate for the transfer pricing situation.

This chapter has reviewed only briefly the areas which seem in greatest need of further study. Certainly a study in each of these areas would reveal even more areas for study. Similarly I may well have omitted some areas for study that should be mentioned here. But I

feel that the topics mentioned in this chapter are most deserving of the next thrust of research in this very important area of EDP costs.

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APPENDIX A

MEASURING CAPACITY IN A MULTI-PROGRAMMING ENVIRONMENT

MEASURING CAPACITY IN A MULTI-PROGRAMMING ENVIRONMENT

Measuring corporate EDP capacity in a multi-programming environment is a difficult task. Typically there is no single measure of capacity. Thus, when a field study EDP manager said, "currently we are operating at 80% of capacity," the statement was difficult to interpret. He might have meant that some element such as the central processor was operating at 80% of the volume he thinks it can handle. Or he might have meant that he thinks the systems resources are operating at an average of about 80% of what he considers to be peak volume. However, it should be noted that this full volume level as envisioned by the various field study EDP managers did not mean that each EDP resource was being utilized 100% of the time. Instead it typically meant some level of operations beyond which unsatisfactory services resulted. At this "full capacity" level the individual elements of the system may be operating at various levels.

For example core-hour use may be at 70% of total core hours available. Tape drive hours may be at 60% of total tape drive hours available. The scanner may be

operating at 50% of total scanner time available, etc. Thus, any single measure of capacity may be misleading.

One way of measuring capacity in any environment is to choose the most constraining element as an indicator of the capacity of the system as a whole. But in a multiprogramming environment it is difficult to determine what element is the critical or constraining element of the system. At different points in time the element may change.

In a multiprogramming environment there are several items which must be considered in any attempt to measure capacity:

1. The measurement of the use of the various systems elements.
2. The nature of the job mix in the period of time in question.
3. The required quality of service in terms of turnaround time.

The measurement of the utilization rate of each element of a system has become possible only in the last few years unless the firm wrote its own software package to accomplish this. Few firms had either the capability or desire to write such software. Now, however, there are a number of commercial devices available to accomplish this measurement task.

The actual use measurement is accomplished by either hardware (mechanical devices attached at various

points to a given system to measure use of specific elements) or by software (internal programs that measure the amount of each resource that is being used for each job). One mechanical analyzer is produced by CPA, Computer Programming & Analysis, Inc. This firm produces and sells analyzers of varying sizes which may be attached to a system to monitor use.

Commercial software measurement packages are available from a number of sources. Several management consulting firms with EDP expertise have developed general and tailor made packages for their clients. Software firms have also done this. One firm, Boole & Babbage, has developed a software package they call SMS/360 which is designed for IBM 360 equipment. A good portion of this package is concerned with the measurement of the use of EDP resources by elements.

In addition to these sources of software measurement packages, some firms have developed their own software packages to accomplish the resource measurement task. Five of the field study firms had either written their own resource measurement software or had significantly modified a purchased software package.

The second item, the job mix, is a very important consideration in measuring capacity in a multiprogramming environment. As business EDP applications continue to grow, a firm's job mix becomes more diverse. Some jobs

require substantial amounts of time on various peripheral processing units while other jobs require very little in the way of peripheral units but much core memory. The varying demands on the elements of the EDP installation make it impossible for each of the elements to be operating at one hundred percent of capacity at all times.

Some jobs are said to be "processor bound," meaning that they require a good deal of central processor time. Engineering jobs and simulations often have this characteristic, a lot of internal computation tying up a lot of core hours but without much need for peripheral processing units.

Other jobs are said to be I/O (Input-Output) bound. These jobs require a lot of peripheral processing unit time but relatively little main frame time. Payroll records and many accounting programs have this characteristic.

These varying types of jobs have a marked effect on what systems resources are being used during any given time period.

For example assume the following configuration:

--A central processing unit with 220K core memory available for job use.

--Twenty-four tape drives.

--Sixteen disc drives.

--Two card readers.

--Three printers.

--One scanner.

The installation operates in an OS environment with variable partitioning. OS is a computer executive routine that allows for a multiprogramming environment. Variable partitioning means that the computer allocates its available core memory to the various jobs in the system in the required amount.

The first job in the queue is an inventory update program that requires 40K core memory, 12 tape drives, and a card reader. The second job is a production scheduling job that requires 90K core memory, 12 tape drives, 4 disc drives, and a printer. At this point in time 90K core memory is still available as are 12 disc drives, 1 card reader, 2 printers, and the scanner. But all the tape drives are tied up. Any job requiring a tape drive will have to wait until either the inventory program or the production scheduling program has finished before the new job can be run.

Similarly assume that the first job in the queue is an economic forecasting simulation model which requires 140K core memory, 4 tape drives, 2 disc drives, and 1 printer. Job number two is an engineering test program that requires 80K core memory, 8 tape drives, and 1 printer. In this case there are 12 tape drives, 14 disc drives, 2 card readers, 1 printer and a scanner still

available for use. But all of the useable core memory is being utilized. Thus, no other job can be run until one of the two running programs is finished executing.

Proper job scheduling can help to eliminate a good portion of these "bottle neck" problems. However, as new jobs enter the system and old job requirements change, new problems are created. The job mix must be continuously re-evaluated to find the best running schedule. Even so no mix will allow complete utilization of each element of the system. The dynamic nature of EDP applications to business preclude such a complete utilization of resources. (As noted in Chapter VI, programming techniques such as dynamic programming may possibly be applied to this scheduling area to help alleviate the problem.)

The third factor, time constraint requirements, creates an additional consideration. The value of information received from some computer jobs decreases rapidly if the job is not completed by a certain specified time. Daily production schedules are one such item. If the data for such jobs could be made available far enough in advance to schedule the job in an appropriate job mix, the time constraint consideration would be minimized. However, often this is not possible.

For example one field study firm produced food products. This firm had almost no warehousing operation. Production was geared to meet current orders, and

transportation lines such as trains and trucks were the effective warehouse of this firm. Orders were received via telecommunication lines through the evening and early morning reflecting the sales orders of the previous day. This data was then used in calculating the production schedule for the coming day. This report had to be available before the 8:00 a.m. shift started.

The time between when the job is submitted to be run and when it is completed is referred to as turnaround time. The required turnaround time in a given firm can play an important role in determining the firm's EDP capacity. Rapid turnaround time requirements will typically mean more difficult scheduling problems and less efficient utilization of systems resources.

It should be noted that the quality of service is a subjective evaluation that each firm must make for itself. Thus a firm can change its perceived level of capacity by merely changing its turnaround time requirement. This element of capacity measurement is a very real consideration in evaluating a firm's capacity.

In summary, the measurement of corporate EDP capacity in a multiprogramming environment is not easy. A firm must be able to measure the use of the various elements of its EDP resources, it must consider the nature of the job mix that will be run during the period of time

in question, and it must decide what turnaround time it will require.

Thus, it should be noted that a firm's EDP capacity is a policy decision not only in terms of the resources acquired but also in terms of the quality of the services provided. Once this policy decision has been made, a firm can closely approximate the level of utilization for each of the various elements of its EDP system. If a firm creates a cost center for each of the elements of its EDP installations, then these estimates of utilization levels for each resource may be quite valuable in setting standards.