COST CONTROL OF EDP SERVICES: A COST ACCOUNTING MODEL AND EXAMINATION OF CURRENT PRACTICES

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ABSTRACT

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By

Evan [illegible] Richards, Jr.

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The purpose of this study is threefold.

1. To propose a model of an EDP cost accounting system for management control including the components of that system and determine the individual components' viability in actual practice.

2. To present evidence regarding the use of EDP cost accounting system components and their alternative forms to control the EDP area.

3. To suggest improvements in current EDP cost control practices.

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1. Low level of cost collection and aggregation.

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A model cost accounting system for the EDP area was developed based on traditional cost accounting literature. The model components are:

1. Low level of cost collection and aggregation.
2. Responsibility and cost centers.

3. Budgeting and reporting system.
4. Output or activity measurement and performance criteria.
5. Long-range financial planning.
6. Tracking users' EDP-related costs.
7. Charging system for users.

Six field studies were conducted to examine current EDP cost accounting practices and to determine the extent to which the model was present both as a whole and as individual components. Firms with a relatively high degree of EDP sophistication were chosen. Two larger studies by the General Accounting Office (GAO) and the Cost Accounting Standards Board (CASB) were used to provide summary and supporting data on cost accounting practices for a much larger cross section of firms.

The proposed EDP cost control model was found to exist in a reasonably complete form in one case study firm, and nearly so in the remaining firms. Most components found considerable support on an individual basis.

The level of cost collection and aggregation in the case study firms was about as expected. Most firms used essentially the same chart of accounts in the EDP area as they did in other areas of the firms. The excellent use made of responsibility and cost centers reflected very well-organized EDP areas, and all case study firms were above the observer's expectations in this area based on the revelant EDP and cost accounting literature.

All firms had standard budgeting and reporting practices for the EDP area which were part of an overall corporate procedure. Flexible budgeting was found to be in use in one firm, but was a highly inappropriate

technique of which the EDP managers had taken advantage. Although monthly cost/budget reports were used in both the systems design and computer operations areas, the reports had greater usage as a control device in the computer operations area.

The use of an IBM software package, System Management Facility (SMF), was widespread, but in some firms its use was limited to providing inputs into the charging algorithm rather than also providing utilization and other data for managing the data center. All case study firms had fairly sophisticated work measurement and reporting systems for the data entry area.

The next two areas--long-range financial planning and tracking users' EDP-related costs--were the model components that had the weakest support from the case studies. Two firms had little in the way of formal plans for the EDP area beyond one year. Even the firm that had the most complete long-range planning system could point to little in the way of resultant, concrete benefits. In some cases the lack of formal long-range planning in the EDP area was due to inadequate planning at the corporate level--goals, objectives, and strategies of the corporation were not outlined first.

One firm made a very complete analysis of users' EDP-related costs in its annual summary of EDP costs, and three firms made minor efforts to include such costs. In general, EDP personnel were more responsive to the concept of tracking users' EDP-related costs than to long-range financial planning, and consider the former to be a useful idea.

All firms charged users for computer operations costs, and four charged for systems development costs. There were considerable variations

in the determination and usage made of specific rates. In summary, the model found considerable support on a component by component basis.

Suggested improvements in observed EDP cost accounting practices include:

1. Examine carefully for adequate detail the chart of accounts used to control the EDP area.

2. Examine the use made of SMF or similar data if available.

3. Consider the trade-offs made in cutting EDP costs and increasing users' EDP-related costs.

4. Consider the behavioral effects of the current charging practices in both the systems and computer operations areas.

5. Have top level management examine closely the need for long-range planning at both the corporate and EDP levels.

Questions raised by the study which seem fruitful ground for further research include:

1. The usefulness of long-range planning in the EDP area.

2. The effect of industry practices on a firm's EDP cost control techniques and chargeout practices.

3. User reaction to complex chargeout algorithms.

4. The need for and most effective structure of a priority setting device.

5. EDP capacity measurement.

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A THESIS

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The time and effort spent by many individuals in the firms participating in the study is deeply appreciated.

Finally, a special thanks goes to my wife, Evonne, for her continued support and encouragement throughout my graduate work, and for finding the fine line between encouragement and nagging at the dissertation stage.

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CHAPTER I

STATEMENT OF PROBLEM, METHODOLOGY, AND LIMITATIONS

Introduction

This dissertation examines cost accounting systems used to control and manage the EDP* area of business firms. Costs have often not been well controlled in this area, and many statements in the literature imply or state directly that the cost accounting systems in use are often faulty and partially to blame for the lack of control.

This study develops a cost control model for the EDP area from traditional cost accounting literature and examines the extent to which the model was present in existing control systems of selected business firms. Cost accounting has been refined to a relatively fine art in many manufacturing settings, yet this state has not been reached in the EDP area. This study attempts to refine the state of cost accounting and control systems for the EDP area.

This chapter presents literature support for the existence of a control problem in the EDP area. The purpose of the study and the research methodology are then outlined, and the limitations of the study are delineated. The chapter concludes with an overview of the remaining four chapters.

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*The term "EDP" is used in this study to represent computer operations, systems design, programming, and other related and supportive groups within a business firm.

Statement of Problem

The phenomenal growth of electronic data processing (EDP) in the last two decades has been accompanied by increased management and control problems. The number of computers used in business applications has burgeoned from zero prior to 1953 to roughly 80,000 by the end of 1975. Costs have soared correspondingly. Yet control in general and accounting controls in particular seem to have been often neglected.

> Present management practice in controlling data processing costs does not seem to have kept pace with progress in the other aspects of data processing. Thinking in regard to cost control generally appears more appropriate to the beginning days of computer use for commercial data processing in the early 1950's than to current requirements. [74, p. 269]

Many authors seem to agree about the lack of cost control in the EDP area. Some example comments follow:

> There are five basic reasons why computer installations are not paying for themselves. . . 2. Costs are not being controlled within the computer department. [158, p. 48]

> In too many instances, management has not provided the same direction and control in this important area of operations [EDP] as it has in other areas. Perhaps this is due to the mystique of the computer, the relative newness of EDP, or a difficulty in communicating with EDP people. [100, p. 8]

> Computer-system costing as a relatively new discipline has suffered from a general shortage of historical data. . . . Available data have suffered from serious qualitative shortcomings. . . Many cost reports have not been structured to provide the kinds of data needed for computerized information-systems-cost analysis. [49, p. 20]

> Cost overruns came to be expected from the EDP function. Overruns were ually the worst in system development where overexpenditures of 100 percent were common. The processing of regular EDP jobs and the production of user outputs, however, also were marked by major cost excesses. [162, p. 72]

> Fairly soon after a company begins to use data processing, it often finds that the department is expanding. In many cases, this growth is much more visible in terms of larger staff and greater costs than in terms of increased service to the company. [85, p. 72]

> Most [data processing] installations are running less efficiently than they could, and few data processing departments are subject to the normal rules of assessment that are applied to other cost centers in the corporate environment. Despite its cost, the computer for some reason has been given an almost invoilable status--perhaps because too few people have the combination of DP knowledge and accoutancy acumen to prepare cost efficiency analyses on computer systems. Or perhaps the DP department, for so long isolated from the rest of the company, is reluctant to have outsider criticize its operations. [57, p. 103]

> From the viewpoint of the executive vice president, "The EDP manager always waffles around when he has to explain his budget.' From the viewpoint of the EDP manager, 'The executive vice president never seems to understand why this department needs a lot of money.' [58, p. 76]

> In most companies, EDP management practice has developed in isolation from the organization's other management systems and functions. . . . Management practices are not well formulated nor as well implemented in this portion of the business as in others; and senior management must take care to ensure that the characteristically "messy" EDP department is as effectively controlled and planned as the old (and presumeably neater) regular departments of the company. [106, p. 132]

> Cost overruns have been so common in connection with both systems projects and EDP operations that many management people have come to assume a sort of overbudget inevitability where EDP is concerned. [44, p. 89]

These types of comments are not new. As early as 1958 John Diebold was saying:

> Caught with their budgets down and with the responsibility of enforcing cost reductions on the rest of the organization, many controllers are red-faced about the cash drain of their own computer centers. [73, p. 92]

An initial study done for the National Association of Accountants listed the following among its conclusions:

> In most of the companies studied, management of the computer resource is charactierized by isolation. There is little attempt to apply broadly applicable managerial knowledge and techniques to those areas within the computer operation where they might be relevant. [24, p. 144]

An article summarizing the results of a study conducted for the National Aeronautics and Space Administration concludes as follows:

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> A computerized technical information center offers a new and interesting challenge to the accounting profession. In a field characterized by a serious accounting deficiency, a [computer] center exemplifies the need for dependable financial information. . . . While current applications of managerial accounting procedures are sparse, preliminary investigations indicate that such techniques are feasible and necessary in a center's operation. [72, pp. 609, 610]

One of the most recent articles is also among the most scathing in its remarks:

> If I were backed to the wall for a one-sentence statement of executive responsibility in the EDP area, I'd say: Put a stop to the biggest ripoff that has ever been perpetrated upon business, industry and government over the past 20 years.
>
> A statement like that merits a bit of elaboration. What do I mean by a 20-year ripoff? For 20 years executives have had more and more expensive machinery sold or leased to them to the point where today computing machines are costing big money, and still running inefficiently.
>
> For 20 years executives have employed expensive people--computer people--and they are still working far below achievable productivity--in an age and in a country where productivity is the key to survival.
>
> They are still being led into attempts to computerize which turn out to be outright failures, squandering huge sums of money. They are still being led into EDP developments that fall short of their promised benefits. They are still being promised services in the sales pitch which are not forthcoming in practice.
>
> EDP developments are still being completed much later than promised, at a much higher cost than portrayed at the outset. . . . The whole situation is now reaching serious proportions. Recent studies show that EDP costs are averaging one percent of company costs and are reaching four percent in some cases. This inefficient body of activities is speading into more parts of each organization every day, and it has more power within an organization than most think. [95]

The broadside continues, but space considerations are a limiting factor.

In a recent dissertation on EDP transfer pricing, the original intent was to investigate the EDP cost data of "four or five medium-to-large corporations." Only one company's data was eventually examined "because of poor accounting records and inconsistency of definition." [149, p. 67]

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> The poor quality of the data and the difficulty in collecting usable information cannot be overstressed. Few companies appear to utilize transfer pricing for their MIS services. Those that do seem to rely on rather inadequate and elementary cost accounting systems. This presented data to the researcher that were inconsistent, incomplete and often poorly defined. Many of the cost categories that were defined were affected by more than one variable and it was impossible to isolate the effects of just one of those variables. [149, p. 67-68]

Two alternative conclusions could be implied from such statements:

1. Because of the highly specialized and technical nature of the EDP function, traditional cost accounting systems are of minimal use in controlling EDP costs and operations.

2. Many firms have just not made the required effort to apply cost control techniques used elsewhere in the organization to the EDP area.

Most authors, of course, have held that the latter is true, but few of them have present any evidence of firms that <u>do</u> effectively employ a cost accounting system to control the EDP area.

The approaches to solving this control problem have varied widely. Much of the emphasis in the literature of the area has been placed on the transfer prices of computer services to internal users within the firm. Many authors have evidently felt that if user departments could only be charged, then costs of the EDP area would be automatically controlled. Other authors have proposed specific ways to cut costs here and there. Some have stressed that the EDP area should be controlled much the same as other areas of the firm.

Underlying many of the comments on the problem has often been the implicit assumption that an adequate cost accounting system exists for the EDP area and that the data produced by such are accurate and useful. As the last quoted statement shows, this is not always the case.

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The question might be raised at this point: "What is so special about the EDP area? Isn't cost control important for all areas of the firm? Why pick on this one?" The following reasons could be given for concentrating on this area:

1. Because the EDP area services many users throughout a firm, the degree to which it is well-controlled and efficient influences the operation of the whole organization.

> If the data processing department falls short of its responsibilities, or if its operation is indifferently managed and consequently inefficient, every part of the organization will suffer. . . . Efficiency in the data processing department is less an ideal than a practical necessity. The department is responsible, not just for its own operational efficiency but for the efficiency of most other departments in the organization, in that it provides the information on which these departments rely for their operation. Without reliable information they cannot function efficiently; therefore, the DP department must be operated with extra special precision. The introduction of computer systems into an organization creates a situation in which tremendous reliance is placed upon one department and fundamentally a very high standard is demanded from it. If inefficient performance is tolerated there, it will not just inconvience those who rely on it, but it could seriously affect the functioning of activities throughout the firm. [147, pp. 92-93]

2. The computer resource has a unique set of supply and demand characteristics. On the supply side we see (1) a high ratio of fixed to variable costs, (2) great potential for economies of scale in computer hardware, and (3) incremental capacity usually acquired in large blocks. On the demand side we see (1) a rapid growth in demand and increasingly complex user needs, (2) cyclical processing--monthly and end-of-fiscal-year peaks, and (3) highly variable user priorities and turnaround requirements. [107, pp. 471-473]

3. There are constant changes in available hardware and technology, often with implications for the nature of costs as well as for cost control.

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Chapter

4. EDP centers are typically managed by technicians, often with little or no business orientation or training.

5. EDP costs are often quite large with respect to other service departments in a firm. [71, p. 6] In many installation these costs are growing at an annual rate of around 25 percent. [137, p. 74; 51, p. 29] Thus the problem of controlling EDP costs seems unique and important enough to warrant special attention.

Purpose of the Research

The purpose of this study is threefold:

1. To propose a model of an EDP cost accounting system for management control including the components of that system and to determine the individual components' viability in actual practice.

2. To present evidence regarding the use of EDP cost accounting system components and their alternative forms to control the EDP area.

3. To suggest improvements in current EDP cost control practices.

The outline of the model cost system is presented below. Further development and explanation of the model components is reserved for Chapter Three.

The components of the model cost system are:

1. Low level of cost collection and aggregation.
2. Responsibility and cost centers.
3. Budgeting and reporting system.
4. Output or activity measurement and performance criteria.
5. Long-range financial planning.
6. Tracking users' EDP-related costs.
7. Charging system for users.

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In determing the model's viability in actual practice we are really looking at two propositions:

1. The model EDP cost system provides an effective means of controlling EDP costs and is present (as a whole system) in existing organization practices.

2. All of the postulated components mentioned are needed in a reasonably complete cost control system and are individually present in existing EDP cost accounting and control systems.

Number one focuses on the existence or nonexistence of a reasonably complete EDP cost system. Number two examines the viability fo the individual proposed cost control components. If one or more of the elements is not found in existing practices, its usefulness for EDP control might be questioned.

Methodology

In proposing a control model of any sort, the research methodology should ideally include the following steps. (1) Develop the conceptual model. During this step no attempt should be made to specify the model in such detail that it could be immediately applied to a specific company or situation. This degree of specificity with the EDP cost control model would negate the advantage of general applicability to many corporate EDP departments. (2) Determine the economic validity of the model. To fully determine the proposed model's effects on decision making and resource allocation, it must be implemented and its effects observed. (3) Observe the organizational and behavioral effects of the proposed model. Again, this would require implementation of the model.

Thus, to accomplish (2) and (3) one or more firms must be found which would be willing to implement an untested, conceptual model over

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a period of time. This is wishful thinking. No firm, under normal circumstances would be willing to let the cost accounting system of a multi-million dollar service department be changed at will. Thus other strategies must be used.

There has been considerable precedent set for the use of field studies or case studies as a research methodology in the area of EDP control and management, possibly for the reason given above. Starting with the NAA survey by Churchill, Kempster, and Uretsky in 1969 and continuing with Sollenberger's NAA study in 1971, and Turney's and Heitger's dissertations, both in 1972, field studies have been used almost exclusively. [24, pp. 4-5; 142, pp. 4-5; 149, pp. 67-68; 71, pp. 12-13] The number of firms used varied from one to eighteen.

Field studies, based mainly on interviews, have a number of strengths and weaknesses. [5, pp. 223-224] The advantages include:

1. Realism.

2. The ability in investigate a large number of variables and their interaction in a complex setting.

3. The ability to explore in depth those characteristics which appear of value.

4. The ability to clarify intent and/or meaning of questions asked of the respondent.

5. Interviews are extremely well suited for gathering behavioral data, e.g., opinions, future intentions, and attitudes.

The disadvantages include:

1. The inability to separate and manipulate variables.

2. Great quantities of time and high costs may be involved in collecting such data.

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3. Due to its ex post facto nature, causal relationships are "weaker" than in controlled studies such as laboratory experiments.

4. Face-to-face stresses may cause biased or untruthful data.

5. Faulty interviewer and/or interviewee perception are possible.

In order to determine to some degree the viability of the proposed model and its components, the case study method was chosen. It would have been much easier to stop at the end of the first step (see p. 8) of model construction as others have done. However, the lack of published data regarding actual EDP cost control practices and the need for such data, coupled with the above-mentioned advantages of case studies, provided the impetus for an attempt at determining the validity of the model. The case studies could also provide evidence regarding the question of the degree to which cost accounting systems are useful in controlling EDP costs and the adequacy of several actual systems.

The field studies included visits to six firms. At least two and usually three or more people were interviewed. In most firms, the persons interviewed included the Director of Corpoate Information Systems and managers from computer operations and systems development. Time spent at each firm ranged from one half day to two days. Notes were taken and used as the basis to write a summary of each visit as soon as possible after each interview. Although the interviews were not highly structured, thereby allowing perusal of topics of interest to those being interviewed, certain structured data were obtained from all firms.

The firms that were visited were all large firms within their industries. A breakdown of firms by product class or industry follows:

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Classification	Number of Firms
1. Heavy manufacturing and materials conversion	2
2. Chemicals and pharmaceuticals	2
3. Utilities	1
4. Electronics	1
Total	6

Limitations of the Study

The limitations of the study will be discussed in three parts: (1) the nature of the propositions made, (2) external validity, and (3) the overall question of upper management involvement in the control of the EDP area.

Nature of the Propositions

A statistical or "testable" hypothesis is a statement about one or more specific parameters of a population. [5, p. 210] The propositions stated on page eight are not statements about specific parameters of a opoulation and, as such, are not statistically "testable". It it were possible to chose a random sample of "large" firms, divide the sample into treatment and control groups, implement the proposed cost model in the treatment group firms, and compare results between the two groups over a series of time periods, then specific hypotheses could be stated about certain parameters (e.g., total EDP costs) of the two groups. However, as already stated, this is impossible; no firm would consider it. Thus our propositions remain working hypotheses, not statistical hypotheses.

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External Validity

The concept of external validity relates to the relative strength of the generalizations made from the sample and applied to the population. The six firms chosen were not selected randomly. Generalizations from such a small sample to all business firms would be without merit even if the firms were selected randomly. To improve the degree of external validity the results of two other studies are included in the chapter dealing with the analysis of the field study firms. One of these studies was a very large scale field study conducted by the General Accounting Office (GAO). Approximately 50 computer installations were visited, including 22 business firms, and numerous interviews were conducted. The other study was a questionnaire survey of intrafirm EDP pricing practices conducted by the Cost Accounting Standards Board (CASB). Summarized data from both studies will be used to give a broader basis for a discussion of overall corporate EDP cost control policies and will give some idea of how "typical" the six field study firms are of the corporate population.

Management Involvement

This study does not purport to solve the overall problem of controlling the EDP area within business firms. Many authors have felt that the apparent lack of control in many firms was the result of upper management's hesitancy to appraise EDP expenditures. [See 137; 85; 73; 106; and especially 94] Surely upper management involvement is crucial if costs are to be controlled. Yet the first step in this direction is the designing of an EDP cost accounting system. The accounting system will not guarantee that costs are being controlled--that is management's responsibility. Yet, without an adequate cost accounti

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accounting system, control would be difficult if not impossible. In this study the groundwork for controlling EDP costs is formulated by designing a cost accounting system and to some degree determing in actual practice the viability of its components. Implementation of the system in specific corporate circumstances would require consideration of numerous factors such as corporate size, corporate experience with EDP, corporate goals and objectives, and specific objectives for the EDP area.

Organization of the Study

The study is organized into six chapters. Chapter One introduces the problem and the need for the dissertion. The research methodology and accompanying strengths and limitations are discussed. Chapter Two reviews the literature pertinent to the topic. The discussion will be divided into three general areas for convenience:

1. Literature regarding the overall management of the EDP area which has significance for the control of such costs. This is a broad category and contains some background studies.

2. A brief background on trasfer pricing literature in general.

3. Literature which applies transfer pricing specifically to the EDP area. Proposed models of EDP transfer pricing methods will be examined. Studies which mention transfer pricing, but which are more concerned with the overall control process will be discussed in the first of these three areas.

In Chapter Three the cost accounting model for EDP will be developed. Traditional cost accounting concepts and literature will be applied to the EDP area based on the background of Chapter Two. Chapter Four contains the findings of the field studies. The GAO and CASB studies will be reviewed for a larger picture of EDP cost accounting practice

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practices. The findings will be examined for support or nonsupport of (1) the model and components and of (2) various ideas in the literature regarding actual practices. Chapter Five summarizes the findings, paying particular attention to how EDP cost systems may be improved. Suggestions for future research are included.

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CHAPTER II

SURVEY OF THE LITERATURE

Introduction

The amount of literature devoted to computers and related topics has paralleled their increased usage in the last two (plus) decades. The majority of the literature has dealt with such topics as the changes (real and imagined) brought on by automation, new use or applications of the computer, or technical problems related to hardware and/or software. Only a relatively small, but growing, portion of the literature deals with the control of the EDP resource.

Much of this control literature deals with the acquisition decision, cost/benefit analysis, or the transfer pricing of EDP services. Although recognizing the extreme importance of the acquisition decision and the role that accurate cost data must play, this study is more concerned with the cost control of ongoing operations. This study is also concerned with providing accurate cost data for use in cost/benefit analyses, but the estimating of benefits is beyond its scope. Much of the cost/benefit literature has dealt chiefly with the problems of measuring benefits and has (implicitly) assumed that accurate cost estimates are easily forthcoming from existing accounting data. [For example see 65.] Thus, excluding the transfer pricing articles, only a very small portion of the current literature relates to controlling ongoing computer operations and peripheral services.

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Charging for EDP services used (transfer pricing) is really an internal marketing mechanism; it affects the volume and "product" mix. However, it is not incorrect to think of it as a long-run cost control mechanism. Controlling corporate usage of computer services directly affects the required investment in hardware and personnel and therefore the amount of costs incurred. Since so much of the EDP control literature is devoted to the specifics of this topic we will separate it from the more general literature and provide a brief background/introduction with a summary of the overall transfer pricing literature. Within the first of the three literature review areas, outlined in the previous chapter, books will be discussed first, followed by journal articles and other sources.

Background and EDP Cost Control Studies

Excluding transfer pricing articles, only a relatively small portion of the EDP literature relates to cost control of ongoing computer operations and peripheral services. The National Association of Accountants has sponsored two studies which, although not dealing specifically with control of ongoing operations, provide much helpful background information and discuss EDP control problems, particularly in the development stage.

Books

The first of the two NAA studies is Computer-based Information Systems for Management: A Survey, published in 1969. [24] Although primarily concerned with determining existing computer applications, the study is helpful in several ways. (1) It emphasizes the importance of specifying objectives or goals for the EDP organization within a firm. Heitger later made this a focal point of his dissertation on transfer

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pricing. (2) It identified a divergence of typical EDP-related activities that is likely to cause control problems.

> To the extent the computer resource is devoted to processing the already programmed activities and to automating structured tasks in a relatively straightforward manner, managing the computer is similar to managing a factory production or assembly operation. To the extent the computer resource is devoted to developing new applications in the unstructured or managerial areas, its management problems are more like those of an R & D operation. [24, p. 125]

Several authors have since commented on the similarities between ongoing computer operations and the production process and have reasoned that cost controls similar to those used in manufacturing activities would work well in at least some of the EDP functions.

(3) The study identified a need for continuing management involvement, not only in overseeing the development of new applications, but in the control of ongoing operations. The EDP area is too important to be left "to the nonmanagerial ministrations of technically oriented people." [24, p. 144] Again, several authors have since stressed the same point. (4) Although a case study approach was not new, this study and its successor used such on a large scale, setting considerable precedent for research in this area.

The second study in the NAA series is Sollenberger's Management Control of Information Systems Development. This study will be referenced again in later chapters, but a summary of its major conclusions is in order at this point. Sollenberger's research, and therefore his conclusions, dealt primarily with the general problem of controlling information systems development, but they by necessity overlapped into the area of ongoing operations. His eight general conclusions [142, pp. 8-9] follow:

(1) The key ingredient to successfully managing the information systems development activities is proven managerial skill rather than computer expertise. Others have agreed wholeheartedly with this finding. [For example see 73, p. 95 and 31, p. 5]

(2) The systems function should be highly user-oriented.

(3) Sollenberger concurred with the earlier NAA study in that a strong degree of management involvement at every level in each systems endeavor is desirable. Interestingly enough, he found that this involvement was broader than generally implied in the literature.

(4) "Clear-cut assignment of responsibility is critical to the management of information systems development."

(5) Open communication between users and analysts is essential.

(6) The overall control philosophy of the company was important for its effect in setting plans and measuring performance in the systems area.

(7) "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." This conclusion is discussed further in the paragraph following the eighth conclusion.

(8) The organizational location of the systems function was not a major issue. This result seems strange considering the many comments regarding the desirability and even the necessity of placing the EDP organization at as high a level as possible within the organization. [For examples see 123, pp. 22-23; 73, pp. 93-94; and 98, p. 252] Again, the (relatively) many years of EDP experience these firms have had might be a causal factor for this conclusion. Sollenberger goes on to state

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that "a sufficient authority level and adequate independence were frequently cited as criteria for the appropriate vantage point."

Sollenberger's seventh conclusion and his comments in this area have the most import to the present study. His Chapter Seven discusses control techniques used by systems management. These included: (1) policy development and documentation, (2) a time recording and reporting system for both projects and individual personnel (an integral part of number four), (3) a system service request and related control unit, (4) a project reporting system, (5) cost assignment--charging for system services, and (6) post-implementation evaluation of systems output. Although means and degree of implementation differed in the first four areas, there was not the wide variation in opinion found in the fifth area. Sollenberger lists a number of advantages and disadvantages of transfer pricing of systems services. These will be discussed later in this chapter. A particular strong point of his Chapter Seven is a series of flowcharts showing the interrelationships between items (3), (4), and (5) mentioned above. [142, pp. 120, 124, 131]

We now turn to other books before examining journal articles in this first area. A surprising number of books about planning, organizing, and managing the EDP area contain nothing about cost controls or only passing mention of the topic. [See 161; 123; 19; 66; 103; 160; 16; and 70] Several books were found that did allude to means of controlling EDP costs. These will be discussed in increasing order of importance, starting with those that spent the least time on the subject.

Albrecht's Organization and Management of Information Processing Systems relies heavily on the budget as the principal medium of cost contro. Typical information system "divisional plans" (budgets) are presented and idscussed; later they are broken into "departmental plans." He briefly mentions planning for individual projects but there is no description of how a project reporting system might work. His example schedules of budgets and monthly cost reports are one of the few spots in the literature where a possible chart of accounts for the EDP area is presented. [3, pp. 158, 302] However, there is no discussion of a chart of accounts as such.

Tomlin's Managing the Introduction of Computer Systems briefly touches project reporting in the third chapter, but most of the discussion of cost control is found in the fifth chapter entitled "Departmental Control". Tomlin defines control as "a cycle of events which occur to regulate something which is dynamic" [147, p. 95] and states that:

> Control in the data processing department operates to ensure that the work performed is of an acceptable quality, is produced in an acceptable time, and at an acceptable cost. In addition to the control of work, the DP manager must also control the resources (principally men and machines) to ensure that they execute the work efficiently to meet the three criteria of quality, time, and cost. [147, p. 94]

Much of the ensuing discussion is devoted to splitting EDP control into "administrative," "operations," and "systems" control. His orientation to cost control is essentially one of determining application development costs and thereafter ongoing operating costs. [147, p. 114] His discussion of a charging policy includes rates for (1) systems work, (2) programming, (3) data preparation, and (4) computer processing.

In Managing the EDP Function a chapter is devoted to EDP cost management and control. [44; Chapter Six entitled "EDP Cost Management"] Ditri, *et al*. begin their discussion by enumerating four categories of costs: [44, p. 91]

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(1) Direct variable costs--"these are direct payroll, travel, living, and supplies expenses which relate specifically to production and delivery of products and vary with work volume." An example cited is increased keypunching costs because of a pre-Christmas rush.

(2) Variable overhead costs--"these are production-type costs which vary with work volumes." The wages of supervisors on overtime shifts are an example of such.

(3) Programmed costs--"these are planned costs incurred for a particular time period as a result of a specific management decision." Costs of systems projects are cited as an example.

(4) Standby costs--these are the fixed costs of doing business. They include "the prime shift rental of computer equipment, supervisory salaries, and wages of key personnel."

This categorization of costs is interesting because of a somewhat similar breakdown used by Turney. [149, p. 117] His study will be discussed later in this chapter be cause it is oriented mainly toward transfer pricing. Ditri's cost scheme results from the continuing use of an analogy likening the EDP function to a manufacturing business-in-miniature. While his categories are cited in traditional cost literature, it would seem difficult to draw distinct lines between direct variable and variable overhead costs and between programmed and standby costs in an EDP setting.

He subdivides total EDP-related costs in (1) developmental costs and (2) production costs. Developmental costs include all programmed costs for system projects and some standby costs of the EDP function and organization as a whole. Production costs include all four previously mentioned categories. The discussion of cost management per se is very limited a

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limited and consists chiefly of statements to the effect that costs must be closely associated with scheduling and performance reporting techniques. [44, p. 14] A brief discussion of cost reduction includes several examples of opportunities for improvement such as centralization of facilities and consolidation of reports.

Although Ditri _et al_. touch briefly on the topic of charging internal users for EDP services they do not seem to strongly favor this procedure. [44, pp. 95-96] More emphasis is placed on holding the EDP director responsible for budgeting and expenditures.

A chapter in _Information Systems Administration_ by McFarlan, Nolan, and Norton is entitled "Management Control of the Computer Resource." However, most of the discussion centers around charging for EDP services. Hence this book will be discussed in part three of the present chapter. The book _The Economics of Computers_ by Sharpe will also be discussed later in this chapter since the section of major interest deals with pricing computer services.

Journal Articles

Journal articles (excluding transfer pricing articles) regarding the control of EDP costs are now examined. The first article discussed is a background article providing an excellent overview of the typical development of the EDP area within a firm.

Gibson and Nolan have suggested "four distinct stages in the growth of all EDP facilities, each with its distinctive applications, its rewards and traumata, and its managerial problems." [58, p. 76] The four stages provide an excellent background for discussing other EDP cost control articles and the EDP transfer pricing literature.

Stage One is the "initiation stage." The EDP facility is often located--possibly unwisely--in the accounting department. The first applications are cost-reduction, accounting-type applications such as payroll, accounts receivable, and accounts payable. There is a loose budget and controls in general are notably lacking. Project priorities are often assigned by FIFO; there is no chargeout mechanism.

Stage Two is the "expansion stage." There is a proliferation of applications in all functional areas; e.g., cash flow, general ledger, budgeting, capital budgeting, forecasting, personnel inventory, order processing, sales, and inventory control. This period is again typified by a loose budget and lax controls, often intended to engender new applications development. Upper management is often sales-oriented with respect to the EDP resources. The EDP manager is moved up in the organization, but in the functional area of the first applications. The end of Stage Two is often marked by a sudden, top-management awareness of the runaway computer budget and Stage Three begins with a crash effort to find out what is going on.

Gibson and Nolan entitle Stage Three the "formalization stage," but a more fitting title would be the "control stage." There is often a moratorium on new applications; those that are developed are control-oriented, such as purchasing control and scheduling. A proliferation of controls is instituted to control the runaway budget. Project management and reporting are begun. There is strong budgetary planning for hardware facilities and new applications. A steering committee is set up to ensure that priorities are properly ordered.

Stage Four is the "maturity stage." EDP is set up as a separate functional area, with the EDP manager taking on a high level position. New applications are data-base oriented: on-line customer query system, on-line source data entry, on-line personnel query, simulation models, and financial planning models. There is a refinement of the management control system with the elimination of ineffective control techniques and further development of others. Instead of concern for merely charging out EDP costs to recover these costs, there is emphasis on pricing of computer services for engendering effective use of the computer.

These four stages are useful in explaining some of the discrepancies in the literature and in particular, statements made about actual practices by business firms. A person observing firms in stages one and two would arrive at considerably different conclusions about the control policies of "typical" firms than would a person observing firms in stages three and four. An example of this will be cited in Chapter Four.

The present study develops an accounting-type control model which may be applied (in differing levels of detail) to firms in all four stages. However, case study firms are examined which are well into stage three or into stage four to observe the controls in use and determine to some extent the viability of the model and its components.

In a 1970 article, Homes outlines "twelve areas to investigate for better MIS:"

1. Top management's involvement with the system.
2. Management's ability to organize the MIS function.
3. The use of a master-plan.
4. The attention given to human relations between functions involved.
5. Management's ability to identify its information needs.
6. Management's ability to apply judgment to information.
7. The condition of basic accounting, cost and control systems.
8. The degree of confidence generated by accuracy at the input level.
9. The frequency of irrelevant or outdated data provided.
10. The competence of systems technicians and their grasp of management problems.
11. The justification for projects undertaken.
12. Reliance on equipment vendors. [79, p. 443]

Number three and seven of the above have the most import to the present study. In discussing the use of a master plan, Homes states, "Setting over-all company objectives and planning to meet those objectives still leaves much to be desired in most companies." He outlines the proper use of long-range planning as follows:

> Planning must start by setting long-term company objectives followed with a detailed profit plan. Information needs within the plan must then be determined and provided for in the creation of the data bank. All separate subsystems should be coordinated into one integrated system. Planning should cover the gathering, transmission, and dissemination of data as well as its processing. Never should individual major applications be started without a complete integrated plan. Above all, the matters of systems concepts, goals, and long-range planning must not be left to the discretion of the te chnical staff, but assumed entirely by top management. [79, p. 446]

"The Value of Information" by Rudolph Hirsch is primarily a discussion of when information value can and cannot be calculated, and what determines information costs. [75, pp. 41-45] However, in concluding the article he discusses three ways of controlling the cost of information processing equipment, i.e., the computer. (1) Use a positive reports control scheme. Omit issuing one cycle of a report suspected to be obsolete; if there areno protests, obsolescence is confirmed. (2) "Counteract as far as possible a well-defined executive tendency to use as much and as advanced equipment as possible. The fascination of novelty the desire to appear progressive and the fact that using computers has its status value all play their part. Those responsible for the choice of equipment should avoid novelty for its own sake." [75, p. 44] (It is interesting to note than even as late as 1972, Heitger found one of the corporate EDP objectives to be: "Give the appearance of being progressive." [71, p. 91]) (3) Use a chargeout scheme, including not only computer running time, but also the initial system design, programming effort and program testing time. Hirsch says this would be an incentive to recipients of information not to request low-value information, and to discontinue it when its value decreases. However, he recommends that such a system "not be used in the early days of computer usage in the organization . . . since the effect could then be to discourage worthwhile computer projects."

In a 1970 article, Hirsch considers the EDP cost control problem further. [74] The major thrust of this article is toward a detailed monitoring of the system and programming effort and of actual computer usage by jobs. This information is used to produce a "Project Control Report" and a "Programmer Performance Analysis." Examples of such are given in the article.

Hirsch briefly discusses a cost charge-out method which "has worked well for a large corporate computer user."

> When a department requests computer service, the data processing department estimates the costs of that service and quotes a standard cost to the requesting department. If the latter accepts that cost, it will be charged that amount and none other, regardless of the costs actually incurred. This method has a double advantage: it not only permits 'customer' departments to use data processing services with (budgetary) confidence, but also enables top management to monitor the efficiency of the data processing department simply by analyzing its 'profitability.' [74, pp. 270-271]

This method may work well for one company, but it has some problems, depending on how "profitability" is interpeted. For example, if it means departmental "profit" as a percentage of "sales," the EDP department might be motivated to reduce its size and to quote very high "prices" and accept only a small number of high-margin jobs. This may or may not be conducive to achieving overall corporate goals.

Logue describes seventeen practical suggestions for reducing computer costs. [100] Some of the numbered suggestions include: (9) "determine whether key punching is the best method," (11) eliminate unnecessary applications," (12) "ensure that all reports are being used," and (16) "consider other suppliers for peripheral devices." [100, pp. 13-16] Number fifteen was "install standards and work measurement," but the discussion was oriented toward keypunching, not systems and programming tasks. [100, p. 16] The first two suggestions were "cost-justify present equipment" and "consider the cost of alternate methods." [100, p. 9] Both of these suggestions assume the existence of an adequate cost accounting system for EDP. Little attention is given to improving the quality of the cost accounting system and the way it is used. Logue's last suggestion is "centralize multiple installations." [100, p. 17] On this point he is in agreement with several other authors. [See 53; 82; 86; and 159]

The book by Ditri _et al_. has already been mentioned. In a 1971 article Ditri and Wood present many similar ideas. [102] They break EDP costs into the four types previously discussed. EDP is again likened to a production department with similar controls. They conclude that "the basic division of the management process into the elements of planning, implementation, and control applies to EDP as it does anywhere else." [162, p. 83]

In a 1972 article Brabb and Grosso emphasize two ways of controlling EDP costs. [18] The first is a project reporting scheme involving many of the ideas previously discussed. The second is the use of Facilities Management (FM), i.e., contracting an outside firm to manage and operate the EDP service center. Among the advantages cited for FM is a potential for considerable cost savings. Other advantages and some definite disadvantages are discussed. The authors briefly touch on cost/benefit analysis, but, as in most other articles, the emphasis is on the problem of determing benefits, not costs.

In "Cost Control for Computers," Hendrick Smith examines the similarity of basic flows and controls for production areas and EDP operations. [137] His analogy starts with raw materials (input data and files) and follows through to the finished product (processed data and information). Some of his cost control comments parallel those of Logue, e.g., use alternative suppliers for peripheral equipment. [107, p. 77]

Smith emphasizes the use of budgets. "Hard-nosed budgeting may be the greatest stimulus for achieving EDP cost savings." [137, p. 78] Two rules should be satisfied: (1) responsibility for cost incurrence must be clearly identified and (2) the budgeting process must be simple. In keeping with the first rule, Smith states that controllable and noncontrollable costs should be segregated. He stratifies a "typical EDP budget" in order from the most controllable elements (system development salries and outside fees) to the least controllable elements (administration and allocations). At no point however, does he draw a cutoff line between "controllable" and "noncontrollable" costs. He was probably wise in not doing so because it would be easy to take exception wherever it was drawn; but the fact that he didn't draw such indicates the difficulties a firm would probably have in doing so. This problem will be discussed further in the next chapter.

Smith stresses that costs by themselves are not enough; the EDP manager must have reports highlighting the underlying reasons for the cost performance achieved. These include:

(1) Peak and average utilization reports for major equipment components.

(2) Efficiency reports detailing operating time by major applications, project schedule accomplishments, and data input performance.

(3) Cost exception reports. [137, pp. 78-79]

He briefly mentions the same type of charging system found in Hirsch's 1970 article. Overall he seems to come out in favor of charging users, but he is in favor of a simple algorithm.

> I have seen charging schemes that account not only for computer time but also for tapes maintained, forms consumed, disk files occupied, and even communications channels used. Frankly, simpler approaches satisfy budgeting objectives as well if not better. [137, p. 77]

The point is debatable. Although many authors suggest simplicity as one of the criteria for evaluating a charging algorithm, fairness and impartiality are also suggested. It is doubtful that in this day of multiprogramming and many peripherals that a single basis for charging users could be equitable from a company-wide point of view.

Riley and Williams approach the cost control problem from the standpoint of providing reasonably accurate predictions to users of the cost of obtaining desired information. They reason that this will:

> 1. Protect the most inexperienced users from very costly, naive errors.
> 2. Provide more experienced users with enough information to make intelligent comparisons between the value of information and the cost of obtaining it.
> 3. Provide upper level management with improved means of supervising system usage. [124, p. 26]

Throughout their discussion of cost prediction they seem to assume the existence of a highly organized data base of past costs for various activities. This assumption might hold for some firms, but definitely will not hold for all, e.g., the stage one and stage two firms.

Riley and Williams indicate the need for incorporating desired turnaround times into the cost estimate. Their time classes are (a) crash, (b) normal, (c) overnight, and (d) weekly. There is a premium placed on jobs in the first category and appropriate discounts on jobs in the last two.

Basically their ideas are sound, but there needs to be more of a discussion of the classification of past costs and how these could be used to predict future costs.

Witham's [158] approach to EDP cost control includes the following ideas: (1) utilize a service center for initial applications and in place of very small centers; (2) develop standards for input, operations, programming, etc. and evaluate performances by comparing with these standards; (3) implement those jobs which have the highest potential cost savings for the firm (e.g., inventory models and production scheduling), not just those jobs where there are clerical cost savings; (4) hire a data processing manager who knows something about business; and (5) get management involved in taking an active part in developing computer systems and seeing that the computer is used for "profitable applications."

It is interesting to notice the different emphases regarding the control of EDP costs. Smith is very much budget-oriented; Witham does not even mention budgeting. It is possible that Smith is (unknowingly) oriented toward stage one and two firms whose budgeting systems are very lax and need to be improved. Witham could be writing about those stage three and four firms whose budgeting systems are already very tight and effective.

Although the 1974 article, "Managing the Data Processing Manager," by G. Hunter Jones is not primarily oriented toward cost control, its conclusions reinforce certain ideas mentioned earlier.

> Stress the business aspects of the data processing function rather than technical issues. . . . Require a realistic assessment of the cost-effectiveness of any proposed new application and a reevaluation of anticipated costs and benefits at key milestones to insure that the early indications of the project's value have been borne out. . . . Require technical management to provide understandable explanations of what the department is doing and why, how it relates to company goals, what alternatives have evaluated and why they were discarded. [85, p. 75]

Jones placed particular emphasis on project scheduling and control.

A 1970 article by Donald L. BLack described two forms, the computer alteration request form and the project/alteration cost-out sheet, that can be used to control the costs of changing existing computer programs. [14] The first form is required whenever a modification is to be made to computer production programs. In all except error correction situations, the first form must be accompanied by a cost-savings analysis supporting the requested change. After the second form is completed by the appropriate systems personnel the estimated cost is compared with the projected savings and the alteration request is accepted or rejected correspondingly. The request may also be rejected by any of the involved or affected department users. This system has been implemented by a large insurance company and there were plans for expanded usage of the project/alteration cost-out sheet "as the kick-off document for a computerized system which will report on the status of present alterations and projects, show programmer workload, and forecast the workload over a six month period with notice being drawn to overloads, etc." [14, p. 103]

In "Allocating the Corporate Information Processing Resource" Ted Coe presents a framework which focuses on "what is gained from the system" rather than "what the system costs." [27, p. 22] He states that the framework "focuses on benfits because of the rather extensive work which has already appeared on cost measurement." [27, p. 20] It would be very helpful if he cited the references where this "extensive work" has taken place. As mentioned earlier in this chapter, most cost/benefit studies tend to concentrate on determining benefits, not costs. [For example see 93] Coe himself states that in firms he observed, the justification of new projects on a cost/benefit basis "was hampered by an inability to define benefits, and in some cases, to define costs." [27, p. 19] (Italics added.)

Coe proposes three categories of benefits which need to be examined for each potential system project: (1) direct cost displacement, (2) indirect cost and revenue changes, and (3) benefits in "key-result areas." The third category is really just intangible benefits, and the gist of the article is that intangible benefits should be considered when deciding on new system projects, something that others have been saying for some time.

One of the most interesting--and probably controversial--articles in the area of EDP costs is "EDP: a 20 Year Ripoff!" by Harry Larson. [95] Some of Larson's abrasive comments about "expensive EDP people and machines" were cited in the first chapter. Larson believes that top managements have ignored their responsibility in the EDP area:

> I've seen the ablest and toughest of executives insist on increased productivity by a plant manager, lean on accounting for improved performance and lay it on purchasing in no uncertain terms to cut its staff. But when these same executives turn to EDP they stumble to an uncertain halt, baffled by the snow job and the blizzard of computer jargon. [95]

He recommends, as others have before him, that the same fundamentals of management brought to bear elsewhere in the firm be applied to the EDP area. He knows that problems will be encountered.

> EDP people are not, in general, imbued with a commitment to hit all three of the fundamental goals; namely schedule, budget and performance requirements. There are EDP people who have never seen an EDP development come on schedule, so why should they believe it can be done--all their experience says otherwise. Many EDP people simply assume deep down that hitting all three can't be done. On the contrary--it can be done. The executive's responsibility? Insist on hitting all three! Call a halt to the claimed immunity from normal management controls. [95]

Some of Larson's other suggestions made in the article contain the following points; (1) emphasize user involvement, especially in EDP development; (2) don't be afraid to fire incompetent EDP personnel; (3) arrange more contact between EDP managers and personnel and top management; and (4) charge EDP suppliers (or reduce payments) with the costs of constant changes in computer operating systems. Although Larson's article is very critical of past EDP efficiency and effectiveness, it is at least as critical--if not more so--of top management who have benignly neglected the EDP area. Truly, the blame does belong in both camps.

Part of the solution to many of the problems Larson mentions may lie in broadening the knowledge and interest of EDP personnel in the business operations of their firm. This is the thrust of a 1975 article by Copley. [31] While addressing other EDP personnel, he states that "the commitment to learning the business and direction of our organization must be just as concerted as the commitment was to pursuing data processing knowledge." [31, p. 5]

In an article entitled "Data Processing Managers Need to Know Accounting," Martin [101] goes a step further:

> Required, in successively greater amounts, is the knowledge and ability to apply conventional management techniques, previously felt dispensable since the data processing manager was thought to hold a unique managerial position. [101, p. 26]

Martin goes on to discuss three general areas of accounting--taxation accounting, managerial accounting, and financial accounting--with which an EDP manager should be familiar. He concludes that managerial accounting is the most important for the data processing manager's needs, "although the other areas are influential to a lesser degree." [101, p. 28]

Background on Transfer Pricing

We now briefly review transfer pricing literature in general as a background for discussing transfer pricing in the EDP environment. [For summaries and syntheses of previous writings in this area the following are recommended: 2; 8; 145; and 149.] This portion will be purposely brief and devoid of the usual graphs and charts that accompany such discussions. The interested reader should consult the referenced works for greater details and for additional references for further study.

Transfer prices are the intra-company charges at which goods and services are "sold" by one organizational unit to another. [61, pp. 435-436] A complete history of the literature of transfer pricing is neither possible or needed, but a brief summary will serve to introduce specific models in the area of EDP services.

Major works on transfer pricing began to appear in the mid-50's. Paul Cook and Joel Dean each highlighted problems that arise when transfers occur within a decentralized firm. [29; 37] Each author described and analyzed the major types of systems being used and reached essentially the same conclusion: that divisions should operate as profit centers using market-based prices for intracorporate transfers.

Hirshleifer [76; 78] used a rigorous economic analysis of the problems of transfer pricing and concluded that Cook and Dean's market-price approach could be used only where the commodity being transferred was produced in a purely competitive market. Imperfectly competitive markets implied the use of marginal cost or some price between it and the market price. It should be noted that Hirshleifer's solutions assume technological or "cost independence"--the level of operations in one division will not affect the cost function of the other. This assumption is obviously invalid when discussing transfer pricing of EDP services where the services are often used ("bought") to reduce the buyer's costs.

Most of the transfer pricing articles in the 1960's dealt with the effects of intracorporate pricing on divisional performance, evaluation, and profit measurement. Among the exceptions was Dupoch and Drake's [47] proposal of using marginal costs plus "shadow prices" when market prices were not available and there existed alternative uses of fixed facilities. Recently Onsi [118] has used a short example to illustrate the problems in transfer pricing when such opportunity costs are not considered.

One of the better theoretical and applied treatments of transfer pricing is found in Solomon's Divisional Performance, Management, and Control. [145] His analysis brought together much of Hirshleifer's work and discussed a few additional elementary cases. Horngren [81] and Shillinglaw [133] have brief but excellent discussions of transfer pricing in their respective cost accounting texts.

Gordon [62] has proposed a cost-based transfer pricing system to allocate resources in a socialist economy that may also be used in the administration of a large, decentralized firm in a capitalist economy. This system would probably be very expensive for a single firm to use, and Gordon himself has indicated that "the simpler systems currently in use are adequate for the decentralization problems such firms encounter." [62, p. 427]

Some of the types of transfer prices that have been proposed and/or used are now briefly summarized. Market prices are generally held to be ideal if the market for the intermediate product is perfectly competitive, in which case the market price is the opportunity cost to the firm of not selling units of the product on the external market. In the absence of perfectly competitive markets, which are seldom present, there seems to be at least academic agreement on Hirschleifer's range--marginal cost or some point between it and market price. Marginal cost is considered correct if short-run capacity is not a limiting factor. If capacity is limited, the opportunity cost of the firm as a whole of producing for internal transfers should be added to marginal cost to arrive at the transfer price. (These opportunity costs are usually the "shadow prices" from a linear programming algorithm.) Most of the above methods can in some way (at least partially) be traced back to Hirschleifer's analysis and therefore rely on his assumptions of technological independence.

Although market-based transfer prices have been used in some firms, cost-based prices (usually full cost or full cost plus a markup) and negotiated prices have been widely used. Negotiated prices have been criticized for their artificial nature and limited use for decision making and evaluation purpose. [149, p. 57] The power of the divisional negotiating committee may be unbalanced and/or the division may come to regard the negotiation per se as the most important determinant of their profit. However, a recent examination of transfer prices from a behavioral context leaned heavily in favor of negotiated prices. [156]

Full cost (and cost plus) has been widely criticized because its usage can easily lead to suboptimal decisions. The use of actual costs may pass on the inefficiencies of one division to another; full standard costs may minimize this problem, but suboptimal decisions may still result. [For a very simple example see 81, p. 741]

Solomons proposes an interesting method where no usable market price exists and the supplying division can meet all probable requirements.

> His solution attempts to retain the decision-making advantages of marginal cost and yet provide for recovery of fixed cost. The latter makes the solution more long-term, and satisfies administrative requirements for recovery of all costs. Solomons claims, in addition, that it permits more accurate performance evaluation.
>
> His solution consists of dividing up costs into two parts. The marginal costs (approximated by variable costs) become the transfer price and represent the product cost. Fixed costs are recovered as period costs through a lump sum charge based on expected usage of of capacity. The lump sum charge is calculated from budgetary expectations and is not altered if there is a volume variance. This ensures that only the variable (or marginal) costs enter the short-run decision models as inputs. It is a useful modification to the marginal cost method in situations where marginal cost is constant or declining. In addition the lump-sum charge for ces the buying division to consider the long-run costs of utilizing the selling division's capacity. [149, p. 61]

Turney's dissertation describes how this method might be applied to the EDP area. [149, pp. 62, 166-172] There are some disadvantages to this method, but they will be considered later in the discussion of Turney's work.

Part of the transfer pricing problem is the variety of requirements that a transfer pricing system must meet, namely: (1) goal congruence--the transfer pricing system must motivate profit center managers to pursue their own self-interest in a manner which is conducive to the success of the company as a whole; (2) performance evaluation--the transfer price must allow central management to evaluate as accurately as possible the performance of the profit centers in terms of their separate contributions to corporate profits; and (3) autonomy--if top management wants to preserve a decentralized structure, it must allow the subunits to make decisions as decentralized entities. [81, pp. 697, 730; 126, pp. 99-101] It is not hard to see that these requirements may often be conflicting.

In a recent attempt to synthesize various approaches to transfer pricing, Abdel-khalik and Lusk suggest that possibly this second requirement should be dropped or eliminated. In summary they stated: (1) "performance evaluation does not have to be a function of profits," (2) "transfer pricing may blur the evaluation perspective when the evaluation of performance is strictly profit oriented," and (3) "the same degree of control and evaluation attempted through transfer pricing models may be effected through the setting of standards of divisional performance and the evaluation of deviations from these standards." [2, p. 23]

Although Abdel-khalik and Lusk stress the limitations of transfer pricing for performance evaluation, they do not imply that an intrafirm price mechanism is useless as a tool for allocating scarce resources. Most attempts to apply transfer pricing to EDP services have had efficient resource allocation as a primary goal. [For example see 106, p. 125; 154, p. 15] Before examining various proposed EDP transfer pricing methods and models, let us examine some of the advantages and disadvantages of charging users and criteria that have been proposed for evaluating EDP transfer prices. Also discussed early in this section are some more general articles on transfer prcing EDP services which do not promote a specific method.

EDP Transfer Pricing Literature

Why Charge?

In his NAA study, Sollenberger lists a series of advantages and disadvantages of charging users for systems services. This list also summarizes much of a related article discussing the same area. [142] Because any attempt to further summarize or condense this list would result in the loss of key ideas, it is quoted in full here:

> 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 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 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 of the value of information. Thus, it is more difficult to obtain broad support of the concept of integrated systems if charges for this 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. [142, pp. 129-130]

More firms charged for ongoing computer jobs than for systems development work, and there was more of a conflict in opinion over whether the latter area should be included in an EDP pricing system. Since Sollenberger's study is essentially descriptive in nature, he does not propose a specific model for charging either systems or operations costs to users. He does cite some factors for consideration in each area. In charging for the systems design area, the following points should be considered.

1. The validity of a full-cost charging system where all systems costs are billed out is highly questionable in view of nonproductive and nontracealbe costs present.
2. Flexibility must be provided to all for differences in project scope, user involvement and sponsoring operating areas.
3. Preliminary and economic feasibility studies are probably 'in the company interest' expenditures and not specifically chargeable; also certain projects are of such general interest and affect so many managerial areas, that costs for these might be borne by the corporate systems unit. The charges for systems development work should probably be based on work done once the project is formally approved.
4. The charge should be against the sponsoring manager.
5. The charging system should be simple and easily understood. [142, p. 132]

The following desirable attributes of a charging system for computer operations were listed by one firm in his study:

1. Understandability and ease in administration are prime factors in managerial acceptance and use.
2. The charge should be equitable from a company-wide point of view, provide consistent charges for given work, consider priority graduations and represent the cost of facilities utilized.
3. The charging procedure should be stable over a period of time to allow for valid basis of evaluating implemented systems which were developed under certain operating cost assumptions.
4. In all probability the accounting system used will be neither a full nor marginal cost approach and will try to allocate large fixed costs (salaries and hardware costs) over many variable activities (orders, employees, etc.).
5. The algorithm should be a simple as possible considering the above constraints. [142, pp. 133-134; see also 143, p. 28]

Sollenberger presents an example of a charging algorithm used by one firm which detailed the specific computer resources used (e.g., CPU time, I/O time, disc and tape storage) and multiplied these by constant coefficients to develop a total charge. [142, p. 135] He briefly criticizes the algorithm for its complexity, but adds that complexity may be necessary in a multiprogramming/muliprocessing environment.

Heitger used a deductive approach in reasoning from corporate EDP objectives to criteria for an EDP transfer pricing system. However, since his conclusions were quite specific, his work will be discussed later with specific transfer pricing models and methods.

In a chapter entitled "Management Control of the Computer Resource" in Information System Administration, McFarland et al. state that a good management control system must possess three important attributes:

1. It must have mechanisms to monitor information on the key aspects of employment of computer resources necessary for evaluation.
2. It must have mechanisms for communicating the information to decision-makers.
3. It must have mechanisms to motivate decision-makers to take action which facilites organizational goal realization. [107, p. 467]

They discuss briefly the inital resource commitment to the EDP area and the control of systems development and computer opeations. The unique supply and demand characteristics of computer systems are described. (These were cited in Chapter One, see page 6.) However, most of the chapter is devoted to approaches to charging users for EDP resources.

> The concept of charging users for the computer resource is the core backbone of virtually all organizations' approaches to the management control problem. [107, p. 473]

McFarland et al. then discuss non-charge-out systems, full charge-out systems, and partial charge-out systems, relying heavily on case study examples. They conclude the chapter with a conceptual framework for controlling the computer resource and with a checklist of questions that should be asked before making a charge-out/non-charge-out decision. [107, pp. 482-484] A 1973 article by Dearden is essentially the same as the above-mentioned chapter. [40] However, the questions at the end of the article are better organized and answers are presented in a charge-out/non-charge-out spectrum. Some examples are: [40, p. 78]

	Spectrum		
	Non-chargeout	Partial chargeout	Full chargeout
Are users knowledgeable about the costs and limitations of computers?	No		Yes
Are users highly susceptible to "overselling" of the computer resource?	Yes		No
Is the company's operating philosophy one of decentralization? If so, do the management control system and the location of the resource reflect this fact?	No		Yes
Do complex priorities make it difficult to generate needed management information on schedule?	No		Yes
Is it necessary to monitor and control EDP management closely?	No		Yes

Figure 2-1. Helpful questions in determining a charge-out policy.

A 1973 article by McFarlan stresses two key structures that management needs to control the EDP area.

> The first is a financial reporting system that allows it [management] to do the following things:
> --Review the department's performance on a periodic basis.
> --Compare the department's development against formal plans for it.
> --Check the functioning of the department's project control systems.
> The second is a structure that links the responsiblity for various departmental decisions to the operations of users--ordinarily other company departments. Generally this structure is a procedure to account for EDP expenses, either on a chargeout or an overhead basis. [106, p. 133]

There is an excellent discussion of some advantages and disadvantages of chargeout and overhead accounting for EDP costs. McFarlan argues quite strongly for the use of chargeout systems. He does not discuss the way the transfer price would be determined.

Although many authors favor EDP transfer pricing, few trace a transfer price back to its origin--the EDP cost system. Anderson is an exception. In a 1974 article he states:

> Implementation of a direct charge system requires the development of an integrated, comprehensive cost accounting system to supply the necessary charges. [7, p. 29]

He goes on to state some desirable attributes of an EDP cost system:

1. Comprehensive in scope--all relevant cost centers should be included.
2. Costs should be categorized by project.
3. The user charge should contain an adequate but not excessive amount of detail regarding resources used by individual systems (adequate detailed data ought to be readily available to permit research regarding special problems or questions that may arise).
4. The cost algorithm should be reasonably simple and easy to understand to encourage user acceptance and comprehension.
5. User charges should reasonably and equitably reflect the costs of resources actually commanded by the user.
6. The charges should be stable over time.

7. There should be flexibility in dealing with special situations; some costs may need need to be absorbed by the EDP area (e.g., costs for projects with substantial long-run benefit to the company but with no immediate sponsor).
8. Economy of operation--costs associated with collecting data and generating reports should be minimized. [7, pp. 29-30]

Anderson gives examples of project cost reports, a charging algorithm based on detailed resource measurements, and a charging algorithm based on the user's primary activity unit. He favors the latter type of algorithm but believes that the detailed approach would probably provide more useful information for evaluating system design alternatives within the EDP area itself. [7, p. 31]

In a 1975 article, John B. Wallace argues that in deciding whether or not to bill for computer services consideration should be given as to how decisions are currently made in the organization. [154] If transfer pricing is already used effectively in a decentralized environment of "strong, mature managers," then billing is likely to be effective. If departmental budgets are controlled centrally and "there is a strong tendency to hide one's expenses in the budget of other departments," billing users for EDP costs should be avoided. [154, p. 17]

While Wallace's article is quite wide-ranging and a review of all the points made therein is impossible, it does contain an interesting list of dicisions which nine data center managers said utilize charging data on the cost of systems development and/or the cost of computer operations. These decisions are:

1. Application selection.
2. Project control.
3. Equipment utilization.
4. Computer resource development decision (disc vs. core storage, etc.)
5. Centralization/decentralization of systems development and/or computer operations.
6. Make-or-buy; internal vs. external processing.
7. User evaluation decisions. [154, p. 14]

Although a complete ranking of decisions was not given, charging data were judged most useful by data center managers in the first three decision areas.

Specific Charging Methods

Specific methods of determining EDP transfer prices that have been used in the past or that have been proposed as models are now examined. The discussion will proceed along the following lines.

I. Full Costing Approaches
   A. Average Full Cost
   B. Cost-plus
   C. Standard Full Costs
II. Marginal Costs
III. Other Models
   A. Turney's Model
   B. Value-based Allocation
   C. Axelrod's Model
   D. Nunamaker and Whinston's Model
   E. Flexible Pricing
IV. Other Considerations
   A. Priority Pricing
   B. Multiprogramming

Average Full Cost

Some of the earlier methods of developing unit costs and of pricing EDP services came to be used because of government regulations essentially requiring an average cost method. [88] University computer centers, because of substantial government contracts and grants, were particularly affected by this regulation. The price paid by the government was established *ex post*, following an audit of cost and utilization data for each accounting period. "Provisional prices," based on estimates of utilization, were used in the interim.

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There were great incentives for universities to restrict the use of their computers, even at times when utilization was low. Any increase in utilization of time otherwise idle reduced the computed average cost per unit of time and therefore the price paid by government projects for computer time.

Although most corporations do not sell extensive amounts of computer time to the government, the use of ex post average full cost to determine unit costs causes other problems in the allocation of computer resources. Smidt [136] has suggested that a typical demand pattern over the life of a computer is excess capacity when acquired, gradually diminishing until demand exceeds capacity later in its life. If this be the case, the use of average unit cost results in exorbitant charges early in the system's life, counteracting possible attempts to encourage usgae of the new facility. Late in the system's life, when demand needs to be limited, average costing would result in relatively low charges.

Sollenberger cites an example of one special purpose data center which used an average full cost approach to charging. Its rates "were high because of the special services and applications . . . performed--too high to attract routine high volume applications. . . . A volume decline and rate increase sequence followed which finally ended in closing the data center." [143, p. 40]

A further criticism of the average cost pricing method is that, unless it is coupled with various rates for different classes of computer time, it fails to distinguish and discriminate between high priority and low priority users. A user having a great need for immediate turnaround has no way of purchasing that priority service; another user who is not under such time pressure has no incentive to purchase off-prime-time service.

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In a university setting, a student given a fixed budget for computing time might wish to "buy" more hours of low-quality service to stretch his budget.

Approximating Market Price--Cost-plus

Krasney has proposed a cost-plus transfer price to approximate an outside market price which is usually not available. [94] Standard costs would be determined based on expected activity levels. A "profit margin" would be added based on the firm's average or expected rate or possibly the average ROR of comparable computer service firms. Jobs are submitted to the EDP department which accepts them if estimated benefits exceed the estimated variable costs of the job.

Revenue to the computer center would be determined by multiplying the actual quantity of computer service provided by their respective substitute market rates. The expense charged to the user is some portion of the corresponding revenue recognized by the EDP department. The exact amount is determined by the ratio of the estimated benefits (submitted by the user) and the EDP department's revenue. The maximum charge to the user would be the computer installation's revenue.

Heitger has raised a number of timely questions about Krasney's plan. [71, pp. 52-53] In particular, users would be strongly motivated to estimate benefits at just greater than variable costs, minimizing the amount of expenses charged to their department and misusing one of the very reasons for transfer pricing.

Standard Full Costs

The use of a practical capacity or standard volume as a unit cost standard for allocation purposes in conjunction with full costing eliminat

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eliminates some of the problems of actual full costing. Heitger [71] has advocated standard full cost as the best transfer pricing method in several cases. He reached this conclusion by examining corporate EDP objectivaes and then establishing transfer pricing criteria to meet one or more of the objectives. The five corporate EDP objectives he discovered were:

1. Automate all jobs that can be justified on the basis of cost reduction.
2. Automate all 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. [71, p. 108]

Given the first two objectives, Heiger (relying heavily on Sollenberger [142, pp. 133-134]) develops the following criteria for an EDP transfer pricing system:

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. [71, pp. 109-110]

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

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For firms having the objective of maximum utilization of EDP resources, Heitger replaces the first criterion in the above list with the following two while the remaining five are the same:

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. [71, pp. 113-114]

He concludes that a marginal cost transfer price best satisfies this set of criteria. Heitger contends that this method can only function on a short run basis. Most of the system managers he interviewed felt that a marginal cost charge would swamp their installation with job requests in a very short time.

Objectives four and five were questionable corporate objectives at best and provided no basis for solving the transfer pricing problem.

In one of the earliest studies comparing EDP transfer pricing methods, Wormley examined marginal cost, actual full cost, and standard full cost. [163] Wormley rejects marginal costs for a number of reasons including: (1) the difficulties of determing and equalizing the marginal cost of the transferor division and the marginal revenue (which, it might be added, would often include intangible benefits) of the transferee division, (2) most EDP costs are fixed costs, and (3) marginal cost transfer prices will drive a given system to capacity very quickly and will fail to force an economic utilization of capacity increases. [164, pp. 4-5]

Wormley noted three objections ot actual cost transfer prices: (1) since the price must be calculated after usage has occurred the cost per computer hour is not known to a user when he needs the data and can control his utilization of the resource; (2) the unit cost charged is is unk

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is unknown when budgets are prepared; and (3) the EDP center is not encouraged to control its own spending. [164, p. 5]

Standard full cost is advocated primarily becuase it overcomes the above three objections to actual costs. In addition, Wormley says that it is "relevant, understandable and simple." He does not discuss which particular measure of EDP capacity or utilization should be used.

Sobczak [139] does not specifically advocate "standard full costs" but rather "cost reflective pricing." However, since he advocates "actual costs," but with the rates based on final expected level of utilization, his rates may be, for all practical purpose, considered standard cost rates.

Sobczak argues that two conditions are necessary for a firm to efficiently use its computer resource. (1) "Cost reflective" rates must be available and charged to users. (2) Users must react to these costs in an economic fashion. [139, p. 63] His emphasis on user reaction is important in evaluating all types of transfer pricing systems.

> If users do not respond in a cost sensitive manner--in other words, the prices set on DP services are not a factor in their decision-making process-the DP accounting system has not provided any benefit. In fact, the firm will probably incur a loss since there is usually substantial overhead associated with establishing and maintaining an internal transfer payment system. The point is that distributing costs among the user is not 'good in itself,' and the user must react in order for benefit to be derived. [139, p. 62]

Most of Sobczak's economic analysis is based directly on Sharpe's examples. [131, pp. 442-446] It is interesting, however, that Sharpe concludes in this particular example that marginal cost is the appropriate transfer price; but Sobczak favors standard full cost. Sobczak seems to be mistaken in his analysis of the behavior of EDP costs. For example, he states that "the majority of costs in most computer centers are usually of a variable of semivariable nature."

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[139, p. 63] Contrast this with Dearden and Nolan's statement: "The ratio of fixed to variable costs is high." [40, p. 69; see also 107, p. 471; and 149, p. 132] If Sobczak views fixed costs as negligible, then his standard full cost would be very close to Sharpe's marginal cost.

Chapter Eleven of Sharpe's The Economics of Computers is devoted to pricing computer services with emphasis on internal pricing. Sharpe discusses several different situations. His first example [131, pp. 442-445] is of a marginal cost transfer price, but this was later discarded when the assumptions underlying the method were stated and found to be often unrealistic. In the case of a firm having fully-utilized, fixed capacity, he concludes that the appropriate transfer price "may be more or less than average cost." [131, p. 455] This leaves the reader somewhat in the dark as to which way to proceed. Moreover, it would be extremely difficult (and costly) for a firm to develop the total value, marginal value, and marginal cost curves on which Sharpe's analysis is based.

Marginal Costs

In the absence of an outside market for the transferred commodity, many economists have argued for a transfer price based on marginal cost. However, few have strongly advocated it as a hard and fast rule for EDP transfer pricing. Heitger indicated that marginal cost should be used *if* (and that is a very big "if") one of the corporate EDP objectives is to maximize the utilization of EDP resources. [71, p. 114] Sharpe's initial internal pricing example concluded that marginal cost was an appropriate price. [131, pp. 442-445] However, this example assumed an eq

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"an equilibrium point can be found at a utilization for which marginal cost is defined. Marginal cost is not defined at points at which the total cost curve exhibits a kink [e.g., increments of fixed costs], and it is clearly not defined when utilization reaches capacity." [131, pp. 200-204]

In the tradition of "Solomon's Solution," a marginal cost transfer price which is accompanied by a fixed-cost charge has been proposed for the EDP area. Since this differs from a strict marginal cost price, it will be discussed in the next section.

Turney's Model

Turney [149] has concluded that marginal cost (approximated by variable costs) should be the basis for transfer pricing EDP services. However, users would also be charged fixed costs in lump-sum amounts. He breaks down EDP costs into five categories and suggest cost assignment for each as follows:

1. Development Costs (systems design and analysis; programming); allocation based on negotiations between the user and the EDP department.

2. Incremental Costs (program maintenance and conversion costs); allocation again based on negotiation.

3. Capacity Costs (hardware; some software and personnel costs); allocation based on expectations of user's share of practical capacity; fixed for the budget period regardless of actual usage.

4. Variable Costs (data entry; supplies; some personnel costs); charge users standard variable cost per unit.

5. Congestion Costs (opportunity costs of excessive turnaround; a short-run capacity cost); charge users based on actual usage of computer resources and the desired priority.

All of the above allocations are based on standard costs and users are not charged for inefficiencies in the EDP department.

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Possibly the greatest problem with Turney's approach lies in his handling of the capacity costs. Although this is a lump-sum charge to users, he stresses that it should be itemized according to the different resources utilized by the user. This entails keeping track by users of such items as CPU time peripheral processing time, core used, etc. The user would not be immediately charged for his actual usage of these resources, but the amounts used in one budget period would be the major input into his lump-sum charge for the next. This time-lag in charging users seems to be undesirable if these charges are to be used at all in the performance evaluation of either the user or the EDP center.

Another problem with Turney's analysis if that the costs he includes in variable costs are a poor approximation of marginal costs. He apparently ignors the step-wise increases in hardware costs as the "practical capacity" of a given system is reached and new components must be added to extend capacity.

Value-based Allocation

Another method proposed by Sharpe is an attempt to directly maximize the value of the computer installation to the firm. [131, pp. 469-480] Users must be willing to describe in dollars the value associated with the completion of a job at various times of the day. These values are assumed to be the same as those for the firm as a whole. Linear programming is used to determine the timing (or scheduling) of each job and the "cost" (including opportunity costs) it should be charged.

Axelrod's Model

Axelrod [11] has modeled a control and information system which he claims efficiently allocates computing resources assigned by an rga

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organzation to its internal users by means of maximizing a general value function. His model affects the allocation of computing resources by means of the following controls:

1. The long-term assignment of the computing requirements of internal users to either internal or external computer facilities.

2. The medium-term dynamic control of the level of user demand for services of the organization's internal computer facility.

3. The short-term scheduling of jobs that have entered the internal computer.

Number one is solved by the setting of appropriate transfer prices by a centralized control unit. An iterative procedure based on changing submission times and turnaround times resolves number two. Number three requires the use of various queueing techniques such as FIFO and SJF (shortest job first).

Axelrod's model can be criticized on several points. (1) his heavy reliance on "central control" would seem to invalidate the model in decentralized circumstances where divisional (or departmental) managers are encouraged to make their own decisions about their utilization of computer resources. (2) The costs of implementing his model (and other models attempting to incorporate various opportunity costs--e.g., Sharpe's "value-based allocation") seem very high on an intuitive basis. It is possible to imagine further theoretical extensions that consider more factors than submission and turnaround times (e.g., accuracy of processing, volume of transactions processed, etc.) with a great growth in complexity and administrative overhead. The examples used in his thesis are quite small. Applying his iterative control model to a medium or large size data processing center would seem prohibitive in terms of both time and costs.

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costs. (3) It would be difficult to incorporate Axelrod's transfer prices into a performance evaluation scheme (of users) based on either costs or profits. The transfer prices do not at all reflect the cost of resources being used. Also, because of the lack of cost information about internal computer services, it would be difficult for users to perform cost/benefit analyses for various applications.

Nunamaker and Whinston's Model

Nunamaker and Whinston [117] have proposed a cost allocation procedure base in part on the user's cost of obtaining the service from an alternative (external) source. In many respects this method is very similar to that recently proposed by Moriety. [109] Nunamaker and Whinston apportion the cost savings of having a central computer service versus the use of alternative, external sources to the various users based on the probability of a given user incurring the initial fixed costs of the inhouse center (i.e., being the first job on the system).

Their method implicitly assumes that the total cost of the in-house system is less than the total alternative cost of acquiring those services. Charges exactly equal total actual costs; in fact, the authors apparently considered a transfer pricing approach (rather than a cost allocation procedure) but rejected it because it did not guarantee that the full costs of a facility would be covered. However, Sollenberger [142, p. 134], Sharpe [131, pp. 453, 455], and others have contended that full cost allocation is not necessary to efficiently allocate the computer resource.

Nunamaker and Whinston's method would be extremely costly and time consuming if a large number of users shared a central facility. There would h

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would have to considerable effort expended on determining external prices for all potential jobs and in recalculating the cost allocations every time a new job is added.

Flexible Pricing

Smidt [135] has proposed a flexible pricing scheme where the user may specify either the maximum price he wishes to pay or the maximum turnaround time he can tolerate. Sharpe [131] has pointed out, that given the known parameter (price or turnaround time), the other would be uncertain. In fact, in a highly congested system there is no real assurance that the maximum turnaround time constraint could be met at any price. The major problem with flexible pricing schemes appears to be the uncertainty resulting from them. Especially in the case where turnaround is the specified parameter it seems rather pointless to be constantly varying the price of EDP services when most corporate users cannot easily adjust their demand for that resource. Sollenberger [142, p. 134] has pointed out that one of the desirable attributes of a charging algorithm is stability over time. Otherwise there is little valid basis for evaluating implemented systems which were developed under certain cost assumptions.

Priority Pricing

Sharpe [131, p. 464] and others have suggested that a priority pricing scheme can easily be incorporated into another method. The basic idea is to adjust prices so that computer time is cheaper during off-peak hours. This could be done by means of discounts for jobs run during evening or weekend shifts, or by premiums on prime time applications, or both. Sharpe suggests that an alternative is to maintain equal prices at al

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at all times thereby letting the increased turnaround time be a "price" that peak-load users would have to pay. The problem with this proposal is that there is no way for users who demand fast turnaround at peak-load times to buy it at any price. Users should be allowed, at least in a limited way, the option of paying higher prices for faster turnaround and/or daytime (peak-load) service.

Multiprogramming

Perhaps no other technical innovation has resulted in such a spate of transfer pricing related articles as has multiprogramming. While initially there was some diversity of views regarding approaches to this problem [See 71, pp. 53-55, 139-146; see also 42; 43; and 138], continuing advances in systems software and in internal monitoring packages have made it feasible to measure the usage of individual computer resources (CPU, disc drives, tapes drives, I/O equipment, etc.) for each job. More recent articles touching on this problem have agreed that job costs should be broken down by resource usage and that this is feasible with current technology. [17; 68; 157] Example algorithms may be found in each of the articles cited.

Chapter Summary

In this chapter we have reviewed the EDP cost control literature, touched briefly on transfer pricing literature in general, and examined various EDP transfer pricing methods and models. A few summary points may be drawn where several authors are in substantial agreement. (1) The systems development area is more difficult to control than computer operations. Emphasis should be placed on a project reporting system. (2) The operations area (and to some extent the system design area) can be controlled using many of the same techniques used elsewhere in an organi

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organization. In many instances, upper management, bewildered by the complex technology, has been hesistant to apply these tools to the EDP area. (3) There is general agreement that a pricing mechanism is an effective means of controlling computer usage if handled properly. There is less agreement about the effectiveness of a pricing mechanism as the sole means of allocating scarce resources. Most authors have spent more time on "what pricing method?" rather than asking whether pricing should be used at all. There is some agreement that transfer pricing could be effective not only in controlling computer operations but also in the system development area. Recommendations have usually leaned toward standard costs or a contracted amount.

Although continuing to grow, the proportion of EDP literature related to cost control is still quite small. Much of the approach has been indirect rather than direct--charge users for services to shift the costs to other parts of the organization. Although Heitger was particularly interested in transfer pricing, his comment holds for all control aspects of the EDP area: "A topic as important as this should certainly have a more comprehensive evaluation than the literature showed." [71, p. 57]

One thing is clear from the literature. No one as yet has attempted to crystallize a cost accounting model to control the EDP area. This is the subject of the next chapter.

CHAPTER III

EDP COST SYSTEM FOR MANAGEMENT CONTROL

Introduction

The need for a model EDP cost accounting system (not just a transfer pricing system) has been implied many times in the literature. In his conclusions, Turney stated explicitly:

> Some companies that were looked at possessed only the rudiments of a cost accounting system for MIS. Those companies that did have a cost accounting system were still uncertain as to its correct form. [149, p. 192]

This chapter outlines a model cost accounting system for the EDP area. In a sense this job is difficult for the model is constructed for a hypothetical firm. In order to have a very broad (and possibly vague) model which will cover a very large number of real-world firms, the number of assumptions made about our hypothetical firm would have to be greatly limited. Conversely, a great number of assumptions about the hypothetical firm can be postulated with a resultant, detailed model which applies only to an extremely limited number of firms.

Hopefully, the middle path has been chosen. The assumptions made below do restrict the number of firms to which the model will apply. However, they do permit a good deal more of specificity regarding the model's components. In a few instances the discussion of the model may deal with alternatives that arise from relaxing one or more assumptions. In general we are assuming:

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(1) profit-oriented firms; governmental and non-profit organizations are excluded; however, some of the conclusions may apply to these types of organizations;

(2) medium to large firms; firms spending at least $1 million a year on EDP activities;

(3) some degree of centralization of EDP facilities;*

(4) multiple users are served by the EDP facilities within the firm;

(5) several years experience with EDP; users are relatively knowledgeable about EDP technology.

The model will be based in general upon traditional cost accounting literature. As noted in the previous chapter, several authors have concluded that the techniques used to control other areas of the firm should be applied to the EDP area. Thus, most of the following concepts (with the possible exception of number six) have been used for years elsewhere in business firms.

Components of the EDP Cost System

The components of the cost system are:

(1) Low level of cost collection and aggregation.

(2) Responsibility and cost centers.

(3) Budgeting and reporting system.

(4) Output or activity measurement and performance criteria.

(5) Long-range financial planning.

(6) Tracking users' EDP-related costs.

(7) Charging system for users.

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*This assumption appears well-grounded. Several authors have commented on the growing trend to centralize corporate computer facilities and predict that it will continue. [53; 82; 86; 159] Complete centralization of EDP facilities is not assumed, but where an alternative, such as "distributive processing," is used, this is presumeably done on an integrated basis.

Number one through four of the above are also found in Sollenberger [140] and part of the discussion that follows is based upon ideas from that paper. Following the discussion of each component, an itemization of the factors used for evaluating the results of the field studies is given. These factors are summarized in Figure 5-1 on pages 165-166.

Low Level of Cost Collection and Aggregation

Shillinglaw [133] has suggested that the typical set of cost accounts is three-dimensional; i.e., costs may be classified in three ways:

(1) By organizational unit.

(2) By descriptive element.

(3) By product, project, program or service.

Applying this to the EDP area we may say that costs are often first classified by organizational units or subunits--computer operations, systems design, operating systems support, data entry, etc. This aspect is emphasized in the next section where responsiblity and cost centers are discussed. Classification by descriptive element (or natural element) is exemplified by a breakdown such as salaries, equipment rental, supplies, and so forth. Possible weaknesses in the typical chart of accounts for the EDP area and the resulting implications of such have, amazingly enough, not been discussed in the published literature. Albrecht has come the closest by presenting an example of a monthly cost report for a computer operations area. [3, p. 302] However, there are several weaknesses in his example. Nearly 95% of the costs in his example are carried in two accounts--salries and equipment rental. Yet some of the other accounts detail seemingly trivial information--e.g., "Telephone, long distance" - $6.00; "Supper money" - $36.00 (respectively

.0001467 and .0008797 of total department costs). If this level of detail is needed in these accounts, surely more detail could be provided in place of the two accounts in which 95% of the department's costs are found!

Part of the purpose of descriptive classifications within departments is to aid in the control of costs. Otherwise, each department would be given a single figure of its total costs for a period. Equipment rental (or depreciation) expense should be split up by major types, e.g., mainframes, disc and tape units, printers and card readers, communications equipment, and special purpose equipment such as plotters. A breakdown by these major types would seem much more useful for cost control purposes than knowing that $6.00 was spent on long distance calls. For example, several authors have commented that peripheral devices and equipment are typically at least 20% lower from independent suppliers than from mainframe manufacturers. [137, p. 77; 100, pp. 16-17] A single equipment rental account is hardly the place to turn for the costs relevant to this decision. Also, if an alternative supplier is chosen, the cost savings resulting from that decision would be much easier to track if equipment costs are split by major types.

The same concept holds true for personnel costs. They might be broken down further by type of activity or by shifts. Personnel costs play a very important part in Shillinglaw's third classification--by product, project, program or service. Although they may account for 30-50% of computer operations costs, they frequently run to 90% of other EDP cost centers. [149, p. 78; 3, p. 302] Thus a breakdown by projects is extremely important, especially in the systems design and systems software development areas. Most authors discussing control of the EDP area touch on project management as being a very important control tool. Several books have considered the subject. Sollenberger [142, pp. 120, 124, 131] presents an excellent set of flowcharts showing the interrelationships between the system service request sequence, the project reporting system, and the charging system for system development and operations. Shaw and Atkins' entire book is devoted to system project management. [132]

It is not our purpose here to detail a project reporting and management system. That would vary widely from firm to firm and would be a full-scale study in itself. Rather, we wish to construct the overall model cost accounting system so that it is compatible with and emphasizes a project reporting system. This means that personnel time and costs in particular, must be initially recorded at a detailed, project-by-project level.

A project reporting system affects the cost accounting system in at least two other ways. (1) Not all project costs are incurred within the EDP area. Therefore, the chart of accounts for users must provide some way of recording EDP-related costs incurred in those areas, and if necessary, a way of reporting them by projects. This topic will be further discussed under component six of the model. (2) Some record must be kept of computer time and resources used by the systems development area. This should be separable by projects and preferably translated into dollar amounts so that total project costs can be accumulated. The requisite charging system to accomplish this will be discussed under component seven.

It is desirable that costs be classified in other ways than the three mentioned above. Sollenberger has pointed out that most cost accounting texts contain at least the following classifications: [140, p. 7; see also 81 and 133]

1. Variable and fixed costs.
2. Incremental and full costs.
3. Planned and actual costs.
4. Direct, assignable, and pro-rated costs.
5. Controllable and noncontrollable costs.

The first two classifications are closely related. The fixed/variable dichotomy assumes some type of activity or volume base. This is not easy to define even in many manufacturing operations where certain costs are expected to vary directly with units produced. However, in an age of time-sharing and multiprogramming it is extremely difficult, if not impossible, to pinpoint a single adequate activity base for the EDP area or even computer operations. CPU time might be proposed, but a job that is heavily I/O oriented would use little of that resource while being expensive in terms of cards (or other input) or paper (output). Sollenberger states that the initial cost classification must commonly be made "without reference to an activity base." [140, p. 8] Turney also concluded, after examining several firms, that it was impossible "to determine the activity bases for the variable costs." [149, p. 192] (This is an interesting comment, coming from an author who bases his transfer pricing system on variable costs to approximate marginal costs!)

Therefore, although it is desirable to identify variable and fixed costs in the chart of accounts, it is seldom done for practical reasons. Most EDP costs are either fixed or step-fixed in nature in the short run. Examples cited in the literature as variable costs include data preparation, supplies, operator overtime, and extra shift rental. [149, p. 117]

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Li considers "supplies" such as cards, paper, tape, and power to be partly "committed costs" and partly variable costs. [97, p. 179] He gives no practical way of distinguishing between what is "variable" or "committed." In the only empirical study attempting to separate variable costs, these were found to be less than 5% of total EDP costs. [149, p. 110]

Multiple regression te chniques have been successfully used to estimate the cost and time necessary to develop computer programs. [55] This technique could conceivably be used to determine which factors are the most important determinants of total EDP costs, thereby revealing potential bases for use in analyzing variable costs. However, it is doubtful--with fixed costs running approximately 95% of the total--that a sufficient range of observations could be found to effectively use multiple regression analysis. One of the requirements of this technique is aptly stated by Benston:

> The observations on cost and output should cover as wide a range as possible. If there is very little variations from period to period in cost and output, the functional relationship between the two cannot be estimated effectively by regression analysis. [12, p. 663]

Closely related to the idea of variable costs--and perhaps more relevant to the EDP area--is the concept of incremental costs. These are generally defined as "the difference in total cost between two alternatives" [81, p. 947] and may be thought of as "the net added costs if a change is made." [140, p. 9] Ideally, the chart of accounts should be so constructed that the incremental costs of running a new job or starting a new project may be estimated from past data.

However, difficulties still abound. If excess computer capacity exists, the incremental cost of a new job X may be only the data prep cost

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costs and supplies related to it. However, it may bring the computer system to "capacity" such that, if new job Y is to be run, new disc storage units must be added to the system and a third shift of operators must be hired. Are these fixed costs an incremental cost of job X or job Y? Should they be split between the two jobs? Between all jobs on the system? Because of difficulties such as these, we may conclude that, conceptually, variable/incremental costs should be distinguished in the accounts, but that because most EDP costs come in lumps of fixed or step-fixed costs, it is impractical to do so to any great degree. At best, the examples cited on page 64 could be noted as variable for control purposes.

Three other classifications were mentioned on page 64. The planned vs. actual distinction will be discussed in part three of this model under budgeting. The last two groups on page 64 are closely related. Although they have implications for the chart of accounts, it is perhaps more logical to discuss them in the context of responsibility and cost centers--the next section of the model.

The factors used to evaluate case study firms in the area of cost collection and aggregation are:

1. The degree of classification and detail by descriptive element--particularly in the areas of personnel and equipment costs.

2. The degree of classification and detail by specific program or project--the existence of a project reporting system and detailed charges by individual programs.

Responsibility and Cost Centers

A responsibility accounting system recognizes various decision centers throughout an organization and traces costs (and revenues) to the

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individual managers who are primarily responsible for the costs in question. [81, p. 158] The system is based to a large degree upon the formal organization chart or structure of the company. Within the EDP organization, various areas such as systems development and computer operations should be set up as responsibility centers with the area manager accountable for all controllable costs. These costs would be aggregated at the information systems manager level and added to costs he alone controls. Multiple cost centers can be created within a responsibility center. Cost centers for an area such as computer operations might include key-punching, data communications, etc.

Two questions may be discussed at this point. Why should the "responsiblity center" or "service center" form of organization and reporting be chosen over that of a "profit center?" What are "controllable" and "noncontrollable" costs in an EDP environment?

In contrast to a responsibility center--for which costs alone are usually accumulated--a profit center is "a segment of a business that is responsible for both revenue and expenses." [81, p. 950] (An investment center is held responsible for invested capital used in operations and is often evaluated on a "return on investment" measure. The tern "profit center" is often indiscriminately used to describe both profit <u>and</u> investment centers.) The question of which type of organization structure is best (or preferable) for the EDP area is inevitably linked with the transfer pricing question. In general, there are at least three organizational possibilities for the EDP area:

(1) A strict responsibility center with no transfer pricing for services rendered.

(2) A profit center with transfer prices including a profit margin.

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(3) A modified responsibility center where transfer prices are used (in general, cost-based), but where performance evaluation is based on the control of costs, the quantity and quality of services rendered, and a multitude of other factors including (but without primary emphasis on) the difference between "revenues" and costs. This latter number may well be negative in many cases; i.e., billings should not necessarily cover all costs.

Li [97, pp. 182-183] suggests that alternative one is particularly appropriate (1) where computer services are used mainly by top management or by one operating department or (2) where the system has significant idle capacity. Krasney [94] suggests the second alternative but modifies the term to "pseudo-profit center." Sobczak [139, pp. 61-62] is not directly addressing Krasney's article, but he clearly chows that an attempt to maximize a computer center's revenue by charging prices that are not cost reflective is detrimental to the firm as a whole. Other authors have implied similar ideas, and the computer center/profit center concept is generally rejected <u>except</u> where significant amounts of services are sold to users outside the firm.

Since we are not considering the case of a dedicated facility, significant idle capacity, or the sale of services to external users, the third alternative best fits the assumptions made at the beginning of this chapter. Further discussion of the transfer pricing issue is postponed until later in this chapter.

Controllable and Noncontrollable Costs

We turn now to a discussion of "controllable" and "noncontrollable" costs. Any complete discussion of this topic must by its very nature be very "situation specific." Horngren defines a controllable cost as "a

cost which may be directly regulated at a given level of managerial authority, either in the short run or in the long run." [81, p. 944] Thus it is difficult, if not impossible, to generalize which EDP costs are "controllable" or not. We must be specific as to (1) firm, (2) level of managerial authority, and (3) short run or long run time frame. Further complicating the decision is the fact that there is not a clear-cut dichotomy between controllable and noncontrollable costs. Rather there is a spectrum of varying degree of "controllability." This model will not attempt a breakdown of EDP costs between "controllable" and "noncontrollable" elements when such a decision is so situation specific. Rather we will look at three further cost classification schemes which may help us implement the controllable/noncontrollable classification of costs in a particular situation.

The first of these three classifications is that of direct, assignable, and pro-rated (mentioned earlier on page 64). Direct costs are costs which are specifically traceable to individual jobs, products, or services, to a manger, or to a distinct organizational unit. Indirect costs are costs which are common to two or more cost objects. Often incurred in lumps, they have varying degrees of traceability to specific cost objects. Someqimes indirect costs are further classified as assignable or pro-rated. Assignable costs are indirect costs for which there is "a reasonably clear, precise, and easily determined method of allocating the cost." [140, p. 13] Allocation may be based on the benefits received or on the amount of resources used. Prorated costs are indirect costs which can be allocated only on an arbitary basis which has little logical or theoretical support. Having limited usefulness for decision making, such costs are probably included on many cost reports because of the acc

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account's preoccupation with full cost allocation.

Keeping in mind that the direct/assignable/prorated classification is a continuum, not a series of neat boxes, we may make some generalizations about its relationship to the controllable/noncontrollable classification. In general, direct costs are usually controllable cost, at least in the long run. Wages and salaries of operators are direct costs to computer operations. So are equipment rental and depreciation costs, but the latter are probably not immediately controllable in the short run. Assignable costs have controllable elements in them, particularly when allocated on a resource usage basis. Data entry costs may be an assignable cost to an EDP services user. It is doubtful that prorated costs would be considered controllable except in unusual circumstances. If reported on a manager's responsibility report, they should be shown for information purposes and not for control or evaluation of his performance. [140, p. 14]

Another classification of costs that may be helpful in looking at the controllability question, particularly in the EDP environment, is that of managed, committed, and variable costs.

> A committed cost represents the aftereffect of a decision or commitment made in the past. For example, once the computer planning committee has signed a three-year lease for a computer installation, the rental becomes a committed cost during the three-year period. A managed cost is a cost incurred at the discretion of management at the policy-making level; it differs from a committed cost in that a specific decision authorizing the managed cost is needed for each budget period. A proposal to increase personnel in the computer operations group or to increase their salaries are examples of managed costs. . . . A variable cost is one that tends to vary proportionately with activity. The more hours the computer installation is in operation, for example, the more punched cards will be consumed. [97, p. 178]

In effect, what this classification amounts to is a fixed/variable distinction with fixed costs separated into managed or committed costs.

However, since most EDP costs are fixed or step-fixed, this further subdivision of fixed costs makes sense. The problem lies in making a useful distinction between committed and managed. Yes, the signing of an equipment lease for some time period does commit the lessee to some costs. In addition to the rental payments there exist at least implied commitments to operator and supervisory salaries as well as systems design and programming salaries. Does this mean that all costs associated with the systems design area are committed costs? Probably not. At least some costs would be discretionary or managed. But determing the cutoff point would be difficult if not impossible.

Even though it would be difficult to implement, this cost classification scheme does point out the fact that a manager may not have control over (and therefore should not be held responsible for) all direct costs to his area. Hardware costs are direct to the computer operations manager, but it is doubtful that he is the one who committed the firm to that particular configuration.

A final classification scheme is really but a refinement of the previously discussed one. Wood and Ditri cite four categories of EDP costs:

> 1. Direct variable costs are those which vary directly with production volumes.
> 2. Variable overhead costs are the production costs which vary with changes in work volumes but which are not specifically related to a single product or output.
> 3. Programmed costs are planned costs incureed as a result of management decision.
> 4. Standby costs are . . . the fixed costs of doing business. [162, p. 76]

Programmed costs are the "managed" costs of the previous classification; standby costs are the "committed" costs. Variable costs have been classified into direct and overhead. Examples of direct variable costs

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would be salaries of keypunch operators who prepare input for EDP jobs and costs of printout forms. An example of a variable overhead cost would be the addition of another sift in the computer operations area. Wood and Ditri make an unnecessarily fine distinction between the salaries of supervisors on another shift, which they say represents variable overhead costs, and the salaries of computer operations personnel, which they say are direct variable costs. [162, p. 76] It is doubtful, that in an age of multiprocessing/multiprogramming, the salaries of computer operators can be <u>directly</u> linked to volume

In sumarizing the controllable/noncontrollable distinction the following points may be made:

1. All costs are controllable at some level of management over some time period.

2. An objective of a cost accounting system is to identify costs as controllable/noncontrollable at the lowest possible level of management where the costs can be directly influenced by the manager's own actions and decisions.

3. The controllable/nontrollable classification, while necessary to a good responsibility accounting system, is not a clear split; rather it is a continuum. The three classifications discussed may help in solving the problem but do not provide all the answers. In general, variable and managed costs will be subject to more control in the short run that committed costs.

4. The actual classification of a particular cost as controllable/noncontrollable is very situation specific. Hence, a general model cannot attempt to provide even a suggested list of controllable and noncontrollable costs. It would vary considerably by asking "by whom?" and "over what time frame?"

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The factors used to evaluate case study firms in this area are:

1. Agreement of responsibility centers with formal organization chart.

2. Homogeneous activities within cost centers.

3. Responsibility centers used--not profit or investment centers.

4. Attempt made to separate controllable from noncontrollable costs.

Budgeting and Reporting System

Budgeting is standard operating procedure with most firms and thus most EDP centers. However, budgeting has been far from EDP's *tour de force*. A perusal of the quotes cited in the first chapter of this study indicates the extent of this problem. Cost overruns have become so common that many managers have come to expect them from the EDP function.

Accountants have generally considered the following list to be *the* underlying behavioral assumptions in the budgeting process:

> 1. The budget should be set at a reasonably attainable level.
> 2. Managers should participate in the development of budgets for their own functions in the organization.
> 3. Managers should operate on the principle of management by exception.
> 4. Personnel should be charged or credited only for items within their control.
> 5. Dimensions of performance that cannot be conviently measured in monetary terms are outside the budgetary domain. [125, p. 675]

The extent to which these assumptions are valid has been widely discussed in the accounting literature. It is not our purpose here to survey and summarize this literature in detail. Each assumption and its relationship to budgeting in the EDP area could well be a dissertation in in itself. Rather, we wish to make a few statements that may help explain the lack of success that the EDP area has had with the budgeting process, thereby pointing the way for improvement in the future.

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Past studies have shown that failure in reaching budget goals generally lowers the level of aspiration. [125, p. 676] This may well be the case in the EDP area; but if so, it is at least partly the fault of those who have attempted to inaugurate and expand the use of EDP facilities in a firm. In order to "get a foot in the door," they have often quoted very low cost estimates, hoping that management will approve the new addition or expansion. Then, they reason, when management sees all the tremendous resultant benefits, they will be glad they approved, in spite of the costs turning out a little higher than estimated. A cycle of not living within cost estimates is set up and perpetuated by continual failures. This cycle can be broken by: (1) a hard line approach on the part of top management (as Larson says, they have put up with the "snow job" too long [95]) and (2) by realistic time and cost estimates by EDP personnel.

Findings in the area of participative budgeting are ambiguous at best. It is quite possible, that while participation may enhance satisfaction, it does not necessarily increase production. [125, p. 679]

Management by exception is the practice, by a manager, "of focusing his attention mainly on significant deviations from expected results." [81, p. 947] However, it is often only the unfavorable variances which attract a manager's attention.

> The response to favorable deviations not requiring corrective actions often seems to be weaker than that to unfavorable deviations. As a result, subordinates may be led to view the system as punitive rather than informative. . . . This suggests that effort should be made to emphasize positive as well as negative aspects of performance to provide "positive reinforcement." [125, p. 680]

These ideas apply in particular to a project management system within the EDP area. Project managers who are successful in meeting time and cost es

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estimates should be given "positive reinforcement."

The controllability criterion is one of the most crucial to a responsibility accounting and budgeting system. As mentioned in the previous section, it is also very difficult to apply in actual practice because of the fixed and step-fixed nature of many EDP costs. Difficulty in application does not nullify its usefulness, and efforts should be made to distinguish controllable costs on a manager's cost report from those that are reported for "information only" (if indeed the latter are reported at all).

Obviously there are many dimensions of performance evaluation in an EDP environment that are not measurable in monetary terms. This study is concerned with the single dimension that can be measured in monetary terms.

The degree to which a budgeting system depends on the two previous components cannot be overemphasized. The initial budgeting process is often based largely upon past history and past costs (adjusted, of course, for expected future changes). If costs have not been classified in the ways suggested under part one of this model, the budgeting process is made much more difficult. This is particularly true of a project management and reporting system. If there has not been experience with similar type projects and cost accumulation at the project level, then estimates of future project costs are likely to be in error.

> While estimates are the primary tool during the early phases of the project, in the final analysis the effectiveness of cost control is limited by the quality, timeliness, and completeness of the cost accounting system used. Without accurate, dependable cost reports, estimates and standards cannot be evaluated and improved, nor can management be warned when significant cost variances occur. Good project cost accounting will show up weak spots, stimulate cost reductions through improved methods,

> and provide objective evaluation of efficiency. To assure this occurs, all pertinent expenditures must be captured, properly identified, and posted to the correct budget centers and account categories. [23, p. 395]

It may also be pointed out that while departmental and firm-wide budgeting is usually an annual process, budgeting (estimating time and costs) for systems projects is a continual process occurring year around. The annual budgeting process seeks to determine what costs should be in the systems (and other) area(s), considering those projects that lie before it. Project budgeting is a more specific effort to relate those costs to output. Project budgeting and reporting can generally be a much more effective cost control tool (in those areas where it can be used such as systems design and programming) than the typical monthly departmental budget report. The latter may be completely in line with expectations; i.e., no new personnel have been hired and costs have been incurred as planned. But a look at project report for the area may show that many are behind schedule and have greatly exceeded initial cost estimates. In areas where project management is not generally feasible, such as computer operations, emphasis should be placed on the monthly budget report for control purposes.

The factors used to evaluate case study firms in this area are:

1. The existence of an annual budgeting procedure.

2. The use of participative budgeting.

3. Monthly cost/budgeting reports with monthly and year-to-date cost/budget comparisons.

4. The degree to which managers must "live within" their budgeted amounts.

5. The generation of data to allow continuous cost/benefit analysis for ongoing and projected systems.

Output or Activity Measurement and Performance Criteria

In some EDP areas it is probably easier to hold costs constant while increasing output or performance, then it is to cut costs without damaging performance levels. For example, a given number of operators are required to operate a certain computer system. Attempts to cut costs by reducing the number of operators may be very detrimental to overall production. Yet efforts to increase the operators' efficiency and productivity may meet with relative success. Accurate measures of output or activity are needed, but these alone are not sufficient. Performance criteria or goals should be set to evaluate actual output.

Measures are needed which will report on (1) human output, (2) machine output, (3) machine turnaround and service level performance, and (4) capacity available, used and unused for all EDP resources. [140, p. 18] Human output measurement will be especially important in such areas as systems development, programming, and data preparation. The latter area's output is perhaps the easiest to measure with some unit such as keystrokes per some time period (minute/hour/day) which is reported for all workers. Even a programmer's output may be measured in lines of code per time period although considerable amounts of influential, intangible factors must be recognized. Human output in the systems design area is the most difficult to measure but probably the most important of the three mentioned. Some measure of output could be obtained from project reports by examing total estimated hours, actual hours to date, and the estimated completion percentage for all projects for which a given person is responsible.

The latter three measure are often the "outputs of highly technical machine dependent systems which have few uniformly applied efficiency benchmarks."

> These generate different results depending on, among others, the machine, physical set up, local interpretation, and different levels of detail recorded. Also, since the majority of internal accounting systems are vendor provided, inherent biases exist. Frequently, great detail and exactness obscure the need for basic and fundamental output measures which can be matched against cost. [140, p. 19]

There is really no other practical source for most of these measures, but their limitations should not be forgotten.

One possible change is in the way item two, machine output, is usually reported. Often this item is indistinguishable from item four--resources used. Rather than measuring output in what is really input terms, it has been suggested that it be measured in terms of CAU's, computer activity units. [7, p. 31] These could conceivably be translated into a cost per invoice processed, a cost per order processed, etc.; cost measurements that users of EDP services and upper management may find easier to relate to and understand. These latter measurements do have limitations for internal (EDP) managerial assessments, particularly in the area of cost planning and controls.

The factors used to evaluate case study firms in this area are:

1. The existence of system software or other method for measuring individual resource utilization in the hardware area.

2. The use of the utilization data to manage and control computer operations, not just to provide input into a charging scheme.

3. The existence of work measurement and reporting systems for the data entry area.

4. A reporting system for human output in the systems design and programming areas.

Long-range Financial Planning

Most companies have implicit, if not explicit, long-range goals and objectives. Long-range planning for the firm as a whole is made toward these objectives. The corporate EDP area is not an independent organization attempting to chart its own course. It must serve the corporate interests and goals. Long-range planning for the EDP area is therefore highly dependent upon that of the firm as a whole. In general the time horizon of many firms' planning is at least five years; therefore planning for the EDP area should extend to at least this time frame.

Very little is found in the EDP literature regarding long-range planning. Probably this is because of the inherent difficulties of attempting such activities in this area. Continuous advances in technology have resulted in continuing changes in hardware, software, and approaches to problems. Often these changes may well have greatly limited the accuracy of any long-range planning done in the past. However it must be remembered that it is not the <u>accuracy</u> of long-range planning which is most important, but rather its effect on <u>current</u> actions.

> Planning can be justified only by its ability to assist anagement in its current actions. Long-range planning permits management to view the probable chain of future actions that will follow as a logical consequence of the current decision, the first link in the chain. By this means, current alternatives can be evaluated in the light of how well they will fit into and affect the coordinated structure of future developments that are embodied in the plans. [133, p. 336]

Long-range planning for the EDP area will include estimates of personnel, hardware, and facilities and translation of these into dollar terms. However, even more important than (and hopefully the determinant of) the above items will be the long-range projections of major new projects and applications designed to further corporate goals and objectives.

It is desirable that discounted cash flow (DCF) techniques such as time-adjusted rate of return (ROR) and excess (or net) present value be a

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be used to evaluate long run investments in both hardware and projects. The literature is replete with suggestions on how to measure benefits for such analyses, particularly intangible benefits. We have observed in Chapter One that costs are seldom accurately estimated. This would suggest that a specific decision be subjected to a good deal of sensitivity analysis before conclusions are drawn.

Even more difficult than the initial do/don't decision is the attempt to determine if a given ROR is being achieved. It is conceivable that this might be attempted for the EDP area as a whole. However, it is doubtful whether the EDP area even meets the criteria for a profit center, much less an investment center. (See pages 67-68.) The EDP manager is (usually) not given a free hand in the control of (1) his asset base, (2) his price/quantity mix to internal users, or (3) sales made to external users. These facts, coupled with the measurement problems of determing <u>actual</u> intangible (and even tangible) benefits, are sufficient to question the validity of ROR analysis for the EDP area. The same types of considerations limit the the measurement of actual ROR's on projects attempted. We are not saying that DCF techniques are inappriate to the EDP area, but that EDP acquisitions and projects should be subject to the same scrutiny as other acquistions and projects, including screening through the firm's capital expenditure evaluation techniques. <u>If</u> the firms uses DCF techniques, they should be applied here as elsewhere in the firm. However, recognition must be made of the difficulties in comparing actual ROR with projected ROR for performance evaluation purposes because of the limitations of our present measurement system.

The factors used to evaluate case study firms in this area are:

1. The existence of reasonably complete long-range goals and plans at the corporate level.

2. The existence of long-range goals and plans for future projects in the EDP area.

3. The existence of long-range plans for personnel and hardware, and projected dollar costs.

4. Hardware acquisition decisions made on a basis consistent with other capital budgeting decisions in the firm.

5. Use of a life cycle, cost/benefit approach to system project decisions.

Tracking Users' EDP-related Costs

This is the sole model component not taken from traditional cost accounting literature. Although the need for such a procedure has been implied in the literature, it has not been suggested explicitly. By "tracking users' EDP-related costs" we mean that the users' accounting systems should be so designed that the total amounts of the EDP-related costs are readily available. These costs might include any data preparation done by the user, computer terminals he owns and maintains, and liaison personnel between the use and EDP operations. Without the data it is nearly impossible to arrive at a total cost of data processing activites for the firm. This type of data is also highly relevant to cost/benefit analyses of future applications. Another important reason to monitor these costs is because a centralized computer center might cut back on the quality of its services to users (in an attempt to reduce its own costs) and in so doing might send users' EDP-related costs soaring.

Perhaps the single most important reason for this component is that it facilitates a company-wide budgeting of data processing related costs. In so doing, the duplication of facilities and computer capacity will hopefully be avoided. In one large firm over one hundred mini-computers had been acquired by users without any knowledge at the corporate level that this was taking place. [106, p. 137] In another organization, utilization of a central computer facility declined because its research laboratories had acquired several large pieces of industrial testing equipment that contained their own built-in minicomputers. Simpler (and cheaper) machines could have been acquired and used in combination with the company's central EDP facility. The author concludes that "such questionable and unnecessary duplication of facilities is far from infrequent." [106, pp. 132-133] A careful tracking of users' EDP-related costs would have given warning that something was afoot in both cases.

The factors used to evaluate case study firms in this area are:

1. Annual summary of data processing costs for the firm is prepared.

2. EDP personnel approve or are otherwise aware of hardware acquisitions by other functional areas in the firm.

3. An effort is made to collect and aggregate EDP-related costs in user areas and report these on a systematic basis.

Charging System for Users

Because of the differences between computer operations (production oriented) and systems design (similar to R & D), these areas will be discussed separately. We begin with that of computer operations.

Charging for Computer Operations

As we saw in the previous chapter, there is general agreement in the literature that in a decentralized firm, the benefits of a transfer pricing system for computer operations outweigh the disadvantages or costs. There is, however, wide disagreement as to the best or most appropriate transfer pricing method.

Conceptually, most economists agree that marginal cost (or marginal

cost plus opportunity costs) is the best transfer price for the case where an outside parket price is not available. Yet it was noted in the previous chapter (page 35) that one of the assumptions on which this analysis is built is that of technological or "cost independence"--the level of operations in one division will not affect the cost function of the other. Although this is obviously invalid for the EDP area, it is not clear what effect the relaxing of this assumption would (or should) have on the transfer price.

The preponderance of fixed and step-fixed costs in the EDP area compounds the problem. The step-fixed costs cause the marginal cost curve to be discontinuous with resultant problems in pricing at those spots. The total amount of marginal (approximated by variable) costs as a percentage of total costs is so small (one estimate is 5% [149, p. 110]) that many managers feel that a marginal cost charge "would swamp their installation with job requests in a very short time." [71, p. 114] In the one study where marginal costs were seriously proposed as the appropriate EDP transfer price, it was also suggested that fixed costs be transferred to users in lump sum amounts based on past usage. [149, pp. 169-170, 172] It was noted that this time lag in charging users seems to be undersirable, particularly if the charges were to be used at all in the performance evaluation of either the user of the EDP center.

As mentioned in the previous chapter, actual full cost is riddled with many planning and control problems. In fact, actual cost schemes of any type (marginal or full costing) should be ruled out because they transfer any inefficiencies in the EDP area to users. While standard full costs do not transfer inefficiencies in one department to another, if based on expected usage (especially if that is low compared to machine capacity), they have many of the faults of actual full costs.

We noted earlier that many jobs, once on the system are difficult to remove. [See 71, p. 80] What is needed is a measure of long-run incremental costs to the firm for each application. To determine this would be impossible. How does one decide which job or application should bear the costs of new disc and core storage or possibly of a new mainframe? Which specific application should bear the incremental costs of the second and then the third operator shifts? Which single application is so fundamental to the firm's continued existence that it should bear the costs of computer security measures? We could go on and on. Obviously, some allocation is necessary. The costs incurred in lumps in the data center cannot be neatly charged out in such lumps (unless it is a dedicated facility--in which case transfer pricing is not an issue). Yet, these lumps cannot be ignored. It is truly the ongoing processing of computer jobs that causes these costs to exist, not in an hour-to-hour or even day-to-day sense, but in a cumulative, long-run sense.

The transfer pricing method that comes the closest to measuring all the long-run costs of a job is standard full cost based on a "practical capacity"* level. Thus early users of a given system are not penalized by initially high rates. Assuming economies of scale, as additional computing capacity is added the rate decreases, reflecting lower long-run incremental costs. Note that this measurement base will rarely "recover" 100% of computer operations costs through the charging algorithm. In particular, when a system is new, only a small portion of capacity will

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*Horngren defines practical capacity as "the maximum level at which the plant or department can realistically operate most efficiently, that is ideal capacity less allowances for unavoidable operating interruptions. Also called practical attainable capacity." [81, pp. 949-950] often be utilized and therefore only a small portion of total cost "recovered." It is conceivable that operations right at the level of practical capacity would recover 100% of related costs (if the EDP area incurred costs in line with the standards). However, if this were the case, the company is probably not far away from needing a larger hardware configuration. After it is installed, rates will probably drop because of the additional capacity (assuming economies of scale), utilization will be less than practical capacity, and again the charging system will not "recover" all costs. Therefore, what is expected is a sizeable "volume variance" unless operations are near or at practical capacity. This is really a cost of providing additional capacity for growth which is not being utilized (yet) and therefore should not be charged to users.

The suggestion of using standard costs based on a practical capacity level is not new. It has been previously recommended by Heitger [71, p. 100] who probably adapted it from Wormley [163]. However, it does not solve all questions of implementation. What measure or measures should be used to determine EDP resource usage? Should users be charged for resources used on a detailed resource by resource basis? If so, how should costs be accumulated for and overhead allocated to these resources?

Two approaches to these questions are proposed, based on the experience with and knowledge of EDP that the average user of data processing services has. If he is relatively savvy in such affairs, we suggest a detailed billing of actual computer resources used.

Billing for Resources Used

This suggestion is not new. In fact, there even seems to be a concensus in recent literature that this is the way to go. As to the appropriate measures used determine EDP resource usage, these would be highly dependent upon the specific configuration used. A typical example found in the literature includes the following breakdown: CPU, memory, disc drives, tape drives, printer and readers. [17, p. 161] It is probably not desirable to have the printer(s) and reader(s) lumped into a single average unit charge. Some jobs may have high input and low output levels and vice versa.

There are at least two general approaches to determining unit costs or coefficients used in the charging algorithm. One involves tracing as many costs as possible directly to the resource "centers" and determining unit costs based on practical capacity. Then the overhead and manpower costs that cannot be directly traced in the first step are stated as a percentage of traceable costs. All unit costs are then multiplied by this percentage to arrive at the coefficients in the charging algorithm. [157, pp. 61-62]

Another approach is to attempt to directly allocate overhead to the hardware areas--CPU, memory, disc drives, etc. For example, building expenses could conceivably be allocated by the proportionate amount of square feet used by each hardware component. Electricity and possibly air conditioning could be allocated on the basis of kilowatts used. It is possible that even manpower expenses could be allocated on the relative proportion of time devoted to each type of hardware. [17, pp. 161-163] After all costs are allocated, then the cost coefficients of the charging algorithm are determined based on practical capacity.

Although both methods will charge out approximately the same amount of costs to users, the latter approach is preferable _if_ the allocations are not arbitrary. For example, if some of the manpower expenses _can_ be directly associated with the printer (including bursting and output distribution), these should be a direct determinant of that cost coefficient, not part of an overhead percentage.

Although the charging algorithm should, in general, be stable over time, it should be adjusted as soon as feasible for cost reductions of hardware components and other major cost changes. [71, p. 112] For example, if a firm decides to lease its disc drives from an independent supplier, thereby dramatically reducing the cost of disc storage relative to tape, this change should be reflected in the charging algorithm. A manager may then weigh the cost savings of changing to disc storage from tape against the one-time cost of the systems and programming effort necessary to effect the change (assuming this cost estimate is provided by the systems staff).

Although concern has been expressed in the literature about the loss in productive capacity because of the detailed measurement of resource utilization and the related charging algorithm, this concern seems to have greatly diminished in recent years. It is a well known fact that most business computers are often I/O bound (i.e., input and output are the constraining facts--they cannot "keep up" with the central processor(s)). Although there were initial efforts to use hardware monitors or to "sample" the resources used by a given application over several runs, these measures have generally been scrapped in favor of detailed measurement by means of systems software of computer resources consumed on each run of an application.

Billing in Terms of Computer Activity Units

Billing users for detailed resources consumed is preferable to the following method even if users are not well versed in EDP terms and technology. Possibly an in-house educational program could be utilized to improve their knowledge of this area and the workings of the charging syster

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system in particular. However, if this is not feasible, and users are highly resistant to a detailed algorithm which they cannot understand, a simpler billing method suggested by Anderson can be used. [7, p. 31]

Under this method a single "pseudo-measure" of computer activity is multiplied by an overall cost rate for the particular system on which the job is run. Thus the charge is determined: charge = c · CAU's, where "c" is the overall cost rate and "CAU" represents Computer Activity Unit--a composite measure of computer activity, based in part on memory requested, CPU time, and records transferred on different devices. [7, p. 31] This is a much simpler measure for a user to understand, although it sacrifices some accuracy and equitability.

An extension of this method is to bill users in terms of their work measurement units. Thus a rate could be developed in terms of invoices processed, customers billed, file inquiries or updates made, etc. Thus the user would know that his charges would vary directly with the number of transactions he has processed. Budgeting for EDP costs in his budget would be greatly simplified. However, it is doubtful whether this method could be truely cost reflective over a wide range of volumes and varieties of measurements.

Priority Pricing

Where prime shift time is limited and demand exceeds supply, there are opportunity costs of running any job--the slower turnaround on other jobs in the system or in a queue. Even if it is not feasible to directly measure these costs, it may be desirable to charge varying rates for different classes of service. Thus a user who desires a fast response time and is willing to pay a premium for it may do so. A user satisfied with overnight turnaround may be given a lower rate.

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A simple way to use priority pricing is to determine charges in accord with one of the usual methods, and then multiply that charge by a given percentage depending on the class of service. A high priority job may be billed at 150% or "normal" rates while an "over-the-weekend job" may be charged only 50% of such rates. These percentages may then be adjusted over time to equalize the number of applications run at various times and to give improved service to all users.

A Word of Caution

It may have been implied that a chargeout scheme is the only way to go, but this is not necessarily the case. Some general observations about chargeout schemes will be made which will hopefully put them in more of a perspective.

First, our restrictions and assumptions made at the first of this chapter are quite limiting. Our hypothetical firm is not intended to reflect the case of every firm. Care must be taken in applying the conclusions reached to a particular firm or subset of such.

Second, as Gibson and Nolan have pointed out, it is usually at the third stage of EDP growth that the chargeout scheme is introduced. "This stage frequently includes the first formalization of management reporting systems for computer operations, a new chargeout system, and the establishment of elaborate and cumbrous quality control measures." [58, p. 83] As noted earlier, the first stage of EDP growth consist mostly of cost-reduction, accounting-type applications such as payroll, accounts receivable, accounts payable, and billings. [58, p. 77] There is really no need for a charging scheme at this point. Since most of the applications are accounting oriented, the EDP department may indeed be located within this area.

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In stage two there is a proliferation of applications in all functional areas. It is probably the tremendous increase of costs at this stage, coupled with an ever-enlarging number of users that brings on the stringent controls of stage three including the charging scheme. It may be suggested that some, if not most, of the control measures of stage three should be applied at the beginning of stage two, as the computer center begins to serve all functional areas. The knowledge that they would be charged on a continuing basis for their applications, might cause more managers to carefully weigh the long-run costs and benefits of possible applications. Hopefully the growth in stage two would be more orderly and costs would not soar at quite the same rate. The emphasis on control would be more even through time, instead of the sudden stress on that aspect in stage three.

Although the stage hypothesis of Gibson and Nolan probably applies to many firms, not all will fit neatly within its confines. In an earlier article, Dearden and Nolan suggested a set of questions that should be asked before deciding to use a chargeout scheme (see page 42). [40, p. 78] The company's operating philosophy with respect to centralization/decentralization is particularly important. There is no point in charging a manager in a highly centralized firm for costs that he has little or no control over.

Finally, the limitations of the charging scheme for short-run analysis should be readily apparent. It does not attempt to measure the short run incremental or variable cost of a particular job. If there is a particular "one-time" need for a job by a user, this job might be charged only the short-run incremental costs related to it--systems and progr

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programming costs, data preparation, supplies, additional operator costs (if any), and additional lease costs (if there are such past a given number of hours).

Charging for Systems Services

It makes little sense to attempt to control one large group of EDP costs (computer operations) by charging users while they may obtain "free" systems and programming services. Although charging for systems services is not discussed nearly as much in the literature as charging for computer operations, it has generally found support wherever mentioned. [See 7; 10; 14; 22; 51; 94; and 154]

The term "system services" or "systems development" generally encompasses three types of activity: (1) new systems development (including the programming effort), (2) maintenance programming, and (3) system maintenance. [71, pp. 124-125] New systems development work is generally traceable to one or more requesting departments and should be charged to such although there are exceptions to this rule as we shall see. Some maintenance programming is done at the user's request and should be charged to him. Other maintenance programming is required because of changes in the physical operating system, particularly when converting to a completely new hardware system. It is doubtful whether these costs can be considered controllable by the user and whether he should be charged for such. Finally, the costs of systems maintenance on the operating system should probably be considered part of computer operation's overhead and recovered through that charging algorithm.

Resource Usage Basis

There are two general approaches to charging for system development costs. One entails charging users for time spent on their particular project. Under this method different cost rates would be set for different classes of personnel; e.g., junior analysts or programmers would be "charged out" at lower rates than senior analysts or programmers, etc. Anderson suggests that this could be easily done by setting individual billing rates as a percentage of gross pay. [7, p. 30] He contends that hourly rates should be set at a level which will permit recovery of indirect personnel costs such as vacation pay, training and development, sick leave, and supervision.

There are problems with this method however. First it is in the systems development area that cost estimates are often exceeded. Users could be given a cost estimate and, if charged for actual time spent on that project, could be billed for costs well in excess of the intial estimate. Second, it is doubtful that many indirect costs should be included in the rate. There is a great difference in chargin for systems services and computer operations. Systems development projects are "one-time" efforts; they are not "locked into" the computer system for a long period of time as are ongoing applications. Therefore all we need necessarily be concerned with is short-run incremental costs.

Lump Sum Negotiated Amount

The other approach to charging for systems services is to use a lump sum negotiated amount (or possibly even the lower of the negotiated amount and the actual costs incurred). The following comment is typical of several.

> The charge for development costs will be contractual based on negotiations between the user and MIS. Estimates of the development costs will be prepared by MIS and presented to the user for approval. Once the contractual price has been decided upon MIS must perform the systems and programming at this price; if there are favorable or unfavorable variances from this price they must be borne by MIS. [149, pp. 166-167]

Although this approach is heavily dependent upon the ability of the systems area personnel to accurately and impartially provide cost estimates to all users, it is probably perferable to charging on the basis of actual manhours spent on a project. Users will be more likely to undertake new system projects if they are assured of a maximum contractual price that they will be charged. Care must be taken so that the cost estimates provided to users will cover only the expected incremental costs of the proposed project. In other words, the systems area (as in computer operations) would not be expected to "recover" 100% of its costs by charging users.

Several comments which would apply to both approahces to charging in the systems development area are in order. First, "preliminary and economic feasibility studie are probably 'in the company interest' expenditures and not specifically chargeable. . . . The charges for systems development work should probably be based on work done once the project is formally approved." [142, p. 132] Second, there is the problem of projects (and resultant ongoing computer applications) undertaken for the benfit of two or more sponsoring departments. How should costs be allocated to these departments? The first step should be to trace as many costs as possible directly to the departments involved. One suggestion as to how to handle the remainder is to allocate it based on "the degree of involvement of each user. Thus a user who is expected to utilize sixty percent of the transaction volume of the project should carry sixty percent of the joint development costs." [149, p. 167]

If all else fails it is conceivable that the joint costs could be allocated to users on a benefits received basis. However, what constitutes benefits and how to measure such has long been discussed in the EDP literature. This approach is likely to result in a quite arbitrary allocation, but it may be the best possible under the circumstances.

Third, the further a firm gets involved in data-base oriented systems, the more certain projects will cut across many user areas. Sponsorship by a few areas would be unlikely because the benefits accrue to so many users. Thus the systems development area (and later the computer operations) should have allocations in their own budgets for projects that in the general corporate interests and for which the allocation of costs to users is not feasible or is extremely arbitrary.

Finally, regardless of the charging method for systems design there are likely to be problems over who should bear the costs of changes or improvements in the project after it has been approved. If the changes are requested by the user, the additional costs caused by the changes should be charged to him. If the changes are initiated by the systems area, it should probably bear the costs of such.

A similar problem is encountered in the computer operations area regarding the costs of rerunning jobs. Ideally, costs of reruns caused by users should be charged to them, while the costs of all other reruns should be absorbed by computer operations. [7, p. 81] However, in both of the above situations it is difficult to be equitable without being very costly. The costs of personnel time consumed in presenting such situations to some type of review committed or impartial individual probably exceed the costs of the changes or reruns in most situations. Anderson's suggestion that a general rule of thum be established, and that serious exception be handled individually is probably wise. Thus the systems area should bear the costs of all changes in systems projects unless they are exceptional in amount and caused directly by user request. Likewise, rerun costs should be absorbed by the computer operations area.

The factors used to evaluate case study firms in the area of a charging system for users are:

1. A charge to users is made for EDP resources used in the computer operations area.

    a. The charging system is based on standard full costs and practical capacity--thus no attempt is made to charge out <u>all</u> of computer operations costs.

    b. Charges are based on a detailed measurement of EDP resources consumed.

    c. Charging rates are not changed more often than once a year except in unusual circumstances.

    d. Consideration is given to priority pricing schemes.

2. A charge to users is made for systems design and programming services.

    a. A lump-sum amount is negotiated for larger jobs.

    b. No attempt made to charge out all systems design costs--e.g., no charges are made for preliminary and feasibility studies.

    c. Charges are made for user-initiated maintenance programming work.

    d. Satisfactory resolving of problems in charging multiple sponsors of large-scale, integrated systems.

3. A mechanism exists for resolving user complaints in both charging areas.

Chapter Summary

Although transfer pricing of EDP services has been widely discussed in the literature, there has been little effort to view it in the broader context of an EDP cost accounting system. In this chapter, a model cost accounting system for the EDP area was constructed. A set of assumptions was made about a hypothetical firm, and seven components of the model were outlined and discussed.

Ideally it would be desirable to implement the model in several randomly chosen firms, thereby making some of the more general ideas very situation specific and providing a sample form which to make some generalizations about the population. As discussed in chapter one, this approach is not feasible. Rather, in the following chapter the control system in several firms is examined and particular attention is paid to the existence or nonexistence (or degree of such) of the seven model components. Data from much larger surveys will also be utilized to provide a broader basis for generalizations.

CHAPTER IV

RESEARCH FINDINGS--CURRENT EDP COST CONTROL PRACTICES

Introduction

Very little data has been published on the methods and practices used to control the overall EDP area. The Churchill, *et al*. study [24] was primarily a survey of computer applications in various functional areas. Sollenberger's NAA study [142] was control oriented, but it dealt chiefly with the systems design and development area. Turney [149] had a great deal to say about faulty cost control practices in the EDP area, but his study was based on observations in only one firm. A published four way panel discussion on controlling EDP costs gives but a little insight into some of the approaches used by larger firms. [15]

Little empirical data is available on corporate transfer pricing practices in general. [81, p. 740; see also 8] Martin [102] examined two firms and in general found "inadequate" cost-based transfer prices. Larson [96] conducted "in-depth interviews" at eight firms and found most firms advocating market prices but using prices set by top management action ranging from cost to market-based. Arpan [8] has examined transfer pricing in multinational firms where custom duties, currency devaluations, and changing tax laws are important variables.

Knowledge of transfer pricing practices in the area of EDP services is also sketchy. Heitger [71, p. 84] found all the firms in his study to be using some form of transfer pricing for computer services. *A priori* standard full cost was the method he found most widely used. [71, p. 92] Turney stated that "few companies appear to utilize transfer pricing for their MIS services." [149, p. 68] He found most companies that did have a transfer pricing system to be using an ex post full cost charge. [149, pp. 139-140] McFarlan, et al. cite "several informal surveys" when they state that approximately one third of the EDP management control systems "are based on non-charge-out, one third are based on partial-charge-out, and one third are based on full-charge-out." [107, p. 473]

Thus, little is known about corporate EDP transfer pricing policies and about the underlying cost accounting system used to track and control EDP costs. This chapter is based on the EDP cost accounting systems of the six case study firms. The data is supplemented by the results of two much larger surveys by the GAO and the CASB. After an initial examination of the centralization/decentralization issue and other background information, the discussion will follow the outline of the seven components of the model described in the previous chapter.

Centralization vs. Decentralization of EDP Resources

Two of the case study firms were quite decentralized in their overall organization structure, and their EDP areas paralleled this pattern. Although there were "corporate data processing centers" or the equivalents in both firms, there was not the massive centralization of hardware and processing activities that has been occasionally predicted in the literature.

In firm C*, someone in the controller's office had begun a policy of centralizing computer hardware over 14 years ago. At first it was mostly

*Case study firms were promised anonymity and will be identified the letters A through F.

accounting and clerical type operations with a fair amount of EAM equipment also being used. Gradually it grew in size and in importance to the various operating divisions of the firm. Problems arose among the various users as to who should get first priority in systems projects and how computer job scheduling should be organized. The more vocal people--those complaining the loudest--usually got their way, at the deterioration of service to other, less vocal, users. Finally the corporation president grew tired of hearing V.P.'s scrapping among themselves about computer services, and he had the centralized center split up into several smaller centers, each under divisional control.

This sudden shift toward decentralization seems to have worked fairly well. Immediately after the split, the same amount of work was being handled by the now "decentralized" divisional data centers with no apparent increase in hardware or personnel. (The centers are "decentralized" only in a corporate sense. There is still considerable centralization of data processing activities within the divisions. Several divisions have two IBM 370-145's or larger systems at their divisional data centers. As some measure of the large size of this firm, there are roughly two hundred computer systems in use with nearly one fourth of these being IBM 360's or 370's.) In the seven years since that split-up occurred the company has stuck to a general policy of decentralizing computer services and placing them under line (operating) authority with some staff support and guidance.

There remain mixed feelings in the firm about whether a centralization policy could have worked. One manager believes that centralization would have worked if the centralized corporate D.P. center would have had a "higher quality" management in dealing with the disputing divisions about priorities. Another manager seemed to think that centralization would never have worked and that the divisional V.P.'s would have continued to gripe until their EDP services were directly under their control.

In any case, it seems in retrospect that there was not a tremendous amount of economies of scale attributable to the centralized center before the split-up. Although there is no longer a centralized corporate D.P. center serving all divisional users, certain activities are centralized at a Finance/Personnel data processing center. A rough breakdown of jobs is: personnel--20-25%; controller activities--20-25%; and treasurer/finance activities--50-60%. All hourly and salaried personnel of the corpoation are paid through this center and personnel records are kept here.

In firm A the situation is much the same. However, rather than attempting a course of centralization of resources (as in firm C), this company has long maintained a philosophy of EDP decentralization. There are currently 18 data centers which serve various marketing groups and production facilities. There is a large corporate data center at the company's headquarters which serves all users' needs in that locale. However, recently the marketing group was given the OK to establish their own data center near the company headquarters. The corporate data center people are somewhat chagrined but can do nothing. It again (as in firm C) seems to be the result of an intense desire by a functional area to control their own data processing activities, especially job scheduling. The reasoning goes somewhat along these lines: if we are "paying" (through intra-firm charges) for all these data processing activities, why not pay directly (but perhaps a little more) and have these under our direct control.

Another similar incident occurred in firm F. A certain division was allowed by top management to install an IBM System 32 for A/R work. The corporate computer center people "bent over backwards" trying to get the division's business on this application, even to the point of charging only 50% of its normal rates. However, because the division wanted line control of its own system it was allowed to purchase the System 32. Computer operations personnel felt that this was a terrible waste of manpower and hardware (not to say dollars and cents) because the corporate data center could easily handle the job.

Firm D is really a division of an extremely large company. This division was larger than several other of the case study firms. Its parent company allows and encourages very decentralized operations (at least at a divisional level) so that for most purposes the division could be considered a company in its own right.

In keeping with this corporate philosophy, the division has a very free hand in planning and operating its data processing activities. Most of these activities are centralized in one large divisional D.P. center. Thus while the parent company has a philosophy of decentralizing EDP operations (in keeping with its operating philosophy), these may be, in fact, highly centralized at the divisional level.

The other three firms had a policy of centralizing EDP operations. All three had a high level corporate data processing center. There was some usage of smaller hardware configurations (e.g., IBM System 3's) at branch offices, but often these were used for RJE (remote job entry) purposes.

In analyzing the centralization/decentralization issue in terms of computer hardware the author noticed one interesting fact. At major data processing centers throughout all firms there were usually two large capacity systems, often the same model. None of the companies visited had more than two large scale systems in the same data center (although occasionally some older and smaller hardware models were still around). A configuration that turned up quite often was that of two IBM 370-158's. Also found were two Burrough's B 6700's, two IBM 370-145's and two 370-135's.

In firm C there had apparently been considerably more than two large capacity systems in the corporate data center before the turn toward decentralization of hardware took place. However, several years after the split-up there were no more than two large systems at any divisional data center. Even the smaller firms with centralization policies had no more than two large configurations in their corporate data centers.

Although no conclusive evidence can be given showing why this particular phenomenon was encountered so often, several plausible reasons can be advanced. First, although economies of scale are possible by advancing to larger and larger hardware configurations, there is really no large savings to be made by aggregating many of these large configurations in a single data processing center. This is particularly true when the desires of various users to control their own D.P. activities are considered. Second, the use of two large systems in a single D.P. center is much "safer" than a single extremely large system, although the latter might be less costly in terms of hardware and personnel. If one system "goes down" it does not completely interrupt the operations of the data center, and the more critical applications may continue to be processed. Finally, operators and other personnel can more easily work with either system if both are identical.

In summary, it was found that the massive centralization of hardware and personnel predicted in the literature did not exist. True, the medium to medium large size firms did have highly centralized data processing facilities. Yet, the extremely large firms did not centralize EDP operations at the corporate level, but more typically at the divisional level if at all. It is difficult to say whether this decentralization was caused by (1) the sheer size and geographic dispersion of these firms and their division, (2) their stronger emphasis on decentralization in their operating philosophy, or (3) a combination of these factors.

Level of Cost Collection and Aggregation

In this section two of the ways in which firms classified EDP costs are examined--(1) by descriptive element and (2) by project. A third way in which costs may be classified--by organizational unit--is the subject of the following section.

The chart of accounts for the EDP area varied little between firms. The various sets of accounts covering the computer operations area were quite similar to the example given by Albrecht. [3, p. 302] A typical list from case study firm F is presented below:

Salaries
Salaries--Premium Pay
Salaries--Overtime
Fringe Benefits
Supplies
Office Service Expense
Supplies--Postage
Repairs and Improvements
Repairs--Outside Maintenance Contract
Professional Services--Software Expense
Training Expense
Equipment Rental
Equipment Rental--Property Taxes
Travel
Telephone, Telegraph & Teletype
Telephone--WATS Expense
Depreciation--Equipment

Materials Loss
License Expense
Miscellaneous
Intra-divisional Work
Corporate Information Systems
Computer Systems Research
    Total Direct Expenses
Net Prorates
Work Order Credit
Net Adjustments to Prior Years Expense
    Total Operating Expenses

Usually, the chart of accounts for the systems design area varied slightly in that there was no need to detail equipment rental and depreciation expenses. There was, however, generally provision made for charging the systems area with its share of computer operations charges. (The reverse was also typically true. Notice the "Corporate Information Systems" account in the previous example.) The following is an example set of a chart of accounts for the systems area in firm A:

Salaries
Other Salaries and Wages--Indirect
Departmental Supplies
Printing Material
Telephone--Local
Telegraph & Long Distance Telephone
Purchased Supplies
Entertainment
Travel Expense--Indirect
Purchased Services
Company Paid Tuition
Recruiting Expense
Association & Membership Dues
Other Technical and Education Expense
Periodical Subscriptions--Technical Publications
Other Expense
Other Redistributed Expense
Data Processing Expense
Graphic Arts and Reproducing

Several comments may be made about the accounts used to collect and classify EDP costs. (1) Often the classifications had evolved through time, and there was little apparent effort made to structure the classifications to the needs of EDP managers. In several firms the observation was made that this was essentially the same set of accounts used throughout the company in other divisions and departments. Surely the EDP area differs enough from other activities of a firm to deserve planning and forethought in regards to the set of accounts used to control its operations.

(2) In reviewing Albrecht's example cost report [3, p. 302] it was mentioned earlier (see pp. 61-62) that some of his accounts detail seemingly trivial information while two accounts--salaries and equipment--carry nearly 95% of his total costs without being further subdivided. The degree to which this was true varied between firms. In firms E and F all salaries in the computer operations area were lumped together in a single account. In firm B salaries in the operations area were further divided as follows:

Administrative and Supervisory Personnel
Employees Engaged in Processing, Control, & Scheduling
Employees Engaged in Operations Analysis
Employees Engaged in Data Entry Operations

However this same firm had only two hardware-related accounts:

Computer Equipment Rentals, Maintenance, and Extra Shift Charges
Data Entry Equipment Rentals

This was 100% more than several other firms where a single account was used. A typical title was Rent--Machinery and Miscellaneous. Most firms had a separate account for computer software purchased although this was sometimes included in a general supplies account.

(3) It appeared that an increasing portion of the overall EDP dollar was going toward personnel costs. In the case study firms this percentage varied between 50% and 60%. Approximately 30% to 40% of the EDP dollar was spent on equipment and equipment maintenance. The remainder went for supplies, occupancy, and miscellaneous expenses.

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These percentages were very much in line with those reported by others. [For example, see 149, p. 79] In the systems development area approximately 80% to 90% of the costs incurred were personnel costs. A large share of the remainder was intra-firm D.P. charges due to the testing and installation of new applications. With this high percentage of personnel costs it would seem that a single Salaries and Wages account for the systems area would not be sufficient to adequately control these costs. However, all case study firms further subdivided this account in the following ways. (1) All case study firms utilized a project reporting system which related personnel costs to specific projects. (2) The firms further subdivided the systems area so that salaries and other costs in specific subgroups could be identified.

In all firms the project reporting system was held to be <u>the</u> key tool in the control of systems design costs. Generally two types of costs were accumulated for each project--personnel costs and computer run charges. Two of the firms that did not charge users for systems development effort seemed to have better than average project reporting systems. Since systems services were essentially a free good in these firms, it is possible that a more complete project reporting system was needed to control costs in this area.

The high degree of dependence on project reporting to control systems development costs is supported by GAO data. This study found that 21 out of 22 commercial firms visited employed a time or cost accounting and reporting system for systems development activities. Two thirds of these associated dollar costs with personnel usage. Seventeen firms included charges for computer hardware and peripheral equipment usage in their project reporting system. Only five included charges for supporting services such as keypunching. Thus personnel hours and costs and direct computer charges appear to be the main elements of project progress reports.

(4) Several case study firms made no effort to capture and report occupancy costs as a data processing cost in either the systems or computer operations area. In the GAO study only 12 out of 22 firms accumulated facitilies rental as a specific D.P. cost, and only 14 of 22 did so with utility costs.

Although all case study firms accumulated and classified certain supplies (tapes, "floppy" discs, computer paper, etc.) as a data processing cost apparently this is not a standard operating procedure for all firms. Over one third of the commercial organizations visited in the GAO study (8 out of 22) did <u>not</u> accumulate these costs as "data processing expenses." It is not clear exactly how they were handled, but evidently they were included in some type of general corporate supplies expense account.

Although occupancy, utilities, supplies, and other overhead costs are not very "material" when considered separately and compared against personnel and hardware costs, these smaller costs may exceed 12% of total EDP costs. [149, p. 110] A breakdown for one firm as a percentage of total EDP costs is as follows: supplies--4.9%; occupancy--3.9%; overhead--3.9%. [149, p. 110] A firm attempting to aggregate "total EDP costs for the firm" for either year-to-year comparative purposes or as a percentage of sales to compare with industry averages would risk inappropriate comparisons unless these types of costs were included in its totals.

Responsibility and Cost Centers

All case study firms used some type of responsibility accounting system. Not only did all firms split EDP costs up by at least two functional areas--computer operations and systems design--but all firms used additional functional classifications (e.g., data entry activities, telecommunications, etc.) and/or further subdivided their responsibility centers into subgroups (cost centers).

As an example, a partial organization chart from firm A is presented in Figure 4-1. Firm B was visited shortly after a reorganization of the EDP area. Figure 4-2 is the organization chart before the change, and Figure 4-3 is after the change. The changes made in this firm seem indicative of the trend in several firms--subdivision of large groups in the EDP area, i.e., greater numbers of smaller groups or subgroups.

The responsibility accounting systems used directly paralleled the formal organization charts. For example, in firm A (see Figure 4-1), the Director of Resource Management Systems--Marketing received a monthly cost report summarizing costs for his "division" in addition to four cost reports for each of the departments under his control. Each of the department managers received the cost report covering his area. The Director of Corporate Management Systems received a cost report for each of the four "divisions" under his control (the same report as received at the "division" director's level) in addition to receiving a summary report of all costs under his control.

In none of the firms was there any indication of a desire to turn to a "profit center" or "investment center" orientation rather than a responsibility center structure. In all firms the EDP area was considered a service activity, not a profit-oriented group.

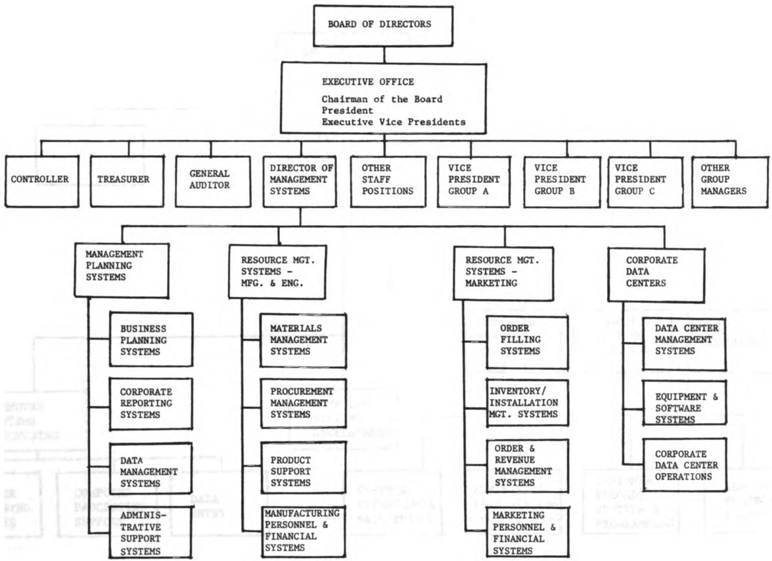

Figure 4-1. EDP organization chart--firm A.

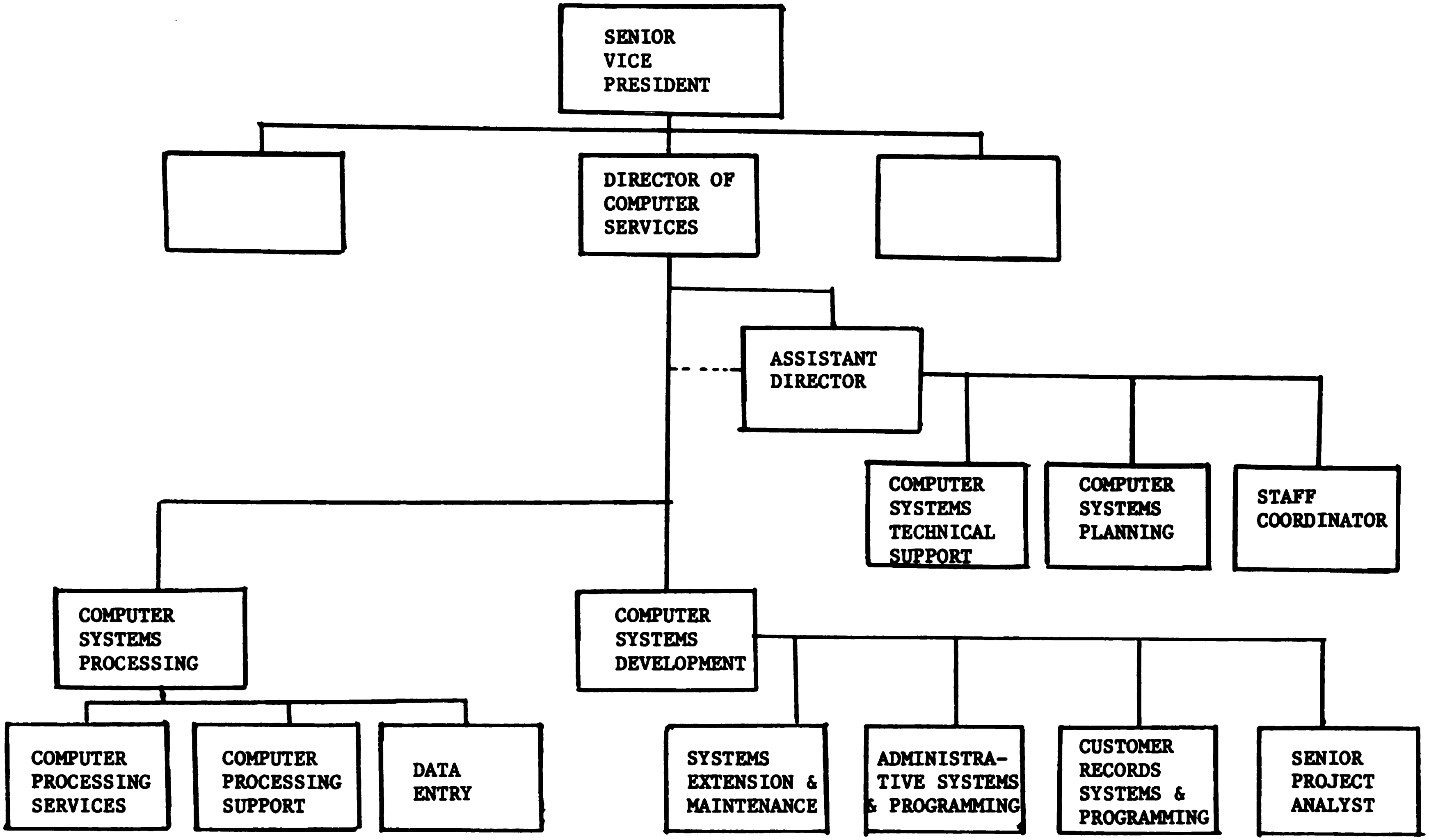

Figure 4-2. EDP organization chart--firm B before change.

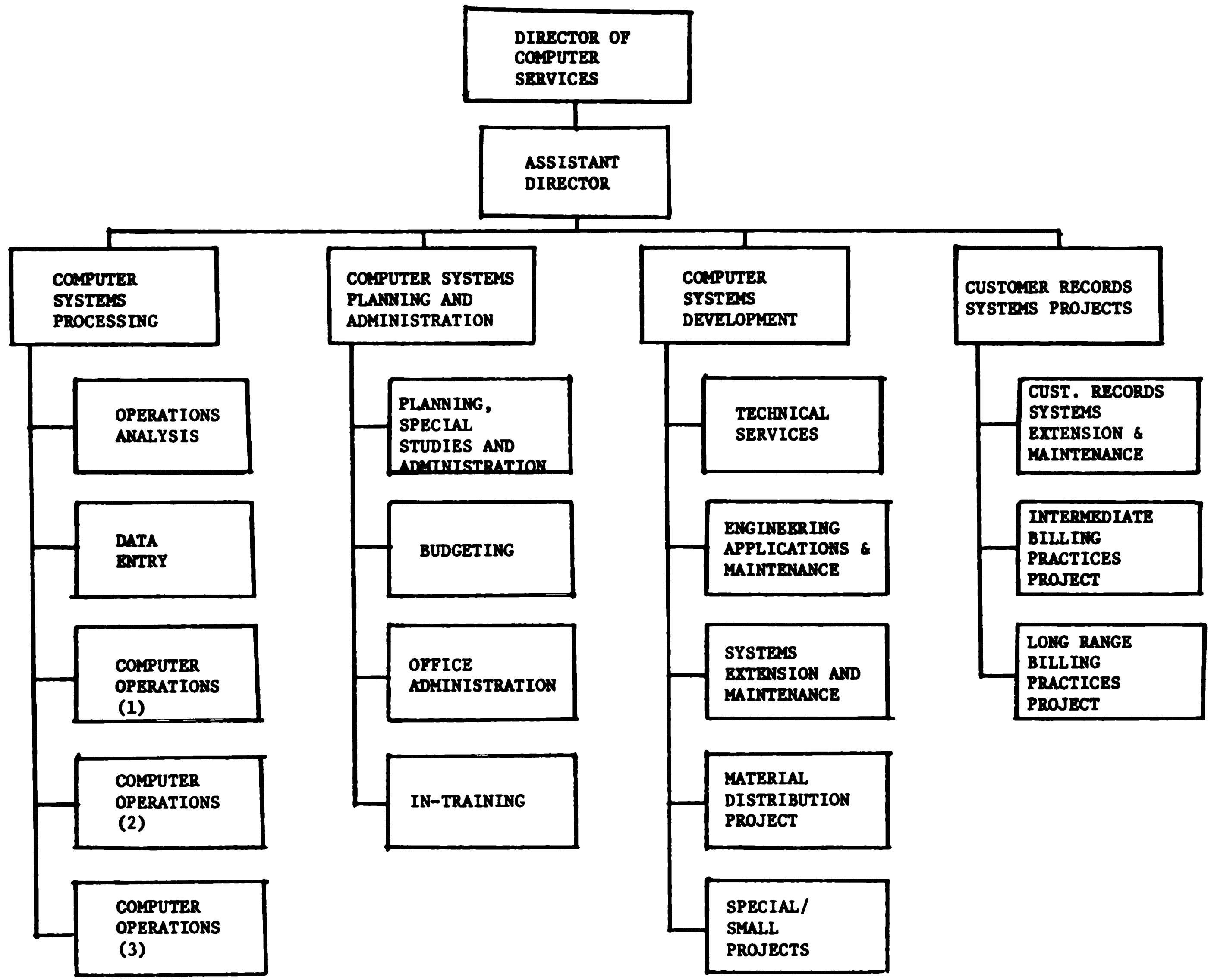

Figure 4-3. EDP organization chart--firm B after change.

The GAO study indicates that a great majority of commercial organizations use various types of cost centers or "cost pools" to collect and summarize EDP costs. Although the following categories are not mutually exclusive, they represent the GAO's breakdown of the 22 commercial firms visited in that study.

Types of cost pools used:

Work functions	13
Organizational units	3
Major projects or programs	-
Individual products or service	1
Other	4
Firms not using any form of cost centers/cost pools	1
	22

The breakdown is somewhat confusing. For example, organizational units (number two above) may be organized on the basis of work functions (number one above) and may be in essence the same breakdown of cost centers.

Controllable/Noncontrollable Costs

In a good responsibility accounting system a manager is held accountable only for those costs over which he can exercise some degree of control. Some of the difficulties of determining controllable and noncontrollable costs were discussed in the previous chapter. Although in the case study firms attempts were made to include only controllable costs in department managers' reports, this effort was more successful in the systems design area than in the computer operations area.

Most expenses included in the systems design area cost reports can be considered direct and therefore controllable expenses to that area and its manager. In the example on pages 103-104 the final group of three expenses may be considered "assignable" costs. It was suggested in the previous chapter that "assignable costs have controllable elements in them, particularly when based on resource usage." [See page 70.] All three of these assignable costs in the example were based on resource usage and were considered controllable costs. Thus in terms of the direct/assignable/prorated classification the costs included in the example on pages 103-104 are all controllable by the area manager. This was the typical pattern in the case study firms. If the managed/committed/variable classification is applied to the systems design area the picture is not as clear. First, variable costs in this area are negligible in the short run. Second, a breakdown between "managed" and "committed" costs in difficult and very situation specific. For example, a high level corporate committee decision may have committed the firm to the design and installation of certain systems with at least an implied commitment of a certain group of analysts and programmers. The costs relating to the other analysts and programmers may be considered managed costs and could conceivably vary from one budget period to another. The difficulty lies in separating "committed" and "managed" costs. There is also the fact that the area manager will be held responsible for the productivity of the analysts and programmers whose salaries constitue "committed" costs. Problems such as these are probably very key reasons why project reporting systems were found to be much more widely used and valued as control tools in the systems design area than the monthly department cost reports, although the latter were also found in every case study firm.

In the computer operations area most costs fell into the "direct" category of the direct/assignable/prorated classification. Two firms subtotaled the direct expenses before including certain miscellaneous and prorated expenses. Titles used were "Total Direct Expenses" and

"Total Controllable Expenses." Items following these subtotals included "net prorates," work order credits," and "net adjustments to prior years expenses."

As mentioned in the previous chapter (page 70) it is difficult to imagine that all the direct costs of the computer operations area can be directly controlled by the manager of that area. Some costs--such as long run lease commitments for hardware and certain operator costs--are committed costs resulting from past decisions. Other costs--e.g., short run lease changes in the number of peripherals leased from independent suppliers--are probably managed costs.

Determining which costs are or are not committed costs is difficult. However, one thing is claer. Managers of computer operations areas are entrusted with a very expensive and important set of resources, and they should be held responsible for the efficient and effective use of the resources under their control. This will generally entail an ongoing comparison of costs with outputs or results. The measuring of outputs will be discussed later in this chapter. Suffice it to say at this point that the monthly cost reports appeared to be of considerable more importance in the evaluation of computer operations than of the systems design area. This is probably true because of certain dissimilarities between the two areas, i.e., the computer operations area is considerably more "manufacturing" or "production" oriented than the systems design area.

One further point was made by those interviewed in the case study firms. To a large degree the costs of both computer operations and systems design are dependent on the needs and demands of the users of these areas. The computer operations area in the short run may serve as an example. If suddenly users submit a new rash of applications or

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very high transaction volumes for existing applications, it is possible that costs in this area will rise (e.g., operator overtime, excess shift rental charges) unless there is considerable slack or unused capacity in current operations. This again points out the fact that the monthly cost reports produced by a responsibility accounting system are not sufficient for the evaluation of performance in the EDP area. The underlying causes of the cost variations must be understood. Output data must be available to compare with costs on an ongoing basis.

Budgeting and Reporting System

All case study firms prepared annual budgets in the EDP area by responsibility centers. This was done in all firms as part of an overall annual corporate budgeting procedure. All firms used "participative budgeting," at least in theory. Department managers "set" (or suggested) their own budgets but often encountered difficulties in getting them approved. Cases were cited where approved budgets went all the way to a top-ranking administrative committee only to have company-wide cuts made. The budgets then filtered back down the organization structure until adequate cuts were made at the department level.

One case study firm used flexible budgeting procedures in preparing the monthly budget reports. Therefore, at the time of setting the annual budget for the coming year, costs had to be broken into fixed and variable components. Both the director of the EDP area and the manager of computer operations in this firm thought that flexible budgeting was an inappropriate technique to use in the EDP area where most of the costs were completly fixed in the short run. However they were both learning to "play the game." They had discovered that if they classified more types

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of costs or a greater percentage of a certain cost in the "variable" category (regardless of its "true" nature), they would be more apt to have a favorable budget variance. For example, in the 1975 budget they classified 10% of computer operators salaries as a "variable" cost. This percentage was being raised to 60% for the 1976 budget, regardless of the fact that they considered these costs to be fixed in nature. Their increases in the costs classified as variable were based on the assumption that volume would continue to increase in the future as it had in the past.

Flexible budgeting is a valuable control technique in situations where a sizeable portion of the costs incurred in a given cost center vary directly with some measure of volume. However, the above example illustrates the extent to which the technique can be misused if applied to an area which has predominately fixed costs and steadily rising volume. CASB data confirms that few firms (only 29 out of 393--or 7%) attempt to separate fixed and variable costs in the EDP area.

On page 117 is a flowchart of the budgeting process supplied by firm D. The term "index" or index budget" refers to the index volume budget, a flexible budget based on the most likely volume levels. The term "standard budget" refers to the standard volume budget, a flexible budget based on the actual volume levels incurred. The budget is prepared several months before the new budget year begins. Thus the term "1975 outlook (7 + 5 months)" refers to the seven months of actual 1975 data and 5 months of projected data which are available at the time fo the 1976 budget preparation.

Note that under the "consolidation" heading, total D.P. costs are summarized by "D.P. Burden Center." This is not the same as the set of

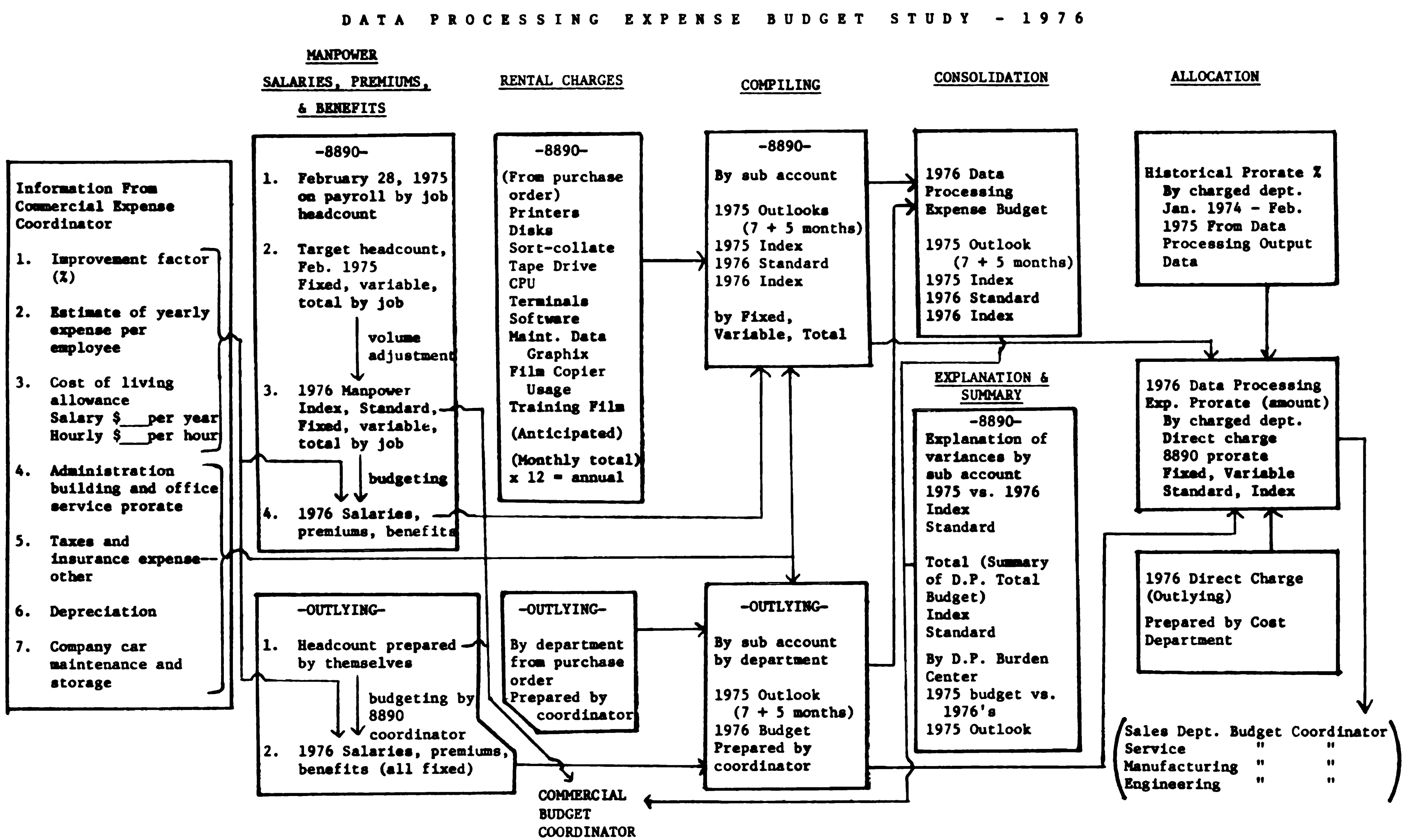

Figure 4-4. Flowchart of the budgeting process--firm D.

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responsibility centers being used, but is rather a group of cost centers used to accumulate costs annually to aid in the setting of rates used in the charging algorithm. Further discussion of these cost centers and the way rates are determined is deferred to a later section of this chapter. Notice however, in the flowchart under the allocation heading, that the breakdown of 1976 D.P. expense by departments is not based directly on their expected usage and planned chargeout rates, but rather on the historical prorate percentage of the past 13 months.

The budgeting in user departments of D.P. expenses charged to these departments was viewed by at least three case study firms as a very important step in the control of EDP costs. Personnel in these firms felt that it was much easier to control EDP costs by reducing (or holding stable) user demand for EDP services. This was done by careful monitoring and control of EDP costs in the user departments' budgets. This approach was deemed a considerable improvement over attempts to control EDP costs merely through that area's budget without regard to the possibilities of increasing demand for services by users. Control of EDP costs through users' budgets is possible only where some type of chargeout or transfer pricing machanism is present.

There was little variation in the format of monthly reports making cost/budget comparisons. At least five columns of numbers were generally present: (1) current month actual, (2) current month budget, (3) current month variance, (4) annual budget, and (5) year-to-date. In several firms there was a column for the previous (actual) year-to-date figures. Often, a budgeted and actual departmental head count was included in the monthly reports.

The degree to which the budgetary constraints were enforced seemed highly dependent on whether the EDP group in question was a corporate staff group or was under divisional (or line) control. Across firms it was observed that EDP groups under line control and authority had to "live within their budgets" to a greater degree then did staff organizations. Although staff groups were expected to meet their budget, there was no constant pressure from a divisional controller (with an eye to his division's "bottom line") to keep costs exactly in line. In at least two firms, there were direct remarks made that there was a more lenient policy toward cost overruns in the staff D.P. center and systems group than in similar groups under line authority.

In all EDP areas, whether they were line or staff, there was considerable flexibility regarding the composition of costs as long as the total was within the budgeted amount. Several managers commented that if their costs exceeded budget estimates in some areas they could often reduce or postpone costs in other areas. Thus, even in line organizations, the budget was not a tool to force rigid conformity to a prescribed plan, but rather a means of seeing that total costs were controlled.

In only one firm did the D.P. personnel think that top management had been "niggardly" (their term) regarding budgetary support of the EDP area. This was probably due in part to the deteriorating financial condition of this firm in the late 1960's, but D.P. personnel felt that management had been "niggardly" on top of that. This condition was somewhat alleviated when this firm was acquired as a subsidiary of a larger firm in 1971. Conditions have steadily "improved" and currently the firm budgets nearly 6% of sales for EDP costs (the highest percentage among the case study firms).

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Most companies had no provision for revising the annual budget in midyear. Those that did have such a provision actually used it only in extraordinary circumstances. It was usually done because of organizational changes, and typically consisted of redistributing the budget to the changed organizational units. One other circumstance that might give rise to a budget revision was the top-level approval of a new systems design project that entailed additional commitments of personnel and hardware. However, on the whole, upward budget revisions were uncommon in all firms.

The GAO study provided little information on the budgeting and reporting procedures of the 22 commercial firms that were visited. The following outline summarizes its findings in this area.

Commercial installation

- a. Cost used as a control measure.
- b. Periodic reporting of actual cost compared to budgets.
- c. The degree of detail included in the reports varies with the management levels of the users.
    1. Very detailed reports are generated for local managers of data processing installations and slightly less detailed reports are generated for users or requestors of the services provided.
    2. Lesser degree of detail is provided to accounting personnel.
    3. Broad summary type reports are being generated for use by top management.
- d. Top management is frequently active during planning and budgeting stages for projects.

Output or Activity Measurement

The discussion of output or resource measurements will be divided into two areas—computer operations (including data preparation) and systems design and programming.

Computer Operations

In the computer operations area there was a relatively high degree of similarity in what resources were tracked. Five of the six case study firms used an IBM system software package called System Management Facility (SMF). SMF is designed to provide, among other things, very detailed measurements of computer resources used (e.g., CPU time and core, tape, and disc usage). The most obvious use of SMF data is for individual job costing and accounting systems. However, the usefulness of SMF data does not end there. Currach and Morino [35] suggest the following breakdown for further uses of SMF data:

1. Workload analysis and classification
2. Trend analysis of resource utilization
3. Standards establishment and enforcement
4. Identification of resource wastage
5. Detection of exceptional conditions
6. Other factors affecting system performance

Although some firms made use of SMF data for other than job costing and charging purposes, there appeared to be much room for improvements, particularly in light of the Currah and Morino paper. Firm C, which made better use of such data than most, required that utilization data from all computers used in the company be provided to the Management Services Office (MSO), a high-level staff group which included the systems area. In all the large-scale configurations in the firm this data was provided by the SMF package in use. Computers with low or declining utilization were subject to close scrutiny and possible removal.

However, another group which had access to this data and probably made more effective use of it was a five-man group of EDP audit specialists located in the Internal Auditing area. The head of the EDP audit group had recently stopped an expansion project for a certain D.P. center which had already reached the president's desk. Based partly on utilization data, a decision was finally made not only to stop the expansion, but to "reverse" the center to an RJE installation. (Evidently the data center manager had been "empire building," to use the auditor's words.)

Although the capabilities of the SMF package seemed to be underused, they may be put to better use in the future. For example, in firm E measurements of computer usage were based on wall clock time starting in 1971 (before that, usage was evidently not tracked at all). However in 1975 this firm began to implement RAS (Resource Accounting System). Initially this is a job costing procedure relying heavily on SMF data. However, it is expected that greater use will be made of SMF data along the lines suggested by Currah and Morino as the system is developed further.

The firm having the Burroughs 6700's also used a resource utilization package similar in purpose to IBM's SMF. This firm was also beginning to make wider use of this package and was planning on following up its Resource Utilization System with a Data Center Information Reporting System. Extensive daily and monthly reports were already in use at the corporate data center and were being implemented throughout the firm's other data centers.

Because the resource accounting systems in use were such an integral part of the charging algorithms used, further discussion of specific resources tracked will be delayed to that section of this chapter. In summary it may be said that SMF and similar type data were not fully utilized in the management, control, and planning of data center operations, although several firms were beginning to make much greater use of this data.

All case study firms used some type of work measurement system to report on personnel productivity in the data entry area. Usually this as measured in terms of strokes perhour, cost per line (a standard number of strokes), or a similar measurement. Firm E had recently implemented a Data Entry Statistical System (DESS) as part of its overall Resource Accounting System. DESS accounted for all data entry (chiefly keypunch) activity. Among the reports generated were daily summaries by operator and by job. The daily report on an operator's activities had the following column headings;

Job
Description
Operator (name and number printed only on the 1st and total lines of the report)
Strokes*
Hours* (in hundreths)
Strokes/Hour
Cost/Hour (a constant)
Cost*
Cards*
Operator Errors*

The statistics for each job worked on during a day occupied a separate line on the report. The starred columns were totaled and an average number of strokes per hour for the day was computed. Nonproductive time periods, such as idle time and lunch and breaks were added to productive hours for a grand total hours worked.

As was expected, there was considerable variance in performance, even between different jobs punched by the same operator in one day. Strokes per hour (by jobs) ranged from a low of 2,400 on a very small jobs to 18,431 on larger jobs. Small jobs probably required as much set up time as larger jobs and therefore resulted in lower averages. Also, some jobs are inherently more difficult to punch and can be expected to take greater amounts of time.

Another daily report provided by DESS was the "Keypunch Statistical Analysis Report by Job. Column headings included:

Job
Description
Operator
Strokes
Hours
Strokes/Hour
Cost/Hour
Cost
Cards
Standard Rate

Thus the data for a given job was broken down by operators that punched that job and then totals and averages were summarized. Although DESS was in operation in Firm E, it had not been fully tied in with the charging system, but plans had been made to do so.

One thing that was expected, but was not found, was specific standards for data entry personnel. Rather than setting specific goals, the case study firms monitored output individually and compared it with that of one's co-workers. Evidently the knowledge that they were being monitored and the ability to check on their own progress was enough motivation to increase or maintain performance in this important area.

Systems Design and Programming

Monthly cost reports, by themselves, are of little use in controlling and managing the systems design and programming area. Since most costs in these areas are fixed personnel costs, there is little fluctuation in amounts from month to month. More important is the attempt to measure and quantify human productivity and progress made on the projects under way.

Thus, all case study firms had detailed project reporting systems. Although these differed in detail, there were many points in common.

All had some type of time recording system as a basic input into the project reporting system. All had similar objectives:

1. To allow management, both within and without the EDP area, and systems personnel to observe and evaluate the progress made on the various projects under way.

2. To build a data base of historical data in order to improve time and cost estimation on future projects.

Three of the case study firms charged for systems work and a fourth used a memo billing procedure. For these firms the project reporting system had a third objective:

3. To provide input data into the charging algorithm, resulting in charges to users of systems services.

The one report common to all case study firms was the project status report. Called by different titles in different firms, this report was generally issued weekly. In its simpler forms this report was concerned chiefly with manhours, not dollar costs. For example, the report used in firm D contained the following information on each project:

Request #
Job Code
Project Name
Requesting Group (or Department)
Requested by (individual's name)
Programmer (Analyst)
Actual Hours (itemized by programmers)
Estimated Total Hours
Total Actual Hours
Percentage Complete
Date Received
Last Activity (date)
Estimated Completion Date

In more elaborate reports, there was a breakdown of analysts; time, a recording of computer charges by projects, and a reporting of total dollar costs. In firm A the following items were reported on a monthly summary report:

System Name and Number
Year-to-date Distribution of Analyst Time (in man-months)
    Functional Analysis
    Technical Design and Specifications
    Programming
    Documentation
    Supervision
    Training
    Other
Year-to-date Man Months
    Total
    Budgeted
Year-to-date Computer Charges
    Total
    Budgeted
Total Year-to-date Annual Budget
Total Year-to-date Actual Costs (includes computer charges and analysts salaries)

Usually at least one other report was generated--a breakdown of analyst/ programmer efforts by individuals rather than by projects. Thus it was possible to tell which projects an individual was working with, and what types (and amounts) of work he had recently done on those projects.

Most managers were enthusiastic about their project reporting systems as a control device, but occasionally some trouble spots appeared. For example, Firm D let the analysts involved with a specifc project estimate the percentage of completion. (Who should know better than they?) Therefore, in the early stages of many projects, the percentage of completion seemed to correlated nicely with the ratio of actual hours to estimated hours. But when the percentage of completion neared the 90-99% level, the number of actual hours used continued to rise with very little change in the completion percentage. More than one project was noted on this firm's project status report that was supposedly 99% complete and already the actual hours worked were more than 350% of the original time estimates. Doubtless, the projects were less than 99% complete because the revised estimated completion dates were still some time in the future.

The evaluation of analyst output and performance was a very subjective task because of varying degress of project difficulty and analyst experience. Even the EDP audit specialists in firm C did not pretend to quantitatively evaluate human outputs. Rather, they relied upon direct observation of the analysts at work.

The GAO summary of resource accounting systems was quite vague and inconclusive. The following definition was used:

> A resource accounting system tracks, accumulates, aggregates, and reports the use of data processing resources in terms of physical consumption measures, such as staff time in terms of hours or years, computer accounting units, etc.

Using this definition, the GAO study found that there were 12 out of 22 commercial installatins visited which used resource accounting systems as a tool for managing and controlling data processing activities.*

Other conclusions included:

a. Output from these systems is also being used as a basis for applying costs to systems development projects and on-going jobs.

b. Output from resource accounting systems was considered an excellent tool for internal management and control at the data processing installations visited.

c. However, personnel at these installations still consider "dollar costs" as the most common, understandable expression for managing and controlling data processing resources.

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*This number (12) seems to be inconsistent with other GAO data. For example, it was found that 20 out of 22 firms made users aware of EDP costs incurred for their benefit, either through cost assignment or memo billing. It would seem that an elementary resource accounting system would be the basis for even the most simple billing algorithm. Therefore it is difficult to understand why only "12 out of 22" firms used resource accounting systems. Perhpas the people interviewed were unfamiliar with GAO terminology.

Long-range Planning

Perhaps no other facet of control was subject to such wide variations between firms as was that of long-range planning for the EDP area. Because of this wide divergence of views and practices, the six case study firms will be discussed individually.

Firm A had perhaps the most comprehensive and unified long-range plans. First, the overall goals and strategies of the corporation were laid out for a five year period and then translated into the outline of a corporate five-year plan. Then operating and staff groups, including the corporate EDP systems group, analyzed the plans in terms of the support required from their group. The EDP area makes hardware and manpower projections and converts these to dollar terms for the five year period. Under consideration was the lengthening of the time frame to ten years. Approval of a five year plan does not commit funds to a particular group. For example, approval of a particular hardware increase or improvement in the five-year plan does not necessarily mean that it will be approved in future operating or capital expenditures budgets. In this particular firm, personnel increases in the EDP area were becoming more and more difficult to get approved (both in the five-year plan and in operating budgets).

All hardware acquisitions and planned system projects had to be justified on a cost/benefit basis excluding intangible benefits. Personnel there claimed a 30% ROI (return on investment) on hardware expenditures, but this was on an *a priori* basis. As in the other case study firms there was little post-implementation examination or audit of hardware or personnel expenditures to see if the claimed benefits (real or intangible) had ever been realized.

The EDP area in firm B was the only one which had a specific group in charge of planning--entitled Computer Systems Planning and Administration. This group was responsible for budgeting, planning, sepcial studies, and "Office Administration" for the EDP activities in the firm. A long-range corporate plan had last been done in 1973 with the EDP area basing its expectations and plans on corporate goals and strategies. For some reason, (possibly the drastic and continuing changes in the corporate environment during this period which probably invalidated most of the long-range work) further corporate long-range plans were not prepared. The EDP area was hit with cost reduction pressures and "insufficient manpower." Besides, it was explained that it would have particularly difficult (add: and probably useless) to attempt a long-range EDP plan without an overall corporate plan. Thus the "planning office" is left with only short-run budgeting and planning functions despite its desire to be more future oriented.

Firm C was the organization which had initially attempted to centralize its EDP facilities, only to reverse it course of action. (See pages 98-99.) Before the split-up of the centralized data center there had been a unified five year plan for the EDP area in terms of manpower, hardware, and dollar costs. For some reason, this practice was discontinued after the data center was divided and the smaller groups put under line authority.

Long-range planning was done in two ways: (1) a Project Budget Request (PBR) and (2) Program Approval. The PBR* was something like a

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*Note: Do not confuse a PBR with a typical user request for systems work. One recent PBR in this firm was the result of six months of collaboration between the corporate staff systems group and a divisional data center. It requested an optical scanning system with an annual cost of $500,000 and expected annual benefits of $1,500,000.

capital expenditure request but encompassed much more and included projected manpower requirements and costs. Very high level approval was required. For PBR's in the EDP area, the data processing personnel would prepare most of the required estimates, but a corporate profit analysis group drafted the final written project request. Projects had to be justified on the basis of tangible benefits, but intangible factors were included in the project request and supposedly considered. ROI was used as a major criterion for acceptance although the cutoff return was not given. There was no way of accurately measuring the resultant benefits after a project was implemented and no attempt was made to do so. Follow-up procedures overall appeared quite weak. Once a project made the approval/disapproval hurdle, it was usually free sailing.

The second long-run planning device, the "Program Approval," was not an authorization to expend funds but rather approval of a course of action. It encompassed a longer time span than a PBR and was considerably broader in scope. It required the highest level of approval--the administrative committee. In such a document, manpower and hardware projections were made for as far as six years into the future. Updates were made as often as quarterly.

A major problem with this means of long-range planning is that it seemed to start with what the EDP personnel want or think they need in the future, and then is examined to find if this fits in with overall corporate goals and strategies. It would seem that corporate goals should come first, and then EDP personnel should determine how they can help reach those goals. Despite the use of these two means of long-range planning, the company's own internal EDP auditor declared that "the absence of solid long-range plans in the data processing area is one of this firms's greatest failures." (The comment is probably too harsh on firm C, particularly in light of the quality fo the long-range planning done in firm D.)

The directors of the overall EDP area for firm D at first said that no long-range planning was done, but then backed down from that position a bit. What plans do exist seem to be very informal (even to the point of existing only in the back of the manager's mind!). Since all equipment was leased, the EDP area felt no need for separate budgets for operations and capital expenditures. Evidently additional hardware rental charges were approved only through the annual budgeting procedure. There seemed to be little effort made to analyze users' long-range requirements and coordinate these in any formal long-run EDP planning.

In firm E the corporate five-year plan consisted of a series of pro forma income statements and supporting schedules. It was soon to be expanded to include pro forma balance sheets. The main types of projections made by the EDP area were manpower and hardware estimates. These were translated into dollar figures and "other costs" were added to the hardware costs so that total EDP costs in the five-year plan were broken down into two groups--personnel and other. The plan was updated annually. Users' long-run requirements were not specifically estimated or coordinated and provided little input into the EDP projections.

Firm F had a corporate five-year plan in which the EDP area participated. In addition to the two usual types of projections--hardware and personnel--a third area was considered--space or occupancy needs. These three were translated into dollar mounts for planning purposes. Plans were updated annually. There was some effort made to coordinate users' requirements in these plans, especially if major new systems were to be implemented during the period.

Firm F purchased tape drives and disc packs and leased CPU's, but the two groups were handled differently. Since all hardware purchases had to be projected and properly approved via a capital expenditures budget, the tape drives and disc pack units were included there. Long-run lease commitments, and thus the CPU's, were included in the operating budget, but were supposedly looked at and reviewed in the same manner as capital expenditures.

The GAO study reported very little in the area of long-range planning.

Tracking Users' EDP-related Costs

The case study firms varied widely in their ideas about and approaches to tracking users' EDP-related costs. Two firms (A and E) did not attempt to even summarize total data processing costs incurred in the firm, much less determine users' EDP-related costs. In firm E the stated reason for the unconcern in this area was that all hardware acquisitions within the firm had to be approved by the MIS manager. Thus users' could not acquire hardware (likewise presumeably incur personnel and other costs) without his knowledge.

In firm A part of the reason for unconcern in this area was probably the difficulty of collecting these types of costs because of the widespread use of data processing equipment throughout the firm. However, firm A needed to know user-related EDP costs as much or more than the other case study firms. An example of such a need had occurred within the last several years. The corporate data center, in an effort to discourage card input, had gradually reduced the number of keypunch operators at the center from 30 to 3. Users were forced to do their own keypunching or find some other means of data entry. However, there was no way to track the users' EDP-related costs, and thus it is not known how much these increased after the cutbacks in keypunch operators.

The remaining four case study firms at least attempted to prepare an annual report on total corporate data processing costs, and included varying degrees of users' EDP-related costs. The most common types of costs included were "dedicated" hardware costs and related personnel costs within user areas. Next came the costs of liason or coordinator-type personnel who, although not located within the data centers or systems groups, nevertheless spent most of their time on data processing type activities. Firm D was probably the most careful in this respect. It went to great lengths to estimated the percentage of an individual's time spent on data processing related tasks, and charged that percentage of his salary as a data processing expense to be included in the annual summary of such. Personnel in the firm considered this annual summary to be a very accurate report, and it probably was by comparison with the other firms' efforts. However, one factor that made the going easier in firm D was its high degree of centralization. Only 20% of its EDP costs were incurred outside of the centralized corporate data center. By comparison, firm F which had a centralized corporate data center incurred 52% of its total EDP costs outside of this center. And this did not include the salaries of individuals whose time was split between the EDP and some other area.

The GAO study reported little information in this area.

Charging System for Users

Although all case study firms had some type of charging mechanism for computer operations, there was considerable variation in the procedures and methods used. Firms also differed widely in their approach to systems and programming costs.

Firm A

Firm A operated 18 decentralized data centers throughout the country. Prior to 1975 each center had had considerable leeway in determining its own charging policies and algorithms. However, in 1975 the corporate systems group began issuing a series of releases giving charging policy guidelines to data center managers. The guidelines were based on policies used at the corporate data center and were a fairly complete documentation of how rates were set at that installation. The author was fortunate enough to obtain a copy of the first and most important release of over 500 pages which had just been printed and collated on the day of his visit to this firm. This was by far the best documentation of charging procedures, goals, and algorithms that any case study firm had or at least made available to the author. Because of the large amount of material covered in this document only the highlights will be touched upon in this chapter. The reader is referred to Appendix A for further interesting and important extracts from this document.

One of the most important statements made in the document was that regarding billing algorithm goals.

> The billing algorithm of an accounting system should meet several goals:
>
> a. Accuracy - Usage data gathered should indeed represent the true amount of a resource consumed by a user task.

b. Repeatability - The charges for a given user task run at different times in different mix environments should be identical $\pm$ a small acceptable tolerance.

c. Flexibility - A number of resources should be monitored for usage and charged to the user task. A given installation charges for those items it has determined are significant. However, since the computer operations environment varies from site to site, a flexible billing formula is necessary. The items of charge may change dynamically.

d. Simplicity - Although flexibility is important in order to insure a user is charged for those resources used, simplicity must temper the tendency to create a complex billing charge function containing too many terms for the user to be able to comprehend or to respond.

e. Linearity - A linear billing charge function meets the goal of simplicity while allowing recomputation of charge by providing for the capability of accumulating units used and than later extending these by a constant rate.

f. Reflection of true cost - It can be shown that when charges to users reflect the true cost of resources used, the system configuration will tend to be modified (excluding non-economic political considerations) to achieve an economic optimality. In other words, the system will reach maximum cost efficiency because users will (given a choice) buy resources which cost the least to the user. Since the resources chosen really are the cheapest, the system is optimized - each subsystem unit is justified or removed as not cost effective.

g. Modification of User Behavior - This goal is a corollary to (f). Demand should be stimulated for resources which are most cost effective. This stimulation is carried out by a favorable pricing structure to those resources which have low value either by virtue of low cost to the data center or by the resource's oversupply (due to a relatively permanently imposed improper configuration).

Most of these goals can be found in the EDP literature. Several of these directly parallel the list of "attributes of a charging technique" made by one firm in Sollenberger's NAA study. [142, pp. 133-134] However, a goal such as "flexibility" is tailored to this firm's particular needs--the variations in environment and users from data center to data center.

Some goals are obviously conflicting--such as "accuracy" and "simplicity"--so we are forewarned that there will probably be tradeoffs in each area.

The list of billable items and charging algorithm are presented in Figure 4-5 on page 137. The charging scheme appears quite complex at first glance, yet several EDP personnel in the corporate systems group were adamant that most users were quite sophisticated in interpreting and responding to the charging scheme. The following example of a user modifying his behavior in response to computer charges was cited (although it is doubtful whether it proves he was a "sophisticated" user).

The user requested a production planning report which was run monthly and used tremendous amounts of I/O. It was costing him around $1,500 a month in charges for this report alone or $18,000 annually. So the user went to the corporate systems area and in effect said: I need the report, but it has to be done cheaper than this. He asked for something in the range of $100 a month. The systems area revised some of the routines and made the peripherals controlling the disc packs more efficient. The result: the user did get "virtually" the same report for a monthly cost of around $100 or $1,200 annually.

Despite the detailed charging algorithm for computer operations and the detailed documentation in this area, there is no charge for the services of the corporate systems group. Thus users are quite willing to use its "free" services as cited in the above example. Systems development costs are considered part of corporate overhead and are included in the proration of that total figure.

Further documentation of firm A's activities is presented in Appendix A and includes:

1. Overview of related subsystems and their functions.

Billable Items:

Task related -
1. Processor time
2. I/O time
3. Cards read
4. Cards punched
5. Lines Printed
6. Code Core
7. Data Core
8. Connect time
9. Queue premium
10. Shift premium
11. Tape mounts
12. Tape open time

Miscellaneous -
1. Inhouse keypunch
2. Vendor keypunch
3. Tape library (can be used for pack library)
4. Offline
5. Clerical
6. Xerox
7. Miscellaneous items

The billing formula for tasks is:

$$\text{task charge} = \left[\sum_{i=1}^{n} (\text{units used of } i)\ (\text{rate for } i)\right] \times \left[1 + \sum_{j=1}^{m} \text{premium } j\right]$$

where:
n = number of billable items
m = number of premiums (discounts)
rate for i = some constant (perhaps 0)
premium j = a function surcharge (+) or discount (-)

Figure 4-5. Billable items and charging algorithm--firm A.

2. Output reports generated.

3. Explanation and rationale of billable items.

4. Overview of policies and procedures.

Firm B

Firm B had a long history of data processing experience and initiated a charging scheme in 1964 for its IBM 360. At first charges were based on wall clock time, but with the advent of multi-programming there was an attempt to have a more detilaed algorithm including CPU time and I/O. However, because of wide fluctuations of costs from the latter algorithm on different runs of the same application, users were billed for the lower of this method or wall lock time.

There were other problems. Computer operations changed rates quarterly in an attempt to make chargeout "revenues" equal department costs. Thus none of the users understood how they were being charged, much less how to react in an economic and rational manner to the fluctuating rates.

With the installation of two IBM 370/158's in 1973 the firm began to use the SMF package for resource measurement and inputs into the charging algorithm. Rates were set annually instead of quarterly. Charges were much more "repeatable" in varying mix environments. The schedule on page 139 shows the billable items and comparative rates for 1974 and 1975. The reduction of rates in 1975 on a number of items was attributed to "reduction in both the amount and cost of the equipment along with a comparable reduction in the number of personnel required to operate the equipment." Rates were set on the basis of usable (practical) capacity of the equipment, not on the basis of expected usage. Thus all computer operation costs were not charged out and the overall

1974-1975 COMPUTER RESOURCE CHARGING COMPARISON

Resource Center	Unit of Measure	1974 Rates per Unit	1975 Rates per Unit
158-158 CPU	CPU Second	.04557	.03902
Core Storage	K-Byte Hours	.07448	.01552*
Magnetic Tapes	Tape Drive Hours	11.15	6.28**
Disk Storage - Dedicated	Disk Spindle per Month	1055.00	1135.00
Disk Storage - Nondedicated	Disk Track - Hours	.00279	.00183***
Printers	Lines Printed	.0006	.00052
Card I/O	Cards Read or Punched	.00062	.00048
Data Entry	Elapsed Hour	7.45	7.45
Remote Job Entry	Lines Printed	.00075	.00052
360/30 Emulation	Elapsed Hours for Old Rates Only	31.50	Same as Other Jobs
7074 Emulation	Cost per Run	1973 Avg. Cost	1973 Avg. Cost
Microfilm - Original	Original Fiche Produced	1.50	1.50
Microfilm - Duplicate	Duplicates Produced	.08	.08

The following items will be charged directly to the applicable using departments on the basis of costs incurred.

--Optical Scanner
--Time-Sharing
--Telecommunications
--[code name] Data Link
--Custom Forms
--Dedicated Keypunches

* A K-Byte hour represents occupancy of 1000 bytes of core storage for one hours of elapsed time.

** A tape drive hour represents the occupancy of one tape drive for one hour of elapsed time.

*** A disk track hour represents the occupancy of one disk track for one hour of elapsed time.

Figure 4-6. Comparative charging rates--firm B.

D.P. area absorbed the remainder which became, in effect, part of corporate overhead. At least users were not charged for capacity costs. Users were required to use the published rates for the upcoming year to determine their dollar budget for EDP costs. Thus a fairly high degree of user sophistication was expected and assumed.

A short study had been made of the desireability of incentive charging rates, i.e., a priority pricing scheme. The study is reproduced in Appendix B. It is interesting to follow the reasoning in the study, particularly in the main reason given for rejecting the priority pricing scheme--that user rates might be forced to fluctuate and operating costs would probably not be reduced. Both ideas have some validity. The users' bad experience with fluctuating rates prior to 1973 had no doubt left them dubious of any system where rates might change more often than once a year. And no doubt operating costs would probably not be significantly reduced; however, an effective priority pricing system might smooth user demand and <u>postpone</u> possible increases in hardware and personnel. It should be noted that not all EDP personnel were in favor of scrapping the priority pricing plan. The Director of Computer Systems Planning and Administration believed that such an idea was feasible and would eventually be implemented.

In a way, it was a sort of back-handed compliment to the EDP users in this firm to have a priority pricing system rejected because of fear of being swamped by nighttime, low-priority jobs to be run at the cheaper rates. The implication was clear that EDP personnel believed most users to be quite sophisticated and responsive to changes in the charging algorithm. Whether this was in fact true was debatable. One reason it could be questioned was the fact that interdepartmental EDP charges apparently did not have a separate account in a user's chart of accounts. They were lumped with other interdepartmental charges or even included under "Miscelleneous--Business Expenses." EDP personnel felt strongly that a separate account should be used for their charges in users' cost reports, and this change was probably to be made in the next budget period.

Firm B used a memo billing procedure for program maintenance and systems design work done for users. The Director of Computer Systems Planning and Administration felt that these items would eventually be formally charged out and included in users' monthly cost reports.

Firm C

Firm C had a large number of computer systems located throughout its various divisions. A corporate staff group collected various utilization measures on hardware used throughout the firm. However, there was no company-wide policy requiring the divisional data centers to charge users although they were encouraged to do so. Charging practices varied from no charging scheme to full chargeout of all computer operations and systems costs. The policies of two data centers at opposite ends of this spectrum will be examined.

The Finance/Personnel Data Center is an example of a large installation in firm C that did not charge users. Two IBM 370-145's were in use in batch mode. Approximately 100 people were employed at the center, with almost 50% of these in data entry (CRT to disc). Three staff groups are the sole users of this data center--the personnel office, the controller's office, and the treasurer's office. One of the main reasons that users were not charged was that the jobs run at this center were not discretionary (e.g., empoyees must be paid) and the user groups were not particularly interested in knowing the cost of the jobs. In fact, the users could not really control the length of jobs such as payroll which was a function of how many employees the company currently had. There were no charges for systems design and programming efforts, because again much of this was nondiscretionary and of a maintenance programming nature.

The data center that has "the most sophisticated charging system" is located in the Sales and Marketing Division. Two IBM 370-158's were in use. The billable items and related rates are given in Figure 4-7 on page 143. However, the schedule is misleading regarding the way the billing operation really works. The rates are used to estimated the total charges for a year for a given user based on his prior year's usage of these resources. This total amount is then split into twelve "monthly assessments" which are charged as lump sum costs to the user. These assessments remain constant for the year unless there is a "material change in the number and size of applications run for that user". Thus there is no direct relationship between the resources consumed in a monthly period and the charge for that period. Users are not charged on a resources used basis but rather on an average anticipated resources usage basis. If "material changes" in a user's ongoing applications and systems work occur during a year then the given rates are used to calculate the gross charge billings for the excessive unanticipated usage.

No prime time charge is used. There had been some experimentation with the idea several years back, but it had been deemed too costly to administer. It is difficult to imagine how a priority pricing scheme

1975 CROSS CHARGE & ESTIMATING RATES

Systems			$ 20.00 Hr.
Programming			18.00 Hr.
Data Entry			8.00 Hr.
E. A. M.			15.00 Hr.
370: Core	(CPU hours x average K-Bytes)	x	$ 1.50 Unit
Tape	(Tape EXCP's/15,000)	x	8.50 Unit
Disk	(Disk EXCP's/15,000)	x	8.00 Unit
Peripheral	(Periph EXCP's/15,000)	x	10.00 Unit

1975 PERMANENT DISK STORAGE CHARGES

	Per Byte (1)	Per Track (13,020	Per Cyl. (247,570)	Per Pack (100,018,280)
Month (1)	.00000769¢	.09902¢	$1.881	$760.14
Day (30)	.00000025¢	.00330¢	.062	25.34
Hour (720)	.00000001¢	.00013¢	.002	1.06

Figure 4-7. Billable items and charging rates--firm C.

would fit into a charging system using lump sum charges. Thus users "pay" for prime time work by experiencing a longer turnaround during this time.

The rates quoted for systems and programming services were somewhat of an anomaly. Most of this type of work was done on program maintenance and was not directly charged to users. Rather these systems charges were included in the fixed "monthly assessment." However, new systems development work was billed to users at the quoted rates if it was "material." Specific criteria for "materiality" were not given.

Not everyone in the firm was pleased with the charging system. The head of the internal EDP audit team made the statement that the company "really doesn't have a chrging system." He, along with others, believed that users should be charged on a resources used basis for both computer operations and systems work.

Firm D

Firm D had a policy that the EDP area must be a "disappearing cost center" and chargeout 100% of its costs. Rates were developed annually for various billable items, and these estimated rates were used during the month. Appendix C presents portions of a recent study done within firm D listing the billable items and documenting how the "estimated rates" are developed. A schematic of the charging or allocation process is presented.

At the end of each month there was a "spreadback" of the difference between costs charged out and actual costs. This "spreadback" was based on the percentage of EDP costs intially charged to a users. Thus, using a very simplistic example, if there were only two users and user A and B had estimated charges of \$150 and \$50 respectively, and actual EDP costs were $240, the "spreadback" procedure would allocate an additional $30 to A and $10 to B.

This procedure was in effect a very precise form of allocating actual costs. It was not a transfer pricing system be cause of the uncertainty of the actual amounts charged to users, even if their exact resource usage was known in advance. Although the "estimated rates" were set for annual periods, the "spreadback" procedure created actual rates that varied from month to month.

Other drawbacks to this sytem included the following:

1. Budgeting on the part of users was made more difficult because of variations in the effective rates.

2. A user's charge was affected by what other users did or did not do.

3. Users were charged capacity costs which they were not responsible for.

In defense of the EDP personnel at the firm, it should be noted that it was not their idea that the EDP area should be a disappearing cost center. This was a requirement passed down by top management, and they were forced to live within this constraint. The detailed measurement of selected resources (as described in Appendix C) is certainly better than the two earlier chargeout methods that preceded the method currently in use.

Prior to 1971 Firm D based computer charges on CPU hours. In that year the basis was changed to core hours in an effort to be more accurate and equitable. No attempt was made to charge for peripherals on a use basis. The reasons given at that time were:

1. It would be too expensive to accumulate the data and use it for charging purposes.

2. Users should feel that the peripheral equipment is for everyone's use and not just for one job.

Evidently the costs to accumulate such data dropped over the next several years and the latter, somewhat nonsensical, argument disappeared. The current charging system as outlined in Appendix C does charge for certain peripherals on a use basis.

Evidently there was a strong user reaction when the change was made to a detailed charging algorithm. Some on-line users' charges jumped by approximately 500%. This was reduced somewhat after "adjusting" the algorithm, but these types of charges were still much higher than before. Interstingly enough, despite the protests, no one cut back in their demand for services.

The Director of Data Processing felt that if a lump-sum, fixed charge were made to all users or no hcarge at all, that there would be a substantial increase in requests for services. On the other hand, he felt that if the rates were raised to include a profit figure, 95% of the jobs would remain because users feel they are so essential.

Firm D was the only firm that could state even a rough dollar figure as the cost of their charging system--$20,000. It was felt that the benefits derived from the system very much outweighed the costs. The GAO study found nine commercial firms that could give a rough range for the annual costs of their charging system. The following categories were used and results were obtained: "minimal annual costs"--three firms; $50,000-100,000--one firm; $100,000-$200,000--five firms. Thus firm D was probably in the low end of the "minimal" category.

Firm D made excellent use of its charging system as an indirect cost conrol tool. EDP costs in users' budgets were closely scrutinized and controlled. This forced users to have only their most important applications run and lessened or controlled demand for EDP services. Thus, without a continuous flood of new applications and constant demands for new systems work, cost within the EDP area were more easily controlled.

Firm E

Firm E was particularly interesting because it was in the process of developing and implementing a charging system base on detailed resource usage. Most of the system was to be operational by and in use during 1976.

Prior to 1971 there was no apparent attempt to allocate data processing costs directly to users. Such costs were lumped in with other corporate overhead costs and allocated on the easiest basis--sales. In 1971 the firm began to make assessments of computer operations costs at the divisonal (not the departmental) level based solely on wall clock time. Charges were made for systems development projects and the EDP area attempted to be a disappearing cost center.

A new Resource Accounting System (RAS) was being developed and implemented over 1975-1976. The following points were given as reasons to undertake such a project and are taken from a presentation made to users:

Why have RAS?

1. MIS resources are expensive.
2. Without RAS, we had no way to determine what systems development costs were or what on-going systems operating costs were.
3. Charging provides an economic basis for resource allocation if resources are limited.
4. Cost benefit analysis can be done by the user; otherwise, only MIS can evaluated the economic feasiblity of proposed systems.
5. User has a "stake" in the efficiency of systems and the services provided by MIS.

6. Users will be "self-governing" in their utilization of MIS resources if the resources are not free.

Statement six was often stated or implied by personnel in other firms, but was not documented elsewhere in such a straightforward manner. The direct implication of the statement is that if MIS resources are free, users cannot be self-governing (presumeably because of their high demand for such resources), and therefore some priority system must be used. This could take the form of a user group or committee, a high-level executive, a top management committee, or an EDP manager or committee. However, the fact that charges are made for MIS resources does not mean that users are completely "self-governing," particularly in the systems design area. Projects must still be approved at some level. In most firms the requisite level of approval increased as the estimated costs of the project increased.

Prior to the development of RAS in firm E, project approval had to be given by the manager of systems development, the director of MIS, and the manager of the user division. It was not clear if this policy was to be continued after the introduction of RAS, but if so, it would definitely put some limitations on the "self-governing" aspects of MIS resource utilization.

The requirements for which RAS was designed to fulfill were given as:

1. Need to know what resources are being consumed and in what quantity.
2. Need to know who consumer are and the quantity of consumption.
3. Need to identify what the consumption is for.
4. Need to cross-charge users based upon consumption.
5. Need to be able to determine what the return on data processing expenditures is.

The ability of RAS to meet the last requirement is quite dubious. There was no provision made for measuring benefits resulting from the various ongoing applications. How the firm was going to attempt to measure "return on data processing expenditures" using only cost data was not made clear. As discussed in Chapter Three (see page 80) there are several reasons why a ROI in the EDP area is difficult if not impossible to calculate.

Although the specific charging algorith for ongoing computer applications was not yet avilable, it was based on the following factors:

1. Central processor utilization factors.
2. Peripheral device utilizaton factors.
3. Memory utilization factors.
4. Operator intervention factors.
5. Supplies factors.
6. System degradation factors.
7. Geographic factors.

The term "geographic factors" was not explained, but apparently had something to do with RJE and time-sharing jobs. Personnel costs were loaded onto the various resource centers for rate determination, but occupancy costs were not included. The systems personnel in charge of RAS had foresight enough to sense potential conflicts with users, and one of the current objectives was to "fine tune" the RAS sub-systems to provide equitable charges. Users were to be sent invoices for a several month period (for information only) before the forma charging system affecting budgetary accounts was to begin.

Firm F

Firm F made the initial move toward centralized corporate computer facilities in 1965. At that time D.P. costs were "pro-rated" out to users; there was no charge for individual jobs. In 1968 the firm began charging on the basis of CPU time and continued this method until 1973 when, using the SMF package, they changed to a resources used basis--CPU, disc, tape, card reader and printer, and RJE.

Initially they also charged for core storage. However, these charges for on-line users took a large jump and fluctuated wildly from run to run. This was attributed to the variable partitioning of core, and when it could not be solved in a reasonable manner, "core usage" was dropped from the charging algorithm.

The following were given as reasons for their confidence in and use of a charging scheme:

1. It reduces the role the systems personnel must play in priority setting. [Notice, however, that this role is <u>not</u> eliminated.]
2. It encourages cost-benefit analysis at the user level.
3. It reduces the requests for services.
4. It gives a basis for the acquisition of new resources.

The stated philosophy at firm F is that the charging system should be based on an efficient shop basis rather than on an expected level of operations basis. In other words, users should not be charged for capacity costs.

However, the actual practices used did not follow the stated philosophy. Around 1971 the firm charged back about 85% of computer operations budget to users. By 1975 this percentage had gradually risen to 90% and the goals was 100% for 1976. The reason that costs were not fully charged out between 1971 and 1975 was <u>not</u> that rates were based on practical capacity; but that rates for the coming year were based on the previous year's actual cost and usage figures. Because costs were rising, actual costs were never fully charged out. For 1976, however, the rates were being based on projected cost estimates for the year (not actual 1975 figures) and on estimated usage for the year (not actual usage in 1975). The stated goal was to arrive at equitable rates which would charge ou 100% of computer operations costs for the year. This is <u>not</u> charging on the basis of practical capacity.

The company was planning on giving premium/discount rates a try. A number of users have RJE's and many jobs are remote batch jobs that are run during prime time--the day shift--when on-line, timesharing users are the heaviest. In an effort to shift some jobs from prime time to evening, runs during the second shift will be charged only 80% of "normal" rates. There are a few users who have jobs so important that they have been given a priority coding (which they can use at their option) to be "next-job-in." There will be a 15-20% premium above normal rates on all jobs using this option. The premium/discount rates are not based on any cost factors; they are merly an attempt to spread demand more evenly.

The general feeling in the EDP area is that that the average user's level of EDP sophistication is quite low when it comes to understanding the "hows," "whys," and "whats" of the amounts he is charged. The current method was chosen because it was "more equitable" than its predecessor; but the users cannot appreciate what that means, nor do they generally have the ability to respond to changes in the relative pricing of resources--e.g., a decrease in the cost of disc storage relative to tape.

Marketing (which was the single largest user) had annual charges for computer operations alone of around $300,000 annually, yet the division seemed to care very little about how it was charged and seldom had any questions. Accounting and finance, on the other hand, incurred annual charges for computer operations of around $20,000, but they went through the charges with a "fine tooth comb" and were continually asking questions.

It is interesting to compare the firm's willingness to use a premium/discount rate structure vis-a-vis the sophistication of its users. Firm F used a premium/discount plan hoping that it would persuade a few users to switchto second shift runs. Other case study firms, such as firm B, (which viewed their users as more sophisticated) shied away from such a plan, fearing that large numbers of users would request second shift runs at the discounted rates.

Three other "work centers" in the EDP area besides computer applications were charged to users--data entry, data coordinators, and systems design. Each work center had included in its budget all direct costs and a pro-rated share of (1) managerial costs (costs of EDP management), (2) occupancy costs, and (3) corporate overhead.

The data entry "work center" charged users only for jobs requiring eight hours or more per month to prepare. Small jobs were not charged. This approach recovered about 75% of the center's costs.

Data coordinators were a functional group whose main responsibilities lay in file maintenance and liason work. If a member of this group dealt almost exclusively with one user, then his "cost" was charged directly to that user. If an employee's time was split, then his time was identified with individual users when possible. About 75% of the costs in this work center were "recovered" through user charges.

Systems design personnel charge out their time whenever it can be specifically identified with a given user. A rate was determined individually as follows:

$$\frac{\text{Total annual costs per man (including prorated costs)}}{252 \times 8 \times 70\%} = \text{hourly rate}$$

The 252 is the expected days of work during the year, and eight is the hours in a work shift. Seventy percent was the estimate of time actually available for user oriented work after educational programs, staff meetings, coffee breaks, etc. were deducted. This procedure charges about 65-70% of systems design costs to users.

One of the problems mentioned at this and other case study firms was the problem caused by the charging system when a very large integrated system was under consideration. It became difficult to measure or even estimate the total benefits accruing to each segment of the firm. Usually the accounting department was called in to set up a percentage of costs to be allocated to the resepctive user departments. Often this allocation was quite arbitrary. As such, it was hard to get all benificiaries to "sign" for a share of the total cost. In some cases, if all the users were not willing to accept their share of costs, justification and approval of the new system was difficult or impossible.

All firms had this problem in some form when the new system became operable and charges for computer usage were made to the various users. However, firms that did not charge users for systems development costs, at least partially avoided this problem at the design stage.

Support from GAO and CASB Findings

All case study firms visited charged at least some users for computer operations, and all but one of the algorithms were based on a resources used basis (one firm used the information but mainly as an input into the next year's charges). Both GAO and CASB studies indicate that the majority of business firms charge users for computer services. The two studies were structured along different lines, and hence their findings were summarized differently.

Table 4-1. GAO and CASB findings--firms charging users.

	Number	%
GAO data:		
Cost Assignment--Always	18	81
Cost Assignment--Sometimes	1	5
Memo Billing	1	5
Users Not Made Aware of Costs	2	9
	22	100
CASB data:		
Users Charged a Composite Rate	31	8
Users Charged Specific Rates	243	61
Other	2	1
Users Not Charged	117	30
	393	100

The GAO study found a considerably higher percentage of firms that charged users than did the CASB survey. The explanation for this difference--and for further differences in the results of the studies--lies chiefly in the manner in which firms were selected for the two studies. Of those in the GAO study, most were chosen for their prowess (or reputation of such) in the EDP area. Neither study attempted to define a specific population, randomly sample it, and generalize the results to the population. However, the CASB study was a more representative selection of firms, chosen from a wide spectrum of industries and services.

Both studies attempted to classify charging and noncharging firms by the size of their D.P. budget as shown in Table 4-2 on page 155. The GAO data are somewhat inconclusive. However, there is a distinct pattern in the CASB statistics. About three fourths of all firms in the survey having EDP service centers costing $2 million or more annually use specific rates (detailed resource usage) to charge users. In the categories below $2 million, the percentage of firms using specific rates decreases markedly. However, even in the lower two categories

Table 4-2. GAO and CASB findings--D.P. budget vs. charging practices

GAO data:

	Data Processing Budget					
	$1-9 mil		$10-24 mil		$25-50 mil	
Assigns Costs	No.	%	No.	%	No.	%
Always	10	91	3	50	5	100
Never	1	9	2	33		
Sometimes	--	--	1	17		
	11	100	6	100	5	100

CASB data:

	Cost Related to EDP Service Center											
	Less Than $ .1 mil		$.1-.5 mil		$.5-2 mil		$2-5 mil		$5-10 mil		Over $10 mil	
Method	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Users Not Charged	6	46	26	50	41	36	22	21	12	22	8	19
Composite Rate	4	31	8	15	8	7	6	5	2	4	3	7
Specific Rates	3	23	18	35	66	57	78	74	40	74	32	74
	13	100	52	100	115	100	106	100	55	100	43	100

approximately half the firms used some type of charging scheme. Although Turney's ("few companies") and Heitger's ("most firms") comments mentioned on pages 97-98 regarding the use of transfer pricing in the EDP area were made in 1972, Heitger's conclusion rings most true today. One reason for the prevalent use of charging systems may be found in Gibson and Nolan's stage hypothesis. [58] Over the last several years many firms have no doubt passed from stages one and two to stages three and four--where control mechanisms such as charging systems begin to be used.

Both GAO and CASB studies listed various consideratons in the approach used in charging users. The GAO data consists of two parts, the first being oriented more to the objectives of charging users and the second to the rationale or criteria used in designing a specific algorithm.

Table 4-3. GAO findings--objectives of and criteria used in designing charging systems

GAO data: Objectives in charging users

	Frequency
Make users more cost conscious	18
Improve D.P. management control over cost	16
Reduce user demand for services	8
Assist D.P. management in controlling service demands	5

(firms could indicate more than one objective)

GAO data: Criteria for charging scheme

Most equitable	18
Consistent	11
Understandable	10
Simple and easy to administer	9
Acceptable	5
Relevant	4
Legal	1
Other	3

The difference between the last two factors in the first set of data is not clearly distinguishable, yet only one firm in the study marked both. Likewise, some of the criteria--e.g., "acceptable" and "relevant"--in the second set of data seem too vague to have any operating interpretability.

Although the CASB entitled their summarized results "Considerations in the Approach Used in Charging Users," their data are more a statement of what is being done, not why. There are some apparent discrepancies in the Casb data presented in Table 4-4 on page 157. 325 firms supported the third statement, yet only 274 firms in the study supposedly charged users. (See page 154.)

The GAO summary of the charging methods being used is presented in Table 4-5 on page 157. The difference between standard full cost and standard operating cost was not identified. Possibly the former contains prorated costs, such as occupancy costs, whereas the latter does not. There is some reason to doubt the stated results when they are

Table 4-4. CASB findings--considerations in charging users

CASB data:

	Frequency
Charges are made on the basis of data that are easily gathered	147
Charges are made on the basis of method(s) and data that are easily understood by users	130
Charges are made on the basis of specific hardware components employed in processing each job	325
Charges are made in a consistent manner such that a user can recognize that the charge to him/her reflects his/her own use of data processing resources and does not reflect a fluctuation in the rate(s), volume of activity within the EDP service center, job mix, and the like	211
Charges are made, where components are substitutable, on the basis of a schedule that would influence users' choice of components (which, in turn, would promote balance in resource utilization in the EDP service center)	65
Charges are made, where resource utilization fluctuates between excess and inadequate capacity within a short time period, on the basis of a schedule that would influence users' timing of job submission (which, in turn, would promote evenness in resource utilization in the EDP service center)	60
Other	21

Table 4-5. GAO findings--charging methods used

GAO data:

Methods used	No.	%
Standard Full Cost	9	42
Standard Marginal Cost	5	26
Standard Operating Cost	3	16
Actual Full Cost	2	11
	19	100

Table 4-6. GAO findings--types of cost accounting systems used

GAO data:

Type of cost accounting system	No.	%
Job Order	10	46
Standard Cost	4	18
Process	2	9
Installations Not Using Cost Accounting System	6	27
	22	100

compared with other GAO data. The GAO study asked the firms to identify the type of cost accounting system used. The results obtained are presented in Table 4-6 on page 157. Seventeen firms in Table 4-5 reported using standard cost charging methods,yet only four firms in Table 4-6 reported having "standard cost" cost accounting systems. The types of cost accounting systems used in the GAO questionnaires and finds were defined in either place. "Standard" or "actual" costs may be used in conjunction with either job order or process cost accounting systems--the two groups are not mutually exclusive. It is difficult to imagine how a true process cost accounting system could be used in the EDP area except possibly in connection with a project reporting system for the systems design area. Finally, the stated result that six firms or twenty-seven percent of the total were not using any type of cost accounting system seems most dubious. How could 19 of the 22 firms regularly charge users for services without having some type of cost accounting system?

The finding in Table 4-5 regarding the use of standard marginal cost seems questionable, particularly in light of CASB findings, if it is really a true marginal cost being used. There is some reason to believe that firms using "standard marginal cost" charging methods excluded only hardware/software costs, but included relatively fixed personnel costs. If both were excluded, in a true marginal cost situation, the remaining variable costs would be so small as to be hardly worth the time and effort to charge users. It is doubtful that the objectives given on page 156 would be reached. Even Turney [149] did not suggest that only marginal costs be charged to users. The CASB study did find that some firms did not include either hardware or software costs in their charging rates, but these firms were very few.

Table 4-7. CASB findings--inclusion of hardware/software costs in charging rates

	No.	%
Rate includes equipment rental or depreciation	40	10
Rates includes equipment rental or depreciation and systems software rental or amortization	223	57
Rate includes neither	13	3
Firms not charging users	117	30
	393	100

One one of the case study firms did not use standard cost rates. This was firm D which allocated the undistributed costs to users at the end of each month on the basis of their previous charges for the month. The other five firms left the undistributed amount in EDP overhead.

The usuable responses from the GAO and CASB findings regarding the disposition of variances are presented below. In a way the CASB analysis is somewhat confusing and vague because the first three alternatives are virtually the same. However, if the third alternative

Table 4-8. GAO & CASB findings--disposition of variances

GAO data:

	No.	%
Left undistributed	7	41
Used to adjust rates	0	0
Allocated to users	6	35
Some combination of the three	4	24
	17	100

CASB data:

Transferred to EDP service center overhead	117	46
Transferred to general corporate overhead	28	11
Transferred to income statement	67	26
Carried forward as adjustment to rates of subsequent period	44	17
	256	100

means transferred or allocated to the income statements (or cost reports) of users, then the CASB data begins to look comparable to the GAO data.

Only one case study firm used a premium/discount plan in conjunction with its charging system, although plans were under way to try this in another firm. The GAO reported eight out of twenty-two firms using priority pricing plans. The following circumstances gave rise to as premium or discount in the rates.

Table 4-9. GAO & CASB findings--circumstances resulting in premium/discount rates

GAO data:

	No.
Job submitted at a specific time of day	3
Job submitted to be processed before a specific deadline	2
Job has a priority coding	4
Other	3

CASB data:

Job submitted at a specific time of day	48
Job submitted to be processed before a specific deadline	13
Job has a priority coding	70
Other	40

The GAO responses do not total eight because some firms responded to more than one reason. The data indicates that considerably more firms appear to use a priority pricing plan than the one out of six ratio found in the case study firms.

Chapter Summary

This chapter has outlined the findings from the case studies in the seven areas of the model described in the previous chapter. Where possible the findings have been supplemented with data from GAO and

CASB studies. Although it is difficult to compare the results from a sample of six case study firms with that from a sample of nearly 400 as in the CASB survey, the case study firms appear to have better than average cost control practices. For example, all case study firms used some type of charging scheme.

The one area where a significant difference was noted was in the use of premium/discount rates. However, as noted earlier in this chapter, several case study firms di not use premium/discount rates because their users were, in effect, "too sophisticated"--too ready and willing to adjust their timing to changing rates.

Overall, the EDP cost accounting systems in the case study firms were neither amazingly perfect nor terribly bad, but rather quite adequate and in some areas very good. The very poor cost accounting systems that Turney suggested existsed, simply were not found. The case study firms' efforts lend credence to the idea that cost accounting systems are of considerable use in controlling EDP costs and operations.

In the next chapter the findings of this chapter will be summarized and the model components of chapter three will be examined in light of these findings. Fruitful areas for further research will be delineated.

CHAPTER V

CONCLUSIONS AND NEW DIRECTIONS

Introduction

The purpose of this chapter is to summarize the case study findings. These will be examined in light of the two propositions suggested in Chapter One:

(1) The presence or nonpresence of the model EDP cost accounting system as a whole system in existing organization practices.

(2) The presence and need for each of the individual model components in a reasonably complete cost control system.

Suggested improvements in EDP cost control practices will be made. New areas for further research will be proposed.

Case Study Conclusions

It is difficult to completely quantify case study data. Any attempt to do so will no doubt omit much information about the firm(s) which is needed to understand more fully the practices used and the reaons behind them. However, in an attempt to summarize the previous chapter and provide a basis for discussing various conclusions, the figure on page 163 is presented. Various aspects of each case study firm's control system are ranked on a simple scale. The rankings are based on the expectations of the observer after surveying the relevant EDP and cost accounting literature and are in terms of the proposed cost

EDP costs as a % of sales	Firm	Level of cost collection and aggregation	Responsibility centers and cost centers	Budgeting and reporting system	Output or activity measurement	Long-range financial planning	Tracking users' EDP-related costs	Computer operations chargeout	Systems design chargeout
1.5%	A	moderate compliance	substantial compliance	moderate compliance	substantial compliance	substantial compliance	not in compliance	substantial compliance	not in compliance
1%	B	moderate compliance	substantial compliance	moderate compliance	moderate compliance	not in compliance	moderate compliance	substantial compliance	moderate compliance
.6%	C	moderate compliance	substantial compliance	moderate compliance	substantial compliance	moderate compliance	moderate compliance	moderate compliance	not in compliance
.2%	D	moderate compliance	substantial compliance	moderate compliance	substantial compliance	not in compliance	substantial compliance	moderate compliance	moderate compliance
6%	E	moderate compliance	substantial compliance	moderate compliance	moderate compliance	moderate compliance	not in compliance	substantial compliance	moderate compliance
1.6%	F	moderate compliance	substantial compliance	moderate compliance	moderate compliance	moderate compliance	moderate compliance	moderate compliance	substantial compliance

Figure 5-1. Summary of case study findings.

control model. At the end of the discussion of each model component in Chapter Three the factors used to evaluate the case study firms in that area were presented. These factors are summarized in Figure 5-2 on pages 165-166.

There is no single ideal measurement of the effectiveness of an EDP cost control system. The EDP costs as a percentage of sales statistics in Figure 5-1 are given as a very rough "ball-park" measurement. These would be expected to vary considerably between industries. For example, the firms with the two highest percentages are both in the pharmaceutical/ chemical industry. Both incur substantial data processing costs in their research efforts, and each has a separate data center dedicated to research efforts. In firm F, if research D.P. costs are omitted, the percentage of EDP costs to sales drops to .8%. The two firms with the loweset percentages were both in the manufacturing and materials conversion classification. Such interindustry idfferences are to be expected and somewhat lessen the comparability of the EDP cost to sales ratios.

Firm E--which had the highest percentage--experienced several problems which partially explain the high percentage figure.

(1) D.P. efforts in the research division.

(2) A "niggardly" attitude toward the EDP area on the part of op management prior to 1971. The firm is still playing "catch-up ball" in the EDP area. For example, it was the last of the case study firms to develop a detailed charging algorithm on a resources used basis.

(3) A major change of hardware in midstream. About 1970, the firm changed form all Univa equipment to IBM. All programs were left in Autocoder and were run using an emulator. These programs are gradually being converted to COBOL,an expensive task expected to take several more years.

I. Level of Cost Collection and Aggregation

1. The degree of classification and detail by descriptive element--particularly in the areas of personnel and equipment costs.
2. The degree of classification and detail by specific program or project--the existence of a project reporting system and detailed charges by individual programs.

II. Responsibility Centers and Cost Centers

1. Agreement of responsibility centers with formal organization chart.
2. Homogeneous activites within cost centers.
3. Responsibility centers used--not profit or investment centers.
4. Attempt made to separate controllable from noncontrollable costs.

III. Budgeting and Reporting System

1. The existence of an annual budgeting procedure.
2. The use of participative budgeting.
3. Monthly cost/budgeting reports with monthly and year-to-date cost/budget comparisons.
4. The degree to which managers must "live within" their budgeted amounts.
5. The gneration of data to allow continuous cost/benefit analysis for ongoing and projected systems.

IV. Output or Activity Measurement

1. The existence of system software or other method for measuring individual resource utilization in the hardware area.
2. The use of the utilization data to manage and control computer operations, not just to provide input into a charging scheme.
3. The existence of work measurement and reporting systems for the data entry area.
4. A reporting system for human output in the systems design and programming area.

V. Long-range Financial Planning

1. The existence of reasonably complete long-range goals and plans at the corporate level.
2. The existence of long-range goals and plans for future projects in the EDP area.
3. The existence of long-range plans for personnel and hardware, and projected dollar costs.

Figure 5-2. Factors used to evaluate case study firms in model component areas. (Continued on page 166)

4. Hardware acquisition decisions made on a basis consistent with other capital budgeting decisions in the firm.
5. Use of a life cycle, cost/benefit approach to system project decisions.

VI. Tracking Users' EDP-related Costs

1. Annual summary of data processing costs for the firm is prepared.
2. EDP personnel approve or are otherwise aware of hardware acquistions by other functional areas in the firm.
3. An effort is made to collect and aggregate EDP-related costs in user areas and report these on a systematic basis.

VII. Charging System for Users

1. A charge to users is made for EDP resources used in the computer operations area.
   a. The charging system is based on standard full costs and practical capacity--thus no attempt is made to charge out <u>all</u> of computer operations costs.
   b. Charges are based on a detailed measurement of EDP resources consumed.
   c. Charging rates are not changed more often than once a year except in unusual circumstances.
   d. Consideration is given to priority pricing schemes.
2. A charge to users is made for systems design and programming services.
   a. A lump-sum amount is negotiated for larger jobs.
   b. Not attempt made to charge out all systems design costs--e.g., no charges made for preliminary and feasibility studies.
   c. Charges are made for user-initiated maintenance programming work.
   d. Satisfactory resolving of problems in charging multiple sponsors of large-scale, integrated systems.
3. A mechanism exists for resolving user complaints in both charging areas.

Figure 5-2. Factors used to evaluate case study firms in model component areas. (Concluded)

The EDP cost/sales percentages from the GAO data are given below.

Table 5-1. GAO findings--EDP costs as a percentage of sales

GAO data:

	No.	%
Less than 1%	6	31
1-10%	10	53
11-24%	2	11
Over 25%	1	5
	19	100

The case study firms compare favorably with the GAO firms--which were also chosen partly for their prowess in the EDP control area. It would have been more helpful if the GAO summary had used a smaller classification group than 1-10% which provides a 10 to 1 leeway for the EDP cost percentages of firms in this group.

In terms of Gibson and Nolan's four stage model of EDP growth (see pages 22-24) all but one of the case study firms appeared to be in the latter part of the third stage ("formalization") or the early part of the fourth stage ("maturity"). Sophisticated applications were common, and the control techniques mentioned in Gibson and Nolan's work were well developed.

Firm E, however, was just entering or partially into the third stage. The Resource Accounting System (RAS) was under development including a more sophisticated charging algorithm, and various controls were beginning to proliferate.

Thus, it must be realized that the conclusions drawn from the case study firms may not apply to firms in Gibson and Nolan's stage one and two. As mentioned previously, however, part of the reason for proposing the model was to allow and encourage firms in stages one and two to control EDP costs in those stages and thereby promote a more orderly growth pattern.

Presence of the Entire Model

The proposed EDP cost control model as a whole was found to exist in a state of "moderate compliance" or better in Firm F. (See page 163.) Although most of the model components were found to be only in "moderate compliance", rather than in "substantial compliance", all were present in this firm.

Most of the other firms were very close to having the complete model present in their existing practices. Firms B and D lacked only a more adequate long-range financial planning system. Firm C did not charge users for systems development costs. Firm E did not attempt to track user's EDP-related costs, but this unconcern was prompted by and partially compensated by the fact that all hardware aquisitions within the firm had to be approved by the MIS manager.

Thus the model, which was based chiefly on traditional cost accounting literature, was found in a reasonably complete state in one firm, and nearly so in the other firms.

Individual Model Components

The first three model components are very closely related. The first component, the level of cost collection and aggregation, was found to be in a "moderate compliance" state in all case study firms. Adequate detail was generally present except for the high percentage of costs carried in two accounts--hardware costs and personnel costs. Most firms used essentially the same chart of accounts in the EDP area as they did in the other areas of the firm.

Weaknesses in the initial classification of accounts were at least partially compensated by the relative strength of the responsibility accounting systems observed. All firms went beyond the expected minimal subdivision of "computer operations" and "systems design." Since the responsibility accounting systems directly paralleled the formal organization charts, what we are really saying is that the firms had well-organized EDP areas. The firms were somewhat weaker in the use and understanding of the idea of "controllable costs." Some firms attempted to subdivide "controllable" and "prorated" costs, yet they did not adhere to the concept of committed costs being "uncontrollable," at least in the short run at a given responsibility level. This particularly true in the computer operations area.

All firms had standard budgeting and reporting practices which were part of an overall corporate procedure. Monthly cost reports were used in all firms, and were very similar in the types of costs and budgeted amounts reported. Flexible budgeting was found to be in use in one firm, but was a highly inappropriate technique of which the EDP managers had taken advantage. Although monthly budget/cost reports were used in both the systems design and computer operations areas, the reports had greater usage as a control device in the computer operations area.

All firms had a project reporting system which was the chief control device in the systems design area. A potential problem of the project reporting system was the practice of allowing system analysts to estimate the percentage of completion on a given project. Projects tended to quickly "reach" a high level of completion where they remained unfinished for some time. But on the whole, the case study firms deemed the project reporting system a very useful and necessary control device.

Because of the widespread use of the IBM SMF package among case study firms, output or activity measurement in computer operations areas were nearly identical. The usage made of these measurement varied considerably however. Some firms viewed the measurements as merely inputs into the charging algorithm. But other firms also used the software package to monitor the utilization of various decentralized data centers throughout the firm or to increase the efficiency of a specific configuration. The four firms given a "substantial compliance" rating in this area were attempting to use SMF and similar adata to manage and control the computer operations area, not just as input for a charging scheme.

All case study firms had fairly sophisticated work measurement and reporting systems for the data entry area. But the productivity of analysts and programmers was more difficult to measure. Typically work measurement in this area was limited to information contained in a project reporting system--the number of hours an individual spent on various assignments or projects. Productivity in this area is difficult if not impossible to quantify. Although the project reporting system was of some help in evaluating an individual's efforts, this was usually done more on the basis of a personal knowledge and observation of one's work.

The next two areas--long-range financial planning and tracking users' EDP-related costs--were the model components that had the weakest support from the case studies. This result was somewhat expected regarding the latter area, but came as a surprise in the first area. Especially surprising were the results from the two case study firms given "not in compliance" ratings in this first area. Neither firm claimed to have much in the way of formal plans beyond one year, and in firm D hardware expenditures--even long-term leases--were approved via the operations budget.

Firm A had the most complete long-range planning system, but there was little in the way of concrete, realized benefits that could be pointed out. Evidently, five years later, Sollenberger's conclusion regarding long-range planning in the systems area still holds true and probably can be extended to include computer operations.

> Planning beyond one year has yet to contribute large dividends to systems development. Activity was still too much crisis oriented rather than plan oriented. The idea of a master plan was either never developed or was seriously downgraded as impractical or not pertinent in the firms studied. Five-year plans were common, but their values were limited primarily to manpower budgeting and broad systems concept development. [142, pp. 10-11]

Note that Sollenberger is <u>not</u> saying that long-range planning is useless, but that it has not yet paid "large dividends." This could be because:

(1) Long-range planning is inappropriate in the EDP area because of rapid technological changes and other reasons; or

(2) Long-range planning has not been properly employed or executed in the EDP area.

One further conclusion can be noted. Long-range planning in the EDP area is impossible or useless if corporate goals, objectives, and strategies are not outlined first. The EDP area is a service center which contributes to corporate goals. It should not attempt to chart its own course unrestrained. Over five years ago Clarke predicted:

> Top management realizes the importance of long range planning in determining the future position of the company. However, this understanding has not included the EDP function. Many top managers today look upon EDP as a necessary evil and fail to consider the impact of the large investment in data processing men and equipment. . . . Management is going to ask the EDP organization for the long range plans and how they will use

> the computer. . . . The days of plodding along aimlessly are almost over. Today's top management has had some exposure to systems and it is going to expect constructive, definitive plans to meet the informational needs of the company. To effectively benefit from a resource one must plan for its use. [26, p. 8]

This expected emphasis on long-range planning was not found in the case study firms. Rather Clarke's comment made in 1971 seemed quite apropos: "Few companies have been or are involved now in future systems planning." [26, p. 8]

The idea of tracking users' EDP-related costs is a novel one suggested by certain incidents reported in the EDP literature. (See pages 81-82.) Firm D included a very complete analysis of such costs in its annual summary of EDP costs. Two firms, A and E, made no attempt to summarize on an annual basis the EDP costs for the firm. The remaining firms prepared annual EDP cost summaries with some minor efforts to include users' EDP-related costs. In general, EDP personnel were more responsive to the concept of tracking users' EDP-related costs than to long-range financial planning, and considered the former to be a useful idea.

The firm which received the "substantial compliance" rating in this area had perhaps the best overall record of cost control. Not only did it have the lowest EDP costs to sales ratio, but EDP costs had remained virtually constant for a five year period. Most of this cost control had been achieved by a significant reduction in personnel. In 1971, 200 people were employed in the EDP area; nearly five years later this figure had been reduced to 144, with much of the reductions coming in the systems and programming areas. The firm appeared reasonably satisfied with the status of its ongoing applications--most users desiring fast turnaround were already online--and much of the programming efforts were in the area of maintenance programming and small jobs.

Five case study firms charged users on a resource usage basis for computer operations costs. Three firms were given "substantial compliance" ratings because their charging system approximated standard full costs based on practical capacity. Costs not charged out were absorbed as part of EDP overhead. The other three firms were considered in "moderate compliance" because (1) capacity was based on actual usage (firm D) or estimated actual usage (firm F) or (2) the prior year's actual usage determined the flat rate charge in the present year (firm C).

Three case study firms charged users for systems development costs. Of these, two firms attempted to charge out <u>all</u> systems development costs. The third--rated in "substantial compliance"--charged out approximately 70% of such costs. Another firm used a memo billing procedure for systems work and the remaining two did not charge at all.

Some reasons previously advanced by various firms for not charging users for systems work have included:

(1) There are different levels of competence in systems analysts. A flat rate hourly charge would cause "unfair" charging because some jobs would get the "good analysts" and some would get the "bad". The alternative to this is placing programmers and analysts into different productivity classes and establishing a separate rate for each class--a difficult and costly procedure.

(2) Analysts may have trouble accurately keeping track of their time if they are currently active on several jobs.

(3) It is hard to stimulate change if users are charged for systems development.

(4) The EDP area (including systems development) can most effectively control its own costs from within.

(5) The cost of creating a charging system and a group in charge of this area may outweigh the benefits received.

(6) Users are reluctant to support large scale integrated systems where all benefits do not accrue to their area.

The first argument can be overcome by establishing a lump-sum, contractual charge for a project regardless of actual time spent (unless delays are caused by the user). The second argument is no longer valid because firms having a project reporting system already collect this kind of data. The third argument is difficult to follow. The systems area should not stimulate change for "change's sake" anyway. The fourth argument is debatable. It can be argued that a coordinated approach--charging users <u>and</u> stressing internal cost control--is more desirable than concentrating on either internal or external control to the exclusion of the other.

The final two arguments bear more weight. The fifth argument is definitely a possibility, particularly in light of the difficulties of measuring the cost of a charging system, much less the benefits resulting from such. Only one case study firm could attempt to set a cost figure on its entire charging system. None could determine the incremental costs of charging users for systems work.

Finally, if top management desired to implement large-scale, integrated systems, it could ask the systems area not to charge for development of such systems where multiple users benefit. This might be preferable to relying on arbitrary cost allocations for sponsoring users. If users were charged for other (nonintegrated) systems, they would be motivated to request integrated systems with other users--a "free" good--thus fulfilling the desires or objectives of top management.

In summary, the model found considerable support on a component by component basis. Charging for systems design efforts was not as strongly supported as charging for computer operations, but the general trend was toward, rather than away from charges in this area. For example, the firm using memo billing planned to formalize those charges in the budgetary accounts.

Long-range financial planning and tracking users' EDP-related costs received the least support, but firms were generally more favorable to the latter idea. Thus long-range financial planning is the most dubious of the model components. Though it found moderate support, firms were unsure of its eventual benefits. In addition, it was relatively costly to perform, not necessarily in an incremental dollar sense, but in taking analysts and managers away from more pressing (and presumably immediately productive) duties.

In the final analysis, it must be remembered that an adequate EDP cost system does not control costs. People control costs. Their job is made easier by the presence of adequate information and means of control. The best of cost accounting systems will do little good unless management--both top level and within the EDP area--is actively involved in the cost control process. An adequate EDP cost accounting system cannot replace proven managerial skill and involvement, but it may encourage both.

Suggested Improvements in Observed EDP Cost Accounting Practices

Various improvements in EDP cost accounting practices have been implied in the last two chatpers. Some of the more important ones will be summarized at this point.

(1) Examine carefully the chart of accounts used to control the EDP area. Are large percentages of costs grouped in one or two accounts?

Is the set of accounts exactly the same as used in other areas of the firm? Does cost data for charging algorithms and other purposes have to come from supplementary records and schedules? Perhaps a restructuring of the chart of accounts for the EDP area will help meet this area's needs better and improve control.

(2) Examine the use made of SMF or similar data if available. If the sole usage of such data is merely as an input into the charging algorithm and a means of determining rates for the coming year, then much of the potential benefits from the SMF system are not being realized. Investigate the uses of this data in the areas of workload analysis and classification, standards establishment and enforcement, and identification of resource wastage and other factors which may degrade system performance.

(3) Consider the trade-offs made in cutting EDP costs and increasing users' EDP-related costs. This may entail tracking the latter and preparing at least annually an EDP cost summary which includes such.

(4) Consider the behavioral effects of the current charging practices in both the systems and computer operations area. If systems services are a "free good", are users motivated to control their use of this resource? Would contractual, fixed-amount charges encourage analysts and programmers to meet time and cost estimates for projects under development? In what ways do users react to the charging system for computer operations and changes made therein? Do they understand clearly the basis on which they are charged? Are they informed enough to budget their own EDP resource usage and costs for the coming year?

In most firms, EDP personnel had a relatively free hand in designing the charging algorithms used. Although nothing is wrong with practice--they are the experts in this area--top management should get involved to the extent of setting goals and criteria and determining if these are met by the practices in use. This was the thrust of Heitger's dissertation, and his general conclusion--use standard cost rates based on practical capacity--holds true today.

Finally in situations where users are charged, ensure that there is a coordinated approach with equal emphasis on cost control in both users' and EDP budgets.

(5) Have top level management examine closely the need for long-range planning at both the corporate and EDP levels. The need for formal plans in this area may vary widely between industries and firms. However, the area should not be ignored. Top level management and EDP managers must be satisfied that orderly, long-term growth and development in this area is not impaired by current actions and plans. For example, the sudden change of hardware in firm E might not have been necessary if long-term considerations had been previously scrutinized.

New Directions in Future Research

A number of questions were raised by this study which seem fruitful ground for further research. Such topics include:

(1) The usefulness of long-range planning in the EDP area. Perhaps one way to approach this problem is to use a case study approach over an extended period of time.

(2) The effect of industry practices on a firm's EDP cost control techniques and chargeout practices. CASB data indicate considerable variation in charging practices between industries. Only 20% of the public utilities did not charge internal users for EDP services (sample size = 25), while 48% of financial institutions did not charge users

(sample size = 44). Possibly industry differences extend to other cost control techniques, although this was not detected in the case study firms because of their limited number.

(3) User reaction to complex chargeout algorithms. Is modification of users' behavior made easier with simpler, possibly transaction-based billing practices? Also, are EDP activities which are charged out subject to "greater control" than those that are not charged to users?

(4) The need for and most effective structure of a priority setting device. It is doubtful whether a charging system will solve all priority problems in the systems development or computer operations areas, especially if these costs are not controlled in users' budgets. Often the setting of priorities is left largely in the hands of EDP managers who cannot hope to please everyone. This was essentially the problem that led to the decentralization of the corporate data center in firm C several years ago. For those firms having centralized data centers the issue is particularly relevant. Various forms and levels of committees and other priority setting devices are in use, and all are probably not equally effective.

(5) EDP capacity measurement. Heitger has previously cited this as an area for further research. [71, pp. 127-128] Practical capacity was the basis suggested in Chapter Three for determination of charging rates, and some firms were attempting to use this basis. However, as Heitger puts it, "a great deal of subjective evaluation was necessary in arriving at practical capacity." [71, p. 122] In one of the case study firms a lengthy two-page worksheet was used to convert maximum available capacity to practical usable capacity. Subtractions for unstaffed

emergency reserve hours, hardware downtime, and software downtime were only the beginning of a long list of necessary "subjective evaluations."

Chapter Summary

This chapter summarized the findings (presented in Chapter Four) in terms of support or nonsupport of the model EDP cost accounting system as a whole and by its various components. The model was found to be reasonably complete in one firm and nearly so in the others. Model components received considerable support on an individual basis. Long-ragne financial planning and tracking users' EDP-related costs received the least support, although the latter was gnerally received with more favor than the former.

Suggestions were made for improving EDP cost control practices based on the literature review, model construction, and case study findings. Finally, new directions for further research were presented.

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APPENDIX A

APPENDIX A

SELECTED EXTRACTS FROM

USER SPECIFICATIONS OF DATA CENTER

ACCOUNTING AND RESOURCE UTILIZATION SYSTEM

(Firm A)

Subsystems and Their Function

The Accounting and Resource Utilization is divided into four subsystems:

(1) Logout and Log Preprocessing

Function: To capture and preprocess system log files and prepare a job oriented file for Accounting and a merged raw log for the Resource Utilization Subsystem.

(2) Accounting

Function: To redistribute data center costs to its users in a equitable and auditable manner through an invoice which displays resource units consumed.

(3) Resource Utilization

Function: To gather statistics on the usage of the various system resources (hardware units, software and personnel) and produce management reports which will enable the data center to reconfigure and reorganize to optimize throughput.

(4) System Software Modifications

Function: To validate the right of a potential user to use computer resources (charge code validation) and to inform a user at the end of each job as to the cost of that job in resource units used and dollars.

Description of Output Reports

Error Diagnostic

Each system program will have an error diagnostic printer file to report system failures due to [system software]* errors as well as any errors detected that cause abnormal termination of the run.

Job Structure By Begin Time

Jobs are listed by begin time with their corresponding tasks also ordered by begin time. All known information about each job is shown in this report. Certain data may be eliminated by parameter inputs set by the user.

Billing Report By Account

Jobs processed are ordered by account number then by begin time. Information contained in this report is similar to the Job Structure By Begin Time Report.

Audit Of Billing Clerk Activity

A sequential listing of all external debits, transfer and reversals to accounts performed by the billing clerk are reported. Also included in this report are all other transactions concerning modification of [certain] files. This report serves as a hard copy record of all actions performed by the clerk.

Audit Of Operator Comments

A sequential listing by computer system of all operator log comments and all operator log to job messages. The report serves as a summary of all messages entered bythe system operators.

If the message is input in a specific format, the computer operator can generate a transaction from the message to allow for automatic reversal of the job if it has an error termination because of a Data Center error. The billing clerk would have to verify the reasonability or accuracy of the reversal.

List of DS-ed Jobs

This report calls the billing clerks attention to jobs that terminated abnormally. These DS-ed jobs are good candidates for charge reversal.

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*Items in brackets indicate that certain specific terms have been changed so that the firm is not identifiable.

Daily Revenue Statistics

Summarized information by system is displayed to reflect where the data center is receiving revenues. Breakouts are given by Job Queue, Run Type, Shift, Compiler Usage and Revenue Sources. An additional Revenue Summary breakout is produced indicating reasons for lost billing. The information produced on this report will be saved in a database bile to allow printing of the monthly report.

Hardcopy Of Billing Clerk Activity

All information for each session of the online inquiry and update program (excluding inquiry) is recorded on theline printer file. This file serves as a permanent record of billing clerk transactions performed during the period logged.

Monthly Account Invoice

This report is designed to be a tear apart report to be distributed to each account (user). A minimum of two pages per user will be produced. The first page will show a summary of all units billed while the second page will provide detail information concerning jobs charged to the account as well as billing clerk credit and debit entries.

Monthly Report By Project

This is a specialized report to meet the needs of those data centers required to produce a monthly statement by Corporate Unit, Project Number, and Cost Center sequence.

Monthly Revenue Statistics

This report will be produced from the data base file generated by the DAILY UPDATER program. As with the daily statistics report, summarized information is reported by Job Queue, Run Type, Compiler Usage, Revenue Source and a Revenue Summary indicating reasons for lost billing.

General Accounting Journal Entries

This report will show data processing charges to all cost centers in standard journal entry form for either the Manufacturing or Marketing Accounting Systems. This report can be used by the accounting department in the preparation of journal entries for data processing charges.

Listing of Accounts

A sorted listing is produced containing all accounts within the system. All information pertaining to each account is printed including account attributes, expiration data, charge number and password for each account.

Explanation and Rationale of Billable Items

(a) Processor Time

Definition:

Processor time is the total time during which a central processing unit (CPU) is executing instructions for the user task.

Rationale:

Processor time is a possible (and suggested) billable item.

1. The processor is a major component of the computer system in terms of cost.

2. Processing data is a major function of the computer system.

3. It is an easily measurable resource.

4. Times are fairly mix independent ($\pm$ 10%).

(b) I/O Time

Definition:

I/O time is the total time an I/O channel is in use controlling an input or output operation for a user task.

Rationale:

I/O time is a possible (and suggested) billable item because:

1. The I/O multiplexor is a major system component relative to total system cost.

2. I/O is a major data processing activity.

3. All I/O operations to all peripheral devices accumulate I/O time except those to a remote file.

4. I/O time is easy to measure.

5. I/O time is mix independent ($\pm$ 10%).

(c) Code Core Integral

Definition:

The code core integral of a user task is the average size of its code area times the sum of its processor and I/O times.

Rationale:

Code core is a possible item because:

1. Core is expensive.

2. Charging for code core will encourage efficient program coding.

3. The code core integral is calculated by the [system software] and is easily obtained from the EOT (end of task) record in the system log.

(d) Data Core Integral

Definition:

The data core memory integral is the accumulation, for all data areas, of the size of the memory area allocated times the sum of the processor and I/O times accumulated during the period in which the data area was present.

Rationale:

Data core integral is a possible billable item because:

1. Core is expensive.

2. If data core was a free resource users would substitute large arrays for disk space which to accesss requires I/O time which is not free (and implies increased job run time).

3. The data core integral is calculated by the [system software] and is easily obtained from the EOT record.

NOTE: If both data and code core integrals are billed, data core should be more expensive. Data must be written to disk overlay before the core area may be reused. Code may be simply forgotten since a copy of all code (all of which is not modified) is always present on disk.

(e) Cards Read

Rationale:

Cards read is a possible billable item because:

1. The cost of reading cards in from the reader to disk (spooling) is not covered by I/O time which is accumulated when reading from disk to core.

2. It will represent a nuisance charge for card handling.

3. It will indirectly charge for disk space used to store the card images.

4. It is a readily available statistic in the EOT log record.

5. It is mix independent.

(f) Cards Punched

Rationale:

Cards punched is a possible billable item because:

1. The cost of the program which punches spooled punch backup disk files, is not billable to any user. Therefore, a charge for cards punched may recover that cost.

2. It can be used to recover the cost of cards and card handling.

3. It can be used to recover the cost of the card punch.

4. It is a readily available statistic in the EOT log record.

5. It is mix independent.

(g) Lines Printed

Rationale:

Lines printed is a possible billable item because:

1. The cost of the program which prints spooled printer backup disk, is not billable to any user. Therefore, a charge for lines printed may recover that cost.

2. It can be used to recover the cost of paper and paper handling.

3. It can be used to recover the cost of the printer.

4. It is a readily available statistic in the EOT log record.

5. It is mix independent.

(h) Connect Time

Definition:

Connect time is the elapsed time between LOGON and LOGOFF for [online] sessions.

Rationale:

Connect time is a possible billable item for the following reasons:

1. The cost of the datacomm subsystem is a significant cost not otherwise billed for directly by any other unit. Note I/O time is not accumulated for remote files.

2. The following items can be billed for using connect time:

   a. Datacomm subsystem including line adapters and adapter clusters.
   b. Modems
   c. Terminals
   d. Supply costs at the remote terminals
   e. Line costs

3. A user will be encourage to maximize the effectiveness of his use of terminals. He will plan a session more carefully.

4. This statistic is easy to gether for it is present in the system log LOGOFF record.

(i) Tape Mounts

Rationale:

Tape mounts is a possible billable item because:

1. It is a major time consuming task for an operator to mount, dismount, and watch for tape status.

2. Users should be discouraged from tape usage when an alternative (disc pack or elimination of the tape altogether) is available.

3. This item complements tape storage charges in that it reflects a greater charge to tapes which are used more often and charges the user, not the owner.

4. This statistic is mix independent.

(j) Tape Open Time

Definition:

Tape open time is the sum of all the open times for all files opened by the user task. An individual file's open time is the elapsed time from open to close of that file.

Rationale:

Tape open time is a possible billable item because:

1. The cost of a tape drive can be recouped via this charge item. Note that a user is tying up the whole unit for the entire time a file is open.

2. Users are discouraged by this charge from using tape files if an alternative exists.

(k) Shift Premium

Definition:

Shift premium is a surcharge (or discount) which is added to the normal cost of a task based on the time of day the task is initiated.

Rationale:

Shift premium is a possible billable item because:

This item will give economic incentives to run in non-prime shifts and so decrease prime shift demand thus load leveling the computer system.

(l) Queue Premium

Definition:

Queue premium is a surcharge or discount on the normal cost of a task based on the queue from which the task is active. Queue parameters indicating level of service include limits on:

1. Priority
2. Process Time
3. I/O time
4. Cards punched
5. Lines printed

The queue used by a job's tasks is noted in the EOT log record.

(m) Keypunch (in-house)

Rationale:

In-house keypunching is a significant and easily isolatable expense. In fact, by Management Systems' policy the Data Entry department must be a separate cost center. The General Accounting system interface produces two journal entries: one for keypunch services, and one for all other computer services.

(n) Tape Library

Explanation:

The billing unit used is reel-months (one reel of tape storage for one month). It is possible to modify the tape library interface program to charge some multiple number of times for packs entered into the tape library. (For example let 1 pack-month = 10 reel-months).

Rationale:

Tape library storage is a significant expense to the data center and it is easy to redistribute the cost back to its source.

(o) Disk and Pack Usage

Explanation:

A program will be produced (on release 2+) to sample disk and packs to determine usage and build debit entries. For now a manual entry may be made. Unit of measure is mega-segment-months.

Rationale:

Disk and pack space represent a major cost. There is, however, trouble in identifying the owner of a file.

(p) Offline

Explanation:

A manual DR entry may be made for offline owrk. The unit of measure is hours.

Rationale:

To account for offline machine and operator time.

(q) Clerical

Explanation:

A manual DR entry may be made for clerical work. The unit of measure is hours.

Rationale:

To account for miscellaneous clerical time.

(r) Xerox

Explanation:

A manual DR entry may be made for Xerox backup file printing. The unit of measure is pages. A DR may be filled out from a summary sheet produced by the Xerox machine at the end of each job.

Rationale:

Xerox printing costs are a substantial data center expense and the user of this service is easy to distinguish.

(s) Dollar Billing

Explanation:

A DR entry for a miscellaneous charge in dollars may be entered.

Rationale:

Some items are charged for so rarely that they do not warrant a category of their own. A convenient unit for this catch-all category is dollars.

(t) 5 Miscellaneous Units

Explanation:

Five spaces for user defined accumulators are provided. Units of measure and meaning is [sic] user specifiable.

Rationale:

To be rationalized by the user who defines the accumulator.

Overview of Policies and Procedures

The general policies which apply to and influence the operating philosophy and practices of the data processing facility are shown in draft form in this section. They define the approach to be used in administering a Data Center Accounting System.

The procedure drafts contained herein indicate the manner by which the policies may be put into practice and administered on an on-going basis. These procedures should be placed in the Standard Practice Manual of the individual unit; they have titled here for the "Data Center Procedure Manual".

This section is organized in the following manner: the policy draft, which in final form would appear in one of the functional manuals (Controller's, Management Systems, Organization & Policy, Data Centers, etc.) is followed by the applicable procedures necessary to implement this policy and provide for its continuance on an on-going basis. The overall functioning of the system was viewed in terms of seven policies, each of which occupies a separate subsection of this section.

[Author's note: Because of the length of the procedure drafts only the policy statements are included in this Appendix.]

The first policy is entitled Accounting for the Use of Data Center Resources, and explains why accounting is an appropriate action by a Data Center. The procedures accompanying this policy indicate the actions that need be taken and the responsibility assignments that must be made to implement the system, and the fact that activity reporting is to be performed on a periodic basis.

A key to accounting is proper identification of the consumer of resources. The Charge Identifier policy indicates the objectives here, and accompanying procedures establish how this is to be controlled.

Reporting of use is in large measure determined by the manner in which resources are allotted to individual organizations within the data processing center. Data Center Organization for Cost Control and its accompany procedures indicate the manner in which this allocation process is to function.

Cost Reflexive Pricing established the philosophy to be adapted by a Data Center in charging for services. The four procedures accompanying this policy describe the manner by which unit prices for services are established and validated.

The fifth policy draft established how Data Center Services Billings are to be handled, and indicates the relationship that is to exist among data centers relative to the interchange of work and the resultant billings. The four procedures here indicate the manner by which services are to be requested, types of services to be offered, billings rendered, and price disputes resolved.

Adjustment to bills are a normal function of data center accounting, and the Customer Credits policy states the principles governing such adjustments. Associated procedures include those for establishing minimum amounts required for credit, the means by which credits are requested, and the manner in which credit transactions are handled.

The seventh and last policy draft is Retention of Accounting Information. Supporting procedures indicate how retention schedules are to be established, how log pooling as a technique can be employed, how report retentions are entered on the data base, where microforms may be used, and how records are transferred from the data processing center to a records storage area.

1. Accounting for the use of Data Center Resources

Rationale

The commitment of the aggregate of resources represented within each data processing facility is indicative of a conscious decision to forego other economic alternatives in favor of this particular use. The prudent management of this aggregate involves the measurement and control of the manner by which the Data Center provides services.

Policy

Each data processing center shall institute a standardized mechanism of internal accounting which has as its basic objective the identification and measurement of activity for those organizations utilizing its services. These services represent a consumption of limited resources having a real economic cost, the use of which must be neither indiscriminate nor capricious.

This cost is to be assessed users of these services in a manner which is comprehensible and which encourages them on a continuing basis to measure the benefits they realize against the costs incurred, and to influence or modify their demands accordingly.

Applicability

All data processing centers for which the prime budgetary responsibility rests with the Management Systems function.

Responsibilities

Each installation manager shall be responsible for the institution of procedures which permit the adequate identification of all users of data processing services, the accumulation of resource activity to their accounts, and the rendering of periodic statements of services provided to each. The management of each activity utilizing the data processing facility shall be responsible for the development of a forecast of the nature and volume of demand required from the data center. These forecasts shall be used as a resource planning tool within the data processing function.

Relation to Operational Analysis

The measure of activity and the variance from forecast, with associated cost and service details, shall be analyzed on a continuing basis withe the objective of improving the effectiveness and efficiency of the data center function. The responsibility for this analysis lies with the management of the data center, with the active cooperation and assistance from its users.

2. Charge Identifiers

Rationale

Proper control over the validity of data processing service request is essential as the honoring of these requests represents a consumption of data processing center resources, the cost of which is to be subsequently distributed to the requestors of service. The mechanism through which this control can be ahieved, in part, is a properly administered program utilizing charge identifiers.

Policy

The fulfilling of service requests by a data processing facility shall be dependent on the existence of a valid charge identifier used to specify the account to which charges for this work shall be accumulated.

Definitions

A charge identifier is a non-significant identifier used to designate an account to which data processing work done is to be charged. An account is a record to which charges for transactions are entered and subsequently distributed to the account holder. A project is an identifier utilized to specify an approved undertaking for which the expenditure of company resources is authorized over a period of time.

Establishment and Maintenance of Account Numbers

The issuance and control of account numbers is the responsibility of the ranking financial manager (or his delegate) at each Corporate unit. Requests for addition, deletions and revisions to accounts are to be handled in accordance with procedure and are properly directed to the financial activity of the unit for review and approval.

Establishment and Maintenance of Project Numbers

The issuance and control of project numbers is the responsibility of the manager (or his delegate) who must monitor and periodically measure the progress on the identified project.

Establishment and Maintenance of Charge Identifiers

The issuance and control of charge identifiers is the responsibility of the manager of the data processing facility (or his delegate) at which the work is to be performed. The determination of the validity of the account number and project number (if used) must be made at the time the charge identifier is established.

Use of Charge Identifiers

It is the responsibility of the data processing function to assure at the time of submission of requests for services that the requestor has the authority to use the charge identifier. This may result from the identification to a line item on an approved processing schedule, use of an authorized usercode and password, authorized signature matching that on specimen signature cards, or other means deemed appropriate. On a periodic basis an audit of the use of charge identifiers should be made to insure the adequacy of the supporting procedural controls.

3. Data Center Organization for Cost Control

Rationale

As interrelated yet distinct functions exist within a data processing facility, the organizational structure for cost control should reflect the distinction of function.

Policy

Data processing facilities shall distinguish, minimally, among data entry, computer maintenance, and computer operations and support functions. This distinction shall be reflected in the accounting treatment for the expenses incurred within each function and the expense offset made as a result.

Responsibilities

The manager of each data processing facility is responsible for initiating the request for and implementing of cost control numbers for each function, and for assuring that all associated expenses are properly placed to each function. The assignment of cost control numbers is the responsibility of the Controller's activity in each corporate unit.

Relief of Incurred Expense

The full cost of operating the function shall be redistributed to all customers in accordance with their use of the resource of the function. This relief shall be made through an expense offset. Independence of offset rates among functions is essential if the true resource costs are to be evidenced. The expense of each function and the offsets made shall be accumulated on an ongoing basis, and periodically examined for adequacy. The reestablishment of offset rates is a drastic action having significant budgetary impact and should be considered only in those instances where existing rates have ceased to have a meaningful relation to existing conditions.

4. Cost Reflexive Pricing

Rationale

The total cost of providing sufficient quality computing services for a given demand level can be calculated from a number of independent cost pools that can be established. A breakeven pricing formula, reflecting rates used to relieve each independently measured cost pool and also reflecting the ratio among these cost pools must be developed and then administered over a period of time.

Policy

The pricing formula adopted must be tailored to the environment of the individual facility and must be adjusted when the environment changes. It must include elements that can be measured independently and which are explainable. Foremost, it must permit the redistribution of the true costs of services to those demanding the services without encouraging arbitrary or capricious allocations of expenses to cost pools.

Expense Budgeting and Annual Demand Forecasts

On an annual basis it is the responsibility of data processing management at the facility level to solicit demand forecasts from all customers and to develop and secure approval of an expense budget that will permit the servicing of the forecasted demand. Several iterative cycles may be required before the expense level and the corresponding demand levels are in balance.

Whereas in the development of the expense budget costs are grouped into expense accounts, in the pricing calculation they are grouped into cost pools. A cost pool is an accumulator wherein similar costs are grouped and against which expenses are relieved. All costs incurred in the operation of a data processing facility are to be assigned to a cost pool, and the gross expense to meet a given demand level is thus the sum of the cost pools.

While the establishment of individual cost pools is at the option of each data processing center, as a general guideline when identifiable costs to a pool reach five percent of gross expense, a distinct cost pool should be created for purposes of expense relief.

Cost Pool Ratios

The Relationship between the cost pools is then shown by the relative proportion they bear to the gross expense. As changes in environment influence the size of each cost pool, and adjustment either in the ratio to other pools or to the unit price should be made.

Resource Unit Pricing

In determining the price of a resource unit, the usable capacity, as distinguished from the theoretical capacity, should be viewed as the upper boundary. Demand forecasts for each unit should then be applied to the total cost to be relieved to determine the price to be charged.

Cost of Applications

The total cost of an application is the sum of the resources used multiplied by the respective rate of each, plus a portion of the unallocated costs of operating the data processing facility.

5. Data Center Services Billings

Rationale

The orderly handling of data center services billings on an interdepartmental, inter-unit, and interdivisional basis makes mandatory the statement of governing principles and criteria for the handling of these transactions.

Policy

In terms of the goods of the Corporation, Data Center Services are goods of a miscellaneous nature for internal use and are handled through negotiation between the buying and selling units. Negotiations shall be substantiated in writing and will be binding. The transactions will handled in accordance with the accounting procedure of the Corporation.

Interdepartmental Billings for Data Center Services

Interdepartmental charges for data center services will be handled monthly and will be computed on the basis of pre-established rates of charge for that period. The charge rate used will be determined by the level of expense offset necessary to cover the costs of handling and approved demand forecast level. The transfer of charges will be handled directly by journal entries from the Data Center Accounting System to the Corporate General Accounting System.

Interdivisional & Inter-unit Computer Services Billings

Requests for data center services between Corporate units will be negotiated by the respective data processing organizations or their functional equivalent. Any special conditions or terms are to be specified at the time of negotiation, and in the event none are specified the types of services provided by the selling facility to its internal customers will be assumed.

When the purchasing and selling facilities each offer data center services, the charge assessed will be at the lower of the two billing rates used. In no event are they to exceed the cost of comparable processing if done at the purchasing facility. Billings shall be redistributed directly to the departments involved.

Where the purchasing facility neither has nor intends to acquire an internal computing capability, it shall negotiate the puchase of services with potential sellers. A negotiated demand forecast for an extended period shall be binding on both parties and charges will be assessed at the rate calculated when the external demand is incorporated with internal demand to determine the base.

Disputes and Settlements

Where price disputes arise, the established mechanism for the resolution of interdivisonal price disputes is to be utilized. All reasonable efforts to resolve the dispute at the unit level are to be exhausted before appeal is made.

6. Customer Credits for Erroneously Billed Data Center Services

Rationale

The statement of governing principles and criteria promotes the understanding between a data center and its customers as to those circumstances wherein credits for erroneous charges will be made to customer accounts. This statement encourages the impartial administration of data center billings.

Policy

Where it is reasonably determinable that a data center customer has, without fault, been assessed charges for services incorrectly performed or billed, corresponding credit will be issued and notification supplied the customer of the credit. The original charge transaction will remain unaltered, but will be offset by a credit to the appropriate customer account.

Responsibilities

The cost of handling customer credits should be considered in determining that level of charge below which no credits will be given. It is the responsibility of the data center manager to make and secure approval of this minimum credit amount. This information is to be available to all customers of the data processing center. It is further the responsibility of the data center management to insure that adequate procedures exist to document the credits made to customer accounts. Where customer billings have been made and credits are requested, it is the responsibility of the requestor to present adequate documentation to identify the erreneous transaction and determine the appropriate credit.

Auditability of Credit Transactions

A record of credits issued, with supporting documentation, is to be separately maintained for purposes of auditing the customer billings made. Where a request for credit is made but subsequently denied, documentation of this fact must also be available. These records will be maintained in the data processing center for the appropriate period and then discarded.

7. Rentention of Data Center Accounting Information

Rationale

The use of data center services for which charges are assessed dictates that the data processing facility maintain for an adequate period records of activity which are sufficient to substantiate these charges.

Policy

The rentention schedules established for documents and computer-readable records will be a nature to provide ease in auditing and general checks of the integrity of these records.

Responsibilities

The Data Center Management in each facility shall be responsible for establishing, adding, or modifying retention periods for its records and shall obtain approval from the Division or Plant Management, as appropriate.

The Data Center manager shall be responsible for confirming that computer readable file retentions are adequate to meet the retention requirements, and that all appropriate procedures to insure records integrity are established and observed.

Where appropriate the use of pooling techniques or microforms will be adopted to facilitate the retention of documents or records. The use of these approaches will be determined at the installation level. [A number of attachments showing record retention schedules and control forms were presented.]

APPENDIX B

APPENDIX B

COMPUTER COST ALLOCATION PHASE II STUDY AND UPDATE

INCENTIVE CHARGING RATES

(Firm B)

A - OBJECTIVE

The primary objective of adopting an incentive rate structure is the optimization of computer resource utilization through the load leveling effect of this type rate. A secondary objective may be one of discouraging large volumes of high-priority, fast turnaround jobs during peak processing periods through the use of a penalty rate structure. These higher rates may be justified as the result of the additional scheduling work required when providing this type service.

B - GENERAL

The use of incentive rates only becomes practical under circumstances where an undesirable amount of unused computer center resource capacity is available. Under this situation, incentive rates might be considered as a means of improving resource utilization. However, if incentive rates are to be considered, it should be noted that unused capacity seldom exists in proportionate quantities among the various resource centers of the operation. Therefore, for an incentive rate structure to work to its fullest advantage, it should be directed toward each individual available resource.

A rate structure that provides a penalty for priority processing (either a graduated scale of priorities and rates or a penalty rate for fast processing during peak periods) does not appear practical at the present time. There can be no assurance under such a scheme that any one job will be intiated before any other jobs of that same priority. Past experience with the use of priorities has indicated that, unless the assignment of such priorities is constantly policed, each using department eventually assigns the highest possible priority to all of its work. Therefore, unless the penalties for high priority processing were established of [sic] ridiculously high levels, a majority of the jobs would be submitted under this classification. Therefore, this approach would be self-defeating. It should also be noted that a high priority on job initiation does not necessarily assure the user of specific or fixed turnaround time for his work. Such other factors as job mix under identical priorities, system work load, bursting and decallating schedules and mail service all contribute to turnaround time. Therefore, only the approach to load leveling will be discussed in the rest of this paper.

C - INITIATING INCENTIVE RATES

Identifying Unused Capacity

The first step in establishing an incentive rate structure is to specifically identify unused capacity. Assuming that the quantity of each resource available in the processing center is no greater than that required to satisfactorily service peak-load periods, unused capacity can be identified as that available during non-peak periods. Therefore, such unused capacity take the form of portions of specific resources during a particular period(s) during the day, week, month or year.

Establishing Goals

The second step to be performed is that of establishing the goals to be achieved as the result of implementing an incentive charging scheme. Such goals as increasing overall revenue, decreasing overall costs and/or providing better service during peak periods were considered. The first, increasing overall revenue, would dictate that the new charging method should be one that attracts new jobs and has a minimal effect in encouraging existing work to be shifted so as to process under the lower rate. The second approach would be one that encourages some portion of the existing peak-load jobs to be shifted to off-peak periods. However, if this were to be the goal it would be necessary to determine that resource costs would be reduced in a meaningful measure prior to implementing the new rate. The third approach is similar to the second except that, rather than reduce operating costs, better processing service would be provided for more jobs during peak periods.

Determining Rates

As the result of establishing incentive rates for off-peak processing, in all probability the overall recovered revenue for the department will be decreased. This would be the result of a certain number of jobs that will be shifted from on-peak to off-peak periods to take advantage of the lower rates. The actual impact on revenue of this type of redistribution of work load can only be speculative at this time. However, it will in all probability not be in a direct ratio to the difference between the two rates.

Determining Applicability of Incentive Rates

To serve the load leveling objective, incentive rates should only be available for jobs that can be started and completed during off-peak periods. A work load profile of the central processing units indicates that presently this off-peak period extends from approximately 3:00 AM to 8:00 AM during normally staffed priods of operation. Therefore, if incentive rates are to be adopted, it would be the recommendation that such be appliable to any job normally requiring four or less hours elapsed processing time that can be started any time during the 12:00 Midnight to 6:00 AM period.

Monitoring and Controlling the System

As mentioned earlier, an incentive charging scheme requires continual monitoring to assure that it is achieving the desired goals. This monitoring activity may require as little time as a few hours per month under situations where everything is performing as anticipated, or it may require a substantial amount of effort under circumstances where new rates need to be prepared and the using departments informed of the change. Over and above the cost of the continuing monitoring activity there will be a rather substantial programming effort required to prepare the necessary monitoring reports at the time the jobs are being processed.

Impact on Charging System

If an incentive rate plan is to be implemented, it will require a certain number of modifications ot the charging system. These changes would involve not only the charging computations, but in all probability require additional information be carried on the reports for use by the using departments.

D - CONCLUSIONS AND RECOMMENDATIONS

It is concluded from this Study that, if even a simple incentive rate structure were to be implemented, a rather substantial initial investment would be incurred. That, based on the experience of one company that tried such a scheme (reference EDP ANALYZER, Page 4, November 1973), the results are highly unpredictable. That to be effective such a plan must control the distribution of work between peak-load and off peak-load periods. This control can only be accomplished through proper rate administration. Proper rate administration can be expected to result in fluctuating rates which are normally undesirable from the users' viewpoint. That, even if successful, the overall benefits to the Company would be minimal unless a meaningful reduction in operating costs could be achieved. Therefore, it is not recommended that an incentive rate plan be initiated at the present time.

If further interest is generated in this area, it is recommended that some trial rates be established and administered and evaluated on a manual basis before incorporating this type of rate into the normal scheme of charging.

APPENDIX C

APPENDIX C

ALLOCATION OF DATA PROCESSING EXPENSE

(Firm D)

Objectives:

a. Provides the data for the monthly control of Data Processing Expense to user (or requesting) departments.

b. Provides the reasonable prorates to be applied to the actual Data Processing Expense allocation for accounting purposes.

c. Provides the historical percentage data of prorate by charged department, for the budgeting purpose.

Approach:

Three basic concepts are used to develop prorates:

Job Code: All operations must belong to a particular job code. A job code consists of an average of over ten programs.

Requsting Department: Called a user department, which has a direct contact with Data Processing Department and has the responsibility for the expense control.

Charged Department: A inal burden center to which the expense is charged.

The expense is accumulated by job code, then allocated by requesting department and by job code, and finally reallocated by charged department. This step is taken by using the predetermined rates of facotrs involved.

Total Data Processing Expense in 8890 [the centralized data center] is divided into two types in terms of the approach method:

<u>Computers Expense</u>: The expense concerning routine program running,
-Central Processing Unit Expense (CPU)
-Line Printer Expense
-Tape Drive Expense
-Online Expense
-Disc Expense
-Atcom Expense

<u>Others</u>: The other expenses,
-Systems Development Expense
-Programming Expense
-Data Preparation Expense
-Microfilm Expense
-Flat Charges

<u>Development of "Computers Expense" Allocation</u>

The basic method is to estimate the burden, to keep it unchanged, to accumulate the actual (or the other suitable units), then to develop rates, and finally to break down the burden by job code.

<u>Estimation of Burden</u>

Computers Expense is divided into the seven basic burden centers based on the function of each. The monthly burder amount in each basic burden center is accumulated based on the estimation of the expense which is considered to be charged to the particulár basic burden center. The basic burden centers and the structure of the burden are as follows:

(1) Basic CPU Burden

CPU Rental (from Purchase Order)	______
Miscellaneous Hardware Rental (P.O.)	______
Program Rental (P.O.)	______
Special "Slop" Miscellaneous Expense (Prorates and so on)	______
X Number of Directors	______
X Supervisors	______
X Softwares	______
X Operators	______
X Stenographers	______
Total	$______

(2) Basic Printer Burden

Hardware Rental (P.O.)	______
Expense Material	______
X Supervisors	______
X Operators	______
Total	$______

(3) Basic Tape Burden

Drives at $______ (P.O.)	______
Drives at $______ (P.O.)	______
Miscellaneous Drives (P.O.)	______
Tape Controllers Rental (P.O.)	______
X Supervisors	______
X Operators	______
Total	$______

(4) Basic Online Burden

Program Rental (P.O.)	______
Controllers Rental (P.O.)	______
X Software	______
X Operators	______
Total	$______

(5) Basic Disk Burden

3330's (P.O.)	$______

(6) Fixed Batch Burden

Hardware Rental (P.O.)	______
X Supervisors	______
X Operators	______
X Librarians	______
Total	$______

(7) Basic Atcom Burden

Hardware Rental (P.O.)	______
X Software	______
Total	$______

<u>Accumulation of "Actual" CPU Hours and the Other Operation Factors</u>

In order to develop the rates to applied to the above basic burdens, the following factors are counted and accumulated by built-in-counters. Accumulation is made <u>by job code</u> and then <u>totaled</u>.

(1) CPU Hours: Batch CPU Hours (All other than below)
Printer CPU Hours
Online CPU Hours
Atcom CPU Hours

(2) Line Count

(3) Tape Drive Hours

(4) Disk Tracks: Work Space Disk Tracks
Online Disk Tracks
Permanent Disk Tracks

(5) Atcom Blocks

Development of Burden Rates

The objective of developing Burden Rates is to allocate the total basic burden into each job. For instance, dividing the Basic CPU Burden by Total CPU Hours provides CPU Rate per hour. CPU Rate times CPU Hours of a particular job code becomes CPU Burden Amount of that job. However, there exist some transfers between basic burden centers, because some function must bear the burden of the other functions. Printing uses CPU, for example.

The following calculation steps are taken:

Basic CPU Burden : a
Basic Printer Burden: b
Basic Tape Burden : c
Basic Online Burden : d
Basic Disk Burden : e
Fixed Batch Burden : f
Basic Atcom Burden : g

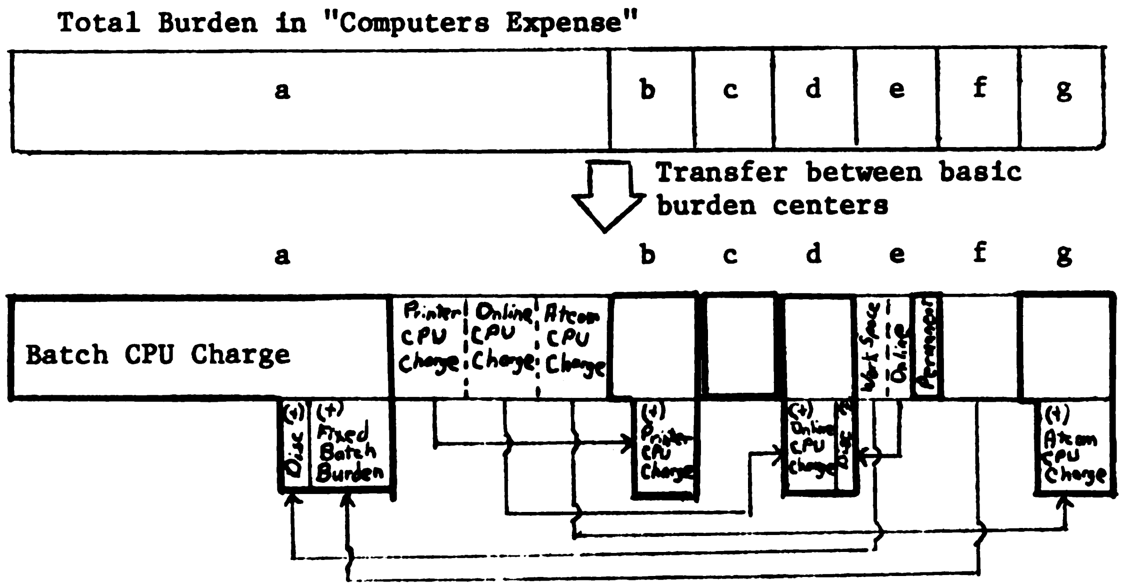

Figure A-1. Illustration of Calculation of Burden Amounts

(1) Calculation of Total CPU Hours

$$\begin{array}{l} \quad \text{Total Batch CPU Hours} \\ + \text{ Total Printer CPU Hours} \\ + \text{ Total Online CPU Hours} \\ \underline{+ \text{ Total Atcom CPU Hours}} \\ \quad \text{Total CPU Hours} \end{array}$$

(2) $$\frac{\text{Basic CPU Burden (a)}}{\text{Total CPU Hours}} = \text{a Rate}$$

(3) a Rate x Total Batch CPU Hours = Batch CPU Charge
a Rate x Total Printer CPU Hours = Printer CPU Charge
a Rate x Total Online CPU Hours = Online CPU Charge
a Rate x Total Atcom CPU Hours = Atcom CPU Charge

(4) Determination of CPU Rate (Batch CPU Rate)

$$\frac{\text{Batch CPU Charge + Fixed Batch Charge + Disk Work Space}}{\text{Total Batch CPU Hours}}$$

= CPU Rate per CPU Hour

(5) Determination of Line Rate

$$\frac{\text{Basic Printer Burden + Printer CPU Charge}}{\text{Total Line Count}} = \text{Line Rate per Line}$$

(6) Determination of Tape Drive Rate

$$\frac{\text{Basic Tape Burden}}{\text{Total Tape Drive Hours}} = \text{Tape Drive Rate per Hour}$$

(7) Determination of Online Rate

$$\frac{\text{Basic Online Burden + Online CPU Charge + Online Disk}}{\text{Total Online CPU Hours}}$$

= Online Rate per CPU Hour

(8) Determination of Disk Rate

$$\frac{\text{Basic Disk Burden - (Work Space Disk + Online Disk)}}{\text{Total Disk Tracks}}$$

= Disk Rate per Track

(9) Determination of Atcom Rate

$$\frac{\text{Basic Atcom Burden + Atcom CPU Charge}}{\text{Total Atcom Blocks}}$$

= Atcom Rate per Block

Development of Burden Amounts by Function by Job Code

(1) CPU Amount = CPU Rate x CPU Hours
Consists of: Basic CPU Burden
+ Fixed Batch Burden
+ Work Space Disk Charge
- Printer CPU Charge
- Online CPU Charge
- Atcom CPU Charge

(2) Line Amount = Line Rate x Line Count
Consists of: Basic Printer Burden
+ Printer CPU Charge

(3) Tape Amount = Tape Drive Rate x Tape Drive Hours
Consists of: Basic Tape Burden

(4) Online Amount = Online Rate x Online CPU Hours
Consists of: Basic Online Burden
+ Online CPU Charge
+ Online Disk Charge

(5) Disk Amount = Disk Rate x Disk Tracks
Consists of: Basic Disk Burden
- Work Space Disk Charge
- Online Disk Charge

(6) Atcom Amount = Atcom Rate x Atcom Blocks
Consists of: Basic Atcom Burden
+ Atcom CPU Charge

Each job code has the above amount by function, as well as the total. The total amount by job code and its grand total provide "All Data Processing Expense" data with "computed expense".

Development of "Others" Allocation

The other type of approach in Data Processing Expense Allocation is based on the development of the predetermined rates and the accumulation of actual manhours.

Development of Rates per Manhour

(1) Systems Developent Rate

(2) Programming Rate
(1) and (2) are calculated together.

Salaries

41 People - 5 systems analysts, 36 programmers = $\$\underline{\ A\ }$
41 x 8 hours x 21 days x 12 months = 82,656 hours per year
$\$\underline{\ A\ } \div$ 82,656 hours = $\$\underline{\ a\ }$ per hour basic rate

Employee Benefits

41 People x $\$\underline{\text{(given)}}$ each = $\$\underline{\ B\ }$
$\$\underline{\ B\ } \div \$\underline{\ A\ } = \underline{\quad}\%$ x $\$\underline{\ a\ } = \$\underline{\ b\ }$ per hour benefits

Overtime Premiums & Cost of Living Allowance

Cost of Living - 41 People x $\$\underline{\text{(Given)}}$ each = $\$\underline{\ C\ }$
$\$\underline{\ C\ } \div \$\underline{\ A\ } = \underline{\quad}\%$ x $\$\underline{\ a\ } = \$\underline{\ c\ }$ per hour C.O.L.A.
Overtime Premium - $\underline{\text{(given)}}\%$ x $\$\underline{\ a\ } = \$\underline{\ d\ }$ per hour O.T.

Buildings, Services, Utilities, Etc.

$$\$\underline{\text{ (Prorate) }} \times \frac{\text{41 People}}{\text{Total Data Processing People}} = \$\underline{\ E\ }$$

$\$\underline{\ E\ } \div$ 82,656 hours = $\$\underline{\ e\ }$ per hour Buildings, etc.

Supplies and Miscellaneous Office Equipment

$$\$\underline{\text{ (Prorate) }} \times \frac{\text{41 People}}{\text{Total Data Processing People}} = \$\underline{\ F\ }$$

$\$\underline{\ F\ } \div$ 82,656 hours = $\$\underline{\ f\ }$ per hour Supplies, etc.

Supervision, Clerical, and Administrative Expense

7 People - 1 steno., 1 analyst, 1 director, 4 supervisors
calculation is the same as above

$\$\underline{\ g\ }$ per hour Supervision, etc.

Total a + b + c + d + e + f + g = Systems Development Rate
= Programming Rate

(3) Data Preparation Rate

Same Method, includes rental of specialized equipment

(4) Microfilm Rate

Same

(5) Flat Rate

Fixed charge of machine rental located outside General Operation Computer Room, but charged to 8890.

Accumulation of "Actual" Manhours

Actual manhours are measured by job code and by category. After totaling of manhours by category, the above rates are adjust for the actual manhours. The adjustment is made because the above rates are calculated on the basis of 8 hour working day but the actual hours for allocation are measured based on the actual working hours. That is, if the rate is \$13 per hour and the actual average working day is 6 hours, the rate to be applied becomes $\$13 \times \frac{8}{6} = \$17.33$.

Requesting Department Splits

Data Processing Expense is finally charged to burden centers. However, as a step, requesting departments are designated to each job code. Approximately 20 jobs out of over 300 have more than one requesting department. The determination of the allocation between these departments is rather arbitrary like 33% for Manufacturing, 33% for Sales, and 34% for Administration. The Cost Department develops splits annually.

Development of All Data Processing Expense by Job Code by Requesting Department

Adjusted Rate x Actual Manhours by Job Code = Expense by Job Code

Computers Expense is consolidated with "others" at this step. As a results, the aggregate Data Processing Expense is prorated into each requesting department on the predetermined basis. A requesting department, which has the responsibility for cost control, can check not only this total expense of each job but the expense breakdown by function (Such as Programming, Printer, Online, etc.) of that. The data can contribute to cost reduction in the direct way such as the change from online to line printer, for example.

Allocation of Data Processing Expense to Charged Departments

Data Processing Expense must be charged to each burden center as a cost for the departmental cost control purpose. Furthermore, this cost must reflect the actual cost incurred in data processing centers.

Charged Department Splits

The accumulated expense by job code in each requesting department is allocated to burden centers. Cost Department develops prorate percentages for this purpose annually, through Budget Prorate Study. The basic idea of percentage development is that the specific job expense should be allocated to burden centers following the extent that these centers receive benefits through the job. As a practical method, volume oriented allocation and expense oriented allocation are most common.

Allocation of Expense

The allocation is made by using the charged department splits, by job code on the requesting department basis.

Allocation of Expense by Data Processing Expense Sub Account

The expense is rearranged by charged department in order to meet the need of accounting, where the breakdown is made by sub account. Charge amount is totaled by charged department and percentage by charged department is gained, which is to be used as the historical data for prorate percentage in budgeting.