The computer has been so widely accepted as a tool of management that there is no longer any debate about its ability to serve the needs of management. But, unfortunately, the introduction of a computer does not in itself guarantee increased effectiveness, efficiencies or profits for the firm. Rather, the computer must be viewed as still another management resource from which certain benefits can be extracted but these advantages do not automatically result from installation of the device. Even in view of this fact, the number of computers being used in business continues to increase at a rapid rate, how rapid being dependent upon which set of projections one chooses to believe. Today, the question is not should a computer be used, but rather how management can best use the computer to serve its needs.

In its survey McKinsey and Company found that while some companies were able to make profitable use of computers others were not (profitable being used here in the sense of both direct and indirect benefits). Their survey indicated that the realization of the computer's potential has its basis in recognition of managerial rather than technical requirements. The companies showing the greatest profits were typically those which recognized the potential of the computer for problem solution throughout the organization. On the other hand, the less successful users were using computers for routine unimaginative activities. Perhaps the most important conclusion of the report is

In the successful companies, top management demonstrated a balanced point of view on computers' potentials and demands. In the average company, by contrast, corporate executives typically underrate their potential or else overrate the importance of the technical requirements.  

In another study made by the National Industrial Conference Board, the failure of managerial personnel to involve themselves with the computer's potential was indicated by the conclusion,

For the purpose of this study,  

Most managements want to know the reasons (supported by facts) why their companies should approve the use of electronic computers. But they are seldom concerned with the mechanics or operating details, except as they affect the policies or general organization structure of the company.
This paper deals with certain aspects of the need for a balanced point of view by management rather than the indifference so frequently encountered. Intensive studies of eight computer centers suggest that management philosophy toward the computer's potential and the role of the computer center in the organization is one of the crucial variables in achieving profitable utilization.

For the purposes of this study,

A computer center consists centrally of a computer, of the stored program type, surrounded by the supporting personnel and equipment to use it. Jobs or demands for services of the center originate both within the center and from organizational units outside of it.

The computer center is unique in that it focuses upon a machine and will therefore be an organizational entity regardless of where it may be assigned within the firm. The attitudes and perceptions of the managerial personnel of the firm will dictate the legitimate activities the center may undertake and will thereby influence the orientation of the personnel assigned to the computer center. Central to this discussion is the concept of classification of the center since it is in this way that management tends to bound its perception of the computer's capabilities. Therefore, we will first consider classifications of centers and then the relationship of such classifications to personnel practices and performance.

CLASSIFICATION OF COMPUTER CENTERS

Traditionally, computer centers have been defined as either business or scientific. "Business" generally meant that the center processed essentially accounting information such as payrolls, inventory transactions, cost data, etc. "Scientific" implied that the center was engaged in solution of unstructured and often loosely defined problems. In the early days of the application of computers to business these classifications may have been useful. For the business center a good accountant could be trained to translate manual or unit record procedures to a program for a "business" type computer. On the other hand, engineers, scientists and mathematicians were required to provide comparable skills for the more expensive and more complex "scientific" computer. Whatever usefulness the two categories may have had has disappeared and in most cases their retention tends to so limit management's perception as to inhibit the development of effective computer operations.

Rather than labeling the computer center in terms which tend to describe the nature of its predominant activity, we suggest management's perception of the center and its role in the firm should be in terms of the degree of structuring of the center's tasks, a concept originally advanced at the 1963 meeting of the Computer Personnel Research Group.4 By degree of structuring is meant the amount of independence the computer center has in dealing with an assigned task. For example, a payroll would usually be a highly structured task. Similarly, processing of checks in a bank would be highly rigid. In both examples the design of the computational procedure is dictated by the data requirements of the firm. Further, these structured tasks tend to become rigid due to volume and legal aspects inherent to the nature of such processes. At the other extreme would be the development of a computer-based simulation of the firm where experimentation and analysis of alternative policies are the objectives. This would be classified as an unstructured task. Thus in the general category of business applications we find both structured and unstructured jobs are among the jobs which may be presented to the computer center. In similar fashion, scientific applications may possess the same range of structuring. The routine reduction of orbital data is, for example, highly structured, while the development of new computer techniques to analyze such data is conversely less structured. It is in terms of a continuum with these two end points that a classification scheme should be developed for a computer center rather than in the descriptive designations of business or scientific.

The center whose mission is unstructured will receive assignments from various organizational units and will be required to use a great deal of ingenuity and flexibility in defining and solving the problems presented; a structured problem is one which would require the computer center to routinely process a set of data in a prescribed manner. In discussing the design of scientific computing facilities, Wagner and Granholm5 have used a somewhat similar conceptual framework for classifying scientific type computational requirements.

Seldom will one find a computer center which is solely devoted to unstructured type of activities, but it is relatively simple to identify many which oper-
ate only on highly structured jobs. Computer centers are required to adapt to the needs of the organization they serve and to process jobs which are both structured and unstructured. Typically a center within a business organization will be processing routine payrolls and other accounting information and will also be engaged in solving management science problems which may involve computer simulation, linear or non-linear programming, queueing theory or other such methods. Non-management science tasks frequently are presented by engineering or research groups. Among these tasks might be, for example, the solution of a problem requiring the inversion of a matrix, generally a highly structured job. On the other hand, the engineer may ask the computer center to develop methods for appraising and analyzing potential new methods of dealing with old problems, an unstructured task.

Subsequent to the original research on which the paper is based another element which must be taken into consideration is that of the changes in available equipment. In particular is the availability of equipment which will permit the simultaneous processing of both structured and unstructured problems, regardless of their organizational origin. Also to be considered is the availability of time-sharing systems with remote consoles which make the computer available to all users without regard to the nature of their problem. In this regard, Fernbach recently pointed out that, "Ten years ago, one was careful not to discuss business and scientific computers in the same tone of voice. Today one thinks of systems that will do everything."6

Faced with the problem of simultaneously undertaking tasks occupying different points on the structured-unstructured continuum the computer center must adjust itself to satisfactorily meet both types of demand. Our research has indicated that in this condition two parallel organizations tend to develop within the computer center—one to handle structured problems and another to handle unstructured tasks. It does not appear efficient, or effective, to have a single group handling both types and, as will be discussed later, in some cases it may be undesirable to place differing demands on a single group of employees.

This partitioning of the organization is illustrated by the experience of a large manufacturing firm which makes extensive use of computers. Within its computing center is one group called the Data Processing Department which handles all routine processing of data regardless of the origin of the work, i.e., commercial, scientific, engineering, research, etc. There is also a group referred to as the Scientific Programming Department which deals with non-structured tasks emanating from the same work sources. Each group has its own director who reports to the head of the computer center. This formalized duality of organization represent management's recognition of an informal system which embodied the same concepts but tended to prohibit economical use of available computers. The inefficiencies resulted from identification of specific machines with the two groups and thus restricted the use of a specific computer to either the scientific or data processing group. Thus the newest machine became known as the "scientific computer" even though it was identical to many others being used for highly structured tasks. This did not mean that the machine was idle most of the time; in fact, it was operated three shifts per day. The loss in effectiveness resulted from the fact that many of the scientific-type problems possessed considerably lower priorities than those assigned to many highly structured, routine jobs. Formalization of the dual organizational structure permitted central scheduling for all computers and in this way management's philosophy adjusted to a solution which, although contrary to traditional concepts, permitted more effective operation.

MANAGEMENT PHILOSOPHY

The relationship of management philosophy to the continuum between structured and unstructured tasks is demonstrated in the ability of the computer center to respond to the needs of the organization. The essential factor is that management face up to two questions:

- Why does it have a computer center?
- What does it need from the center?

In answering these questions management must not only reconsider the initial planning for development of its computer center but must also review the results of their plans. Further, if management expects to obtain anything near optimum use of their computer they must be prepared to devote to this activity an amount of time proportional to its cost and potential.
In too many firms we found these questions are answered by default. The computer is brought in as a highly structured, task-oriented machine. Later, when other demands are placed on the center it typically is not able to perform the service. This results from a failure to recognize the need to prepare for such change. This may, in part, account for the expansion and proliferation of firms specializing in consulting services to computer users. But more important than the added cost of this failure to prepare for changing demands are the organizational pressures and waste which can easily result. A typical and unfortunately too frequent example of such waste is the case of the Linear Company* which we studied in depth. This firm history clearly demonstrates the disadvantages which result from narrow and unrealistic definitions of the role of the computer center within the firm.

The Linear Company installed a large computing system to perform a highly structured task. Relative to this task the computer center was doing an excellent job; in fact, management had nothing but praise for the success of the computer application. However, management’s perception of the role of the computer center was “to process orders and effectively maintain inventory.” The director of the computer center understood he had under his control a large machine with substantial idle time and a staff which was capable of dealing with other problems. The research department of Linear Company had been assigned the task of developing a computer simulation of the firm which would be used to test management decisions and changes. The director of research and his staff laid out the general nature of the project, engaged a consulting firm to have the simulator programmed, and then contracted with a service bureau for the required computations. Whenever management sought advice on a question which was applicable to the simulator they merely had the service bureau enter the current information and make a run. Then the research department would analyze the output. Naturally the service bureau charged a high, but reasonable, rate for their services. But with idle time in the company’s computer center, we might question the necessity of the research department utilizing facilities of other organizations.

We find the answer to this question in analysis of the attitudes of the personnel involved and their preconceptions of the role of the firm’s computer center. Management’s view was, “the computer center’s job is to maintain inventory and associated records.” The director of the computer center felt, “we are a computer center and are capable of satisfying all of the company’s computational needs.” The director of research obviously “heard” management’s view and felt, “the computer center can not handle our type of problem.” Since their project differed from the accepted mission of the computer center, they sought outside computer services. The consequence was delays in obtaining results and organization frictions and frustrations. The director of the computer center was unable to understand why, “the director of research was so unfriendly.” On the other hand, management saw nothing wrong with the arrangement. Management’s perception of the role and mission of its computer indicated to the Director of Research what his proper behavior should be. This is an unfortunate example of misuse of available resources.

THE INTERACTION OF THE CLASSIFICATION SYSTEM AND PERSONNEL

Not only will management’s philosophy determine the legitimate scope of activities of the computer center but it will also influence the way in which the center is staffed. This influence will demonstrate itself in that staffing will be in such a manner that it can most effectively respond to management’s demands and management’s perception of the proper role of the center.

People who are able to successfully communicate and relate with computers may be broken into at least two major groupings, those with predominately professional orientations and those primarily organizationally oriented. By professional orientation we mean people who relate to the profession of computation rather than to a specific firm or to a specific goal of the firm. Typically such an individual will be a member of at least one professional computer group. He is more likely to have been attracted to his present employer from the general computer labor market and will tend to look back there in addition to his present employer for opportunities for advancement. He is the person most likely to be attracted by the professional recruiter at a computer conference or by an advertisement in a computer journal. He thus tends to possess a potential for relatively high mobility, and

*Fictitious.
recognizing this potential he tends to try to increase his abilities so as to develop professionally thereby opening new opportunities for himself not only with his present employer but also in the general labor market. This person will tend to be extremely competent and will usually be best suited for dealing with relatively unstructured assignments. Structured assignments will fail to present a challenge to him with resulting lowered performance and morale. Continued structured assignments may cause him to seek a new employer where assignments are commensurate with his abilities and interests.

The counterpart of the professionally oriented individual is one whose major loyalties and goals are to the firm. He is typically selected for his computer position from some other organizational unit within the firm and then trained for his present position. This person does not usually view the computer field as his profession but rather as another assignment in his progress through the hierarchy of the company. Thus he tends to force the computer into the mold of his area of major interest rather than restating his personal values in terms of the computer. Self-development is likely to be limited to those aspects of computer technology which directly relate to his next position within the organization and to his specific functional profession, if he possesses one. His objectives will tend to emphasize proficiency and greater understanding of his employer's objectives, and on this basis he will tend to be most compatible in dealing with the more highly structured tasks within his field or primary interest. Typical of such individuals are accountants who are assigned to a computer center to implement data processing applications in the accounting area or engineers who are assigned to provide the technical ability required to systematize and program a technical application. Both look to their primary interest fields for advancement and usually do not consider the computer labor market when they decide to change jobs.

The importance of recruiting computer personnel whose personal orientation is compatible with the role assigned the computer center within the organization is further emphasized in a study by Deutsch & Shea, Inc.⁷ In this study of 549 programmers it was found that 21.1 percent of the respondents indicated that internal climate, management politics, and working conditions were a factor in causing them to leave their previous job. In addition, 18.4 percent replied they changed jobs because of lack of job interest.⁸ This is especially interesting because the study states, "we feel that the sample involved is not representative of the total population in the sense that it is skewed, by virtue of its source, towards programmers with experience in the scientific aspects of programming."⁹ The source of the sample was the membership file of the Association for Computing Machinery.

It is possible to distinguish between those programmers with different orientations. In a recent RAND study¹⁰ a number of tests were given to programmers which were then correlated with supervisory ratings. It was found that:

Correlation with supervisor's rankings for the Programming Aptitude Test and the Test of Sequential Instructions were higher for the scientific sample than for the business sample. For the scientific sample there is good predictive information available from high and low group scores. For the business sample the study shows that the best predictive value is in the second highest test score group and in the lowest group.¹¹

In an examination of the interests of both groups, the RAND study reported:

Overall, both samples expressed an overwhelming preference for mathematics subjects. This would certainly be expected of the scientific sample which was composed largely of people with math backgrounds (63%), but it included the business programmers, of whom only 18 percent had backgrounds in math.¹²

Thus if management has defined its needs it is possible to staff the center with the type of personnel who can make the greatest contribution. If the center’s activities are restricted primarily to a set of highly structured tasks, carefully selected intelligent individuals from within the organization can be trained to adequately perform such tasks. If new personnel are needed they might be hired from other businesses with similar activities. If, on the other hand, management is required to go to the general labor market to acquire its computational skills, it could easily and inadvertently disrupt a highly structured center.

CONCLUSIONS

Management’s philosophy as demonstrated in the staffing of the center tends to establish parameters
on the profit potential of the computer center. It appears that in the short run highly structured centers are most efficient. That is, they implement desired procedures and complete assignments in the shortest possible time and at relatively low cost. But this apparent efficiency is short lived, for in the long run the lack of questioning attitudes, the failure of the center to formulate alternative solutions to policy problems if not to completely fail to comprehend the total problem rather than the specific segment under consideration, and the lack of experimentation will lead to higher costs in terms of both production and lost opportunities. Possibly even more serious is the inability of such center to deal with new challenges without outside assistance. This condition is well displayed in the dependence of such organizations on consultants or the technical staffs of computer manufacturers.

Optimizing on short-run considerations is obviously not the best way of introducing the computer into a firm, but this philosophy will probably not change for some time. It has been suggested that the optimal return from the computer results from applications somewhere between the highly structured and highly unstructured endpoints. This hypothesis is in accordance with the findings of the McKinsey study which indicated that those companies which had used computers for only routine, unimaginative classes of activities such as payroll, billing, inventory, etc. failed to show a profit. Those indicating optimal usage were the firm which resorted to what we might call higher ordered applications of computers to problems, problems which emanated from relatively unstructured tasks. But if the center has been staffed solely for fully structured tasks, it will be unable to cope with a change in management’s need.

IMPLICATIONS

From our intensive study of eight computer centers it can be concluded that, while computers may be installed to meet a specific need, a broader frame of reference is required in management’s approach to the assignment of tasks and the staffing of the department. A department established to meet rigidly defined or implied managerial needs may never have the imagination or perception needed to break out of this tight mould and engage in new and more profitable uses of the computer.

On the other hand, the computer center cannot be allowed to run rampant, acting as an end unto itself. As an organizational unit it must show a profit and assume its place as a responsible member of the organization. The NICB study pointed out that “In organizing an electronic data-processing activity, the authority of the manager and the internal and external relationships of the various work units require careful consideration to ensure efficient and harmonious operation.”13 This view is reinforced and expanded by Brabb and Hutchins who state “The primary administrative responsibility of the manager of data processing can be defined as the organization of the EDP department to more effectively contribute to the over-all objectives of the company.”14

In no way does this portend a new order of things in which management tends to be subservient to the computer center. Rather, attaining the profit potential of the computer requires clear understanding of its capabilities and the adjustment of managerial philosophy over a period of time. Unlike most of its other equipment investments, management should not perceive the computer as a static, single purpose machine facility or as merely another means of increasing productivity; instead the need is for a viable attitude and a constant quest for new applications and uses for the computer.

REFERENCES

2. Ibid., p. 174.
8. Ibid., p. 44.
9. Ibid., p. 6.
11. Ibid., p. 19.
12. Ibid., p. 16.