search, design, budgeting, effective use of resources, and accepting responsibility for his own decisions and the final outcome of his endeavor. It means a move away from the illusion of efficiency through specialization by functions. Instead, specialists in successful pioneering are demanded. It means a determined effort to grow “empire builders” because our new frontiers are indeed the size of empires.

References


Discussion

R. A. Spohn (International Business Machines Corporation): Are there any examples of companies who have overcome the market decline problem?

Professor Forrester: Yes. Companies that are alert to the danger make it a policy to live in a succession of profitable peaks on a series of product life cycles. This can be done as a considered, designed policy if one understands the forces at work. Such companies are in the minority, but enough have persisted in looking ahead to new products and discarding the old ones to indicate that the system can be successful.

B. C. Heyel (ADP Services, Inc.): The big trouble is that today’s enterprise demands such huge investments that the old-type pioneers cannot get started. What can be done about this?

Professor Forrester: There is ample capital looking for good men with good ideas. I am not speaking of the old-type pioneer who would follow exactly the pattern of the past; that is no longer pioneering. There are many examples of new enterprises which grow from the ability of one or two men to manage well and to attract and use money available for new investment. For example, two men that I know have started a new company in the digital equipment business; they have shown a net profit for their first full year of operation; are exceeding a half million dollars a year of commercial, nongovernment business before the end of their second year; and they are effectively selling to the largest companies in the field and also successfully competing against them.

It only takes sound judgment, skill, imagination, integrity, a clear interpretation of the signs and trends of the future, and confidence. Investment money seeks out such people.

Data Processing in Banking and Other Services

B. W. Taunton

In general, the managers of the more progressive industrial firms early recognized the advantages that might be gained through the use of digital and analog computers to supervise and control manufacturing and production operations. No doubt this is due, in part at least, to those pressures which require the enterprising firm to seek out and try every means of improving its products and the efficiency of its production, in order to maintain a competitive advantage. Perhaps it is also due in part to the familiarity of such concerns with machines.

But the use of computers for the processing of data, so far, has been relatively limited. Generally, management has been reluctant to depart from the more orthodox accounting and reporting procedures with which they have been familiar, in favor of a new system, which, at first blush, appears to be costly and perhaps, more important, involves so many unknowns. In the author’s opinion, it is the latter uncertainties of the successful installation and operation of such equipment even more than the expense that is involved that has discouraged these managers from taking such a step. The manufacturers of the equipment, in many instances, may be partially responsible for this situation, since they have contributed to the uncertainties, through lack of knowledge of how to use effectively the equipment which they are making and, in many instances, they have been responsible for undue delays in the perfection of design, production, and delivery of equipment which they are endeavoring to market in advance of actual construction.

During the 10-year period between 1947 and 1957, professional and technical workers have increased at the rate of 60.6% and clerical workers at the rate of 22.8%. During the same period factory workers have increased only 4.4%, and the laboring forces only 4.1%, the latter in spite of the fact that over-all production of consumer and other goods has grown by leaps and bounds since the second World War. Unless one learns from industry the advantages to be gained by the use of more advanced and automatic techniques to increase effectively the production of clerical workers, the point where the economic burden of doing clerical work is impossible to bear, even if a sufficient number of workers is found to do it at all, will be reached soon.

It would seem that the use of electronic data-processing equipment will go a long way toward solving accounting and other data processing problems, and it is believed that this will be equally true in the case of the smaller firm, as well as the larger one, since such equipment may be obtained in large or small capacities and consequently at relative cost to meet the needs of concerns of various sizes. Furthermore, the author believes that, with proper study and planning, a computer system can be selected, installed, and put upon an operating basis on schedule, if the schedule is a realistic one. As a practical illustration, a discussion follows of the experiences leading to the selection and installation of a large-scale data processing system at the First National Bank of Boston.

As early as 1950, the Methods Department began to take cognizance of the existence and development of computer systems which might be used in data processing operations. In 1954 it became quite evident that the developments in this field were such as to warrant the assignment of at least one member of this department to its study on a full-time basis. Thereafter research activities became much more intensified.

It was decided first to attempt to find some practical means of determining the answer to two basic questions. First, could electronic data-processing equipment be used in any one or more of the bank’s applications effectively? Second, if the answer to the first question was “yes,” what kind of equipment should be used?

The first of these two problems, that of whether or not to use electronics at all is considered. Of the more than 90 different types of services which are offered to cus-

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tomers, there were several requiring the manipulation of large files of data, such as check handling for approximately 108,000 customers, personal trust accounting, installment loan accounting for approximately 65,000 borrowers, commercial loans, mortgage loans, and factoring accounts involving records for some 78,000 debtors accounts, corporate trust accounting, involving 765,000 accounts, payroll, some 83,000 savings accounts, personal money orders, and others. Some had already been mechanized to a considerable extent through extensive use of such modern techniques as those involving punched-card equipment. Others had changed little over the years and encompassed a tremendous volume of paper work. Of course, one specific application could have been selected, perhaps one of those least mechanized, and the introduction of the use of an electronic system in that area could have been attempted. This approach, however, seemed to be too limited in nature. It is frequently heard that the stored program computer is referred to as general-purpose equipment. It was reasoned, therefore, that if this be true it might be anticipated that the equipment could be used in various applications, if it lived up to its label. So, a different approach was tried.

The larger applications were examined with a view to selecting two of them that might represent the extremes in requirements for data processing, that is, the upper and lower limits of data processing requirements that any particular system could be called upon to handle. As a result of these studies, two applications were selected, the deposit accounting function and the corporate trust operation. Here were two that were diametrically opposed to each other. To round off figures, more than 220,000 items were processed on the average day against 100,000 checking accounts. Forty-eight percent of these accounts were active in a given day. A fixed record length might readily be assigned to each master record which would accommodate the largest as well as the smallest account. A substantial number of mathematical operations were required to process the accounts. Little alphabetical information was involved, it being presently limited to the name and address, which must be referred to ordinarily only once a month in order to prepare statements for customers. More than 900 inquiries a day had to be processed against the file, most of which required an immediate answer. While at first blush, it would seem that the files should best be kept in alphabetical order, it developed that there was no requirement to do so. The file could be operated efficiently with a numbering system.

On the other hand, the corporate trust function involved a tremendous file with relatively few items to be posted, actually 68/100ths of 1% would be affected daily. The file must be kept in alphabetical sequence. It was largely alphabetical in nature, and very little in the way of mathematical work was required. The record length necessary was variable, running from as few as 167 characters of information in one account to more than 47,000 characters of information in another. Inquiries that must be answered by reference to the file were relatively few and far between, and in most instances could be scheduled.

All other operations seemed to fall between these two, insofar as data processing requirements were concerned. Notably, they were the two largest applications and, at the same time, the two that required the greatest amount of clerical effort. In contrast, some other larger applications have been operated since as early as 1931 on punched-card tabulating equipment.

With a complete set of statistics available relative to current operations in these two areas, attention was turned to the electronic data-processing equipment available and an attempt was made to evaluate whether or not any of it might meet the requirements. To program both applications in their entirety would be an exhaustive job. The bank, therefore, tried to analyze the problem and to reach some common basis for comparing different types of equipment. It was concluded that file maintenance in accounting procedures was the most difficult and the most repetitive and time-consuming operation. File maintenance means the preservation of a record of each account and updating it with the daily transactions, in order that it might be available at all times for the preparation of the multitude of reports that are required to operate a business. It was, therefore, determined to limit initially the studies to this phase of the data processing problems.

Next, it was determined that, within each of the three areas in which computers are classified, that is, small, medium, and large, the internal speeds of the computers then available were not significantly different. Far more important were the speeds with which these devices could process files, that is, their ability to read and write large volumes of data in order to locate the account, bring in the transaction, and write out an updated account. Hence, the relative merits of various computer systems in terms of the time which it would require to read master files and transactions, and to write the new master files for the two applications selected for that purpose were measured.

In each instance, the records were established in such a fashion as to make the most efficient use of each of the systems tested, and to take into consideration the limitations and advantages peculiar to each such system. The medium-sized computer field was chosen and one of the better known computers in this area was selected because it was felt that if one medium-sized computer was found that might reasonably perform the work, the other competitive models would be examined in turn.

The results of these studies indicated that the bank could handle the deposit accounting operation in less than 3 hours each day and 1/10th of the corporate trust file in approximately 1.8 hours each day. If any computer system could handle the specific data processing problems, it must be in this category. With this in mind, each of the large-scale computer systems then available was studied and one of them (the one which was selected) was found capable of handling the deposit accounting operation in something less than 1/2 hour, and 100%, as distinguished from 10% of the corporate trust file, in a little over one hour. It should be emphasized that these, of course, are not total processing times, but only a measure used to make comparisons, since it was the area in which the major differences in equipment existed.

The results of these studies were then, for the first time, made available to the equipment manufacturers who were requested to review them and to modify
them, if they felt the calculations were substantially in error.

In June of 1956, a report was forwarded to senior management outlining the studies to date and reporting conclusions to the effect that, 1. electronic data processing equipment was available, which could do the job, and, 2. it appeared that the system, which was eventually selected, would be capable of handling a substantial number of applications on a one-shift basis, and permitted the addition of other applications, as time went on. It was pointed out that since the time required to do the processing on this system was substantially less than that of comparable models, at comparable prices, the machine selected, as first choice, would be the more economical of those available.

Until this time, little thought had been given to the economic feasibility of acquiring a computer system of any type. The department had merely determined the answer to two questions: Could such equipment be used effectively and, if so, what specific system might best do it?

Here the cost department took over and began to draw some comparisons between the cost of operating the recommended system and existing costs. This subject will be treated only briefly. Basically, the position was taken that installation and conversion costs should be amortized over a period of years. It appeared that during the first 2 to 3 years of operation, increased costs should be anticipated but that, thereafter, they might be reduced, particularly when additional equipment of a peripheral nature could be acquired which would facilitate the transfer of data encoded on paper checks to machine language to be processed within the system. No attempt was made to reduce to figures such intangibles as continuing increases in salaries with a consequent increase in conversion costs postponed to a later date, or the hidden costs to be found in the less efficient, but more orthodox, procedures which are followed today. Nevertheless, it is believed such increases will serve as a substantial cushion to absorb ultimately any miscalculations that may have been made.

When the department submitted what proved to be the last feasibility report to management, together with a recommendation that such equipment be acquired, a suggestion was included that the studies be reviewed by independent consultants. Subsequently, management retained a well-known management consultant firm to review the feasibility studies, and an equally well-known computer expert to examine the design and specifications of the computer, which then had not been constructed, and advise the bank upon the probability of the manufacturer being able to deliver one which would satisfactorily meet performance tests within the time limits suggested. With very minor exceptions, the consultants approved the findings and recommendations and, in turn, recommended that the bank proceed. Late in October 1956, a contract was executed for a system to be installed early in 1958.

Immediately, plans were implemented which had been developed for the installation and operation of the equipment. The day the contract was signed, a communication was addressed individually to each of the members of the staff. This communication briefly outlined the decision to acquire such equipment and contained reassurances that its use would not adversely affect anyone's position in the bank. Prior to this various articles in the house organ were published, periodically, with respect to the studies of electronic equipment. Therefore, the notice probably came as no surprise to the employees. Simultaneously with the distribution of the notice, a meeting of the officers of the bank was called. At this meeting, initial plans for the use of the equipment were outlined. Divisional and department heads were advised that the bank would shortly seek qualified personnel to enlist as programmers, and that their cooperation in arranging for the release of any individuals, so selected, was requested.

On October 29, 1956, the first of several courses which were to follow was inaugurated, designed to train personnel and programmers in the use of the equipment. Each of these courses was so arranged that the first 2 days provided an over-all discussion of the system; the first 2 weeks, a more detailed explanation of how it operated and how it might be used; and the remaining 4 weeks, actual training in the details of programming. Many of the senior officers and divisional heads attended the first 2 days of these courses, and department managers and supervisors attended the 2 weeks' courses.

In all, 23 people were selected for the programming staff. The group included staff members, supervisors or junior officers within the area initially to be programmed, selected for their experience in these areas. In addition, the group included three persons selected for their knowledge of, and familiarity with, the installation and operation of tabulating equipment, and four who were on our Methods Department staff. Following the completion of the 6 weeks of basic training provided by the manufacturer of the equipment, these people then attended classes of construction intended to initiate them in a method of systems analysis which would be consistent in each of the areas to be programmed, and which, in the bank's judgment, would meet the needs of an electronic installation of the type that was involved.

On January 2, 1957, the programmers were divided into three groups, one to cover deposit accounting, one to cover corporate trust work, and one to cover loan operations (the latter includes commercial loans, mortgage loans, instalment loans, and factored accounts). Each group consisted of one person formerly associated with the Methods Department, one person experienced in the use of tabulating equipment, and two or more who had been drawn from the operating departments.

The first activity of each group, the most time-consuming of the entire operation, was to analyze in detail the current operations in the area to which they had been assigned. The analysis consisted of two basic factors. First, they were required to flow chart, in detail, the flow of data from the time it entered the bank to the time it was ultimately disposed of in the accounting procedures. The type of flow charting used was considerably different from that which might normally be expected. Only five basic symbols were used, and emphasis was placed entirely upon the form of, and the movement of data, rather than who handled it, or through what departments it passed. Very little attention was actually given to departmental lines in this analysis. The second factor in the study was an analysis of the forms used to convey these data through accounting procedures. A copy of each piece of paper used, whether a preprinted form or a piece of scratch paper, completed with a typical entry or entries, was attached to an analysis sheet which gathered those statistical data which are so essential to properly program a computer. The estimates indicate that, to date, approximately 65% of the time devoted to the development of the program was spent in defining the problem, 25% in solving it, and 10% in translating it into machine language.

By the fall of 1957, plans had been developed for the preparation of the site in which the machine was to be located, and toward the latter part of the year site preparations actually began. The system, containing all of the units which were ordered, normally required approximately 4,500 to 5,000 square feet of floor space including the field engineers' quarters and the central power supply. However, in order to provide room for expansion of the system to accommodate such things
maintain an alphabetical file in this way in this operation, why do you not follow the same procedure with respect to all other files? The answer is that, in this particular type of file, a substantial proportion of the daily transactions consists of opening and closing of accounts and there is no practical way of controlling input to the system so that account numbers are reflected in the data. Every transaction must be looked up, and a number assigned to it if a numbering system is to be used. On the other hand, in an operation such as the handling of checking accounts, there are relatively few accounts opened or closed from day to day, and practically all of the transactions affecting it can be precoded with an account number, so that it is readily available when the check or deposit is presented to the bank. The low activity in the file also has some bearing, since the amount of time required for the computer to calculate the key would be quite significant if approximately 10% or more of the accounts were to be affected on a daily basis.

In addition to the applications which are presently operating on the computer system, basic programs for the loan operations are rapidly being completed, and they will be added to the electronic data processing during the coming calendar year. Thereafter, attention will be turned to such other services as personal trust, payroll, savings accounting, expense distribution, and others. At the present time, it appears that the bank will be able to handle all of these applications on the computer which has been installed and that, as time goes on, there will be need only to expand the peripheral equipment, such as the printers, to take care of these additions as well as the increases in volume that is expected.

The author has taken some time to outline the bank's experiences in approaching the use of electronics for data processing, and installing and operating a computer system. It is hoped that this outline will be accepted as being in the nature of a progress report, and that it may be of some help to potential users of electronic equipment, both large and small, as well as to those interested in the manufacture of such equipment. It is felt that many who have not already done so, are capable of accomplishing the same task and undoubtedly with better results. Perhaps this progress will encourage some to take another critical look at this tool for business. By way of summarization, the following points are emphasized:

1. The use of electronics should be of paramount interest to senior management, who must determine the result that it wishes to accomplish and be willing to support rather drastic changes in organization if need be. Select one or two individuals in whom management has implicit confidence and who have an over-all knowledge of the business and an over-all interest in its success to study the potentials to be found in the use of such equipment, and to direct the installation and operation if a computer should be ultimately selected. While much can be said in favor of committees they frequently result in extensive and expensive periods of research and little in the way of decision.

2. Make personal evaluations. Do not depend upon the manufacturers. It has been said that electronic engineers understand the mechanics of the computer but rarely the mechanics of the company. It is much easier to teach the machine to someone who understands the business, and who is progressive and willing to accept new ideas than it is to teach one who knows the machine all of the intricacies of your business.

3. Consider all your accounting problems, not just the one or two that may be foremost in your mind because they are the most critical from one viewpoint or another. A computer should not be considered as another bookkeeping or tabulating machine to be superimposed upon one or more existing operations, nor ordinarily should it be left to individual departments to decide how or why a computer should be used.

4. If the use of a computer is indicated, management has a right to anticipate higher quality work, as well as increased quantity. Question the adequacy and efficiency of present methods, but in doing so, ascertain whether or not you are talking to the man who designed them. And remember that quality and quantity can be materially dissipated by the insistence that information shall be provided exactly as it always has been.

5. If it is decided that electronics is a tool that can be applied to the specific business, select the hardware that will not only perform best now, but that will perform, at least, equally as well, in so far as possible to judge, 5 years from now. A system that is limited to fulfilling only present requirements and permitting no expansion of changes in methods may well lead to substantial and expensive changes later; changes which can wipe out all of the advantages that might be gained as a result of the initial installation.

In conclusion, emphasis should be placed on the fact that the electronic computer is a tool which, when put to proper use, will serve banks and other service businesses, as well as industrial organizations, in solving a wide variety of data processing problems. Studies which have been conducted have convinced this bank that this tool can be useful to a wide range of firms of various sizes. Appropriately, electronic data-processing systems are available in a variety of sizes, and they are priced accordingly. Businessmen should not arbitrarily assume that their organizations are too small to make it economically feasible for them to use these tools. To the contrary, avoid such ill-considered conclusions and examine carefully the possibility of whether or not such equipment will be of aid along the road to success in business.

Discussion

R. D'Antonio (International Business Machines Corporation): For commercial applications, how sophisticated should the error detection system be? What is the maximum time allowable between failure and detection?

Mr. Taunton: I do not think that you really need too sophisticated an error detection system. I think in business we need to know immediately that an error has occurred. In using a computer on an application, you are processing a tremendous amount of data at pretty high speed. If we are getting off the track because the computer is not following through, we should know it so that we can stop the process. We want to know whether we are doing the job, or whether the maintenance engineer should repair the machine.

As to maximum time allowable between failure and detection, it should be kept pretty low. I would be more inclined to measure it in minutes rather than in milliseconds. I do think manufacturers have introduced too much sophistication into some of our data machines and made them perhaps a little more expensive than they really need to be, in order to have a good sales point in promoting a piece of equipment to uninformed customers. I have seen one or two cases and recent announcements where the checking circuitry being offered to the customer is rather expensive and not at all economically justifiable.