

lance over the data-collection system that is so necessary to high-speed processing.

- 2) Such an organization provides a coordination medium through which standards of operations, procedures and practices may be established. It also provides a natural working medium for the exchange of mechanical techniques and departmental operating experience.
- 3) By being directly related to the service center, the satellite group is in a position to call for and get expert service and advice from the service center. It may borrow a keypunch operator to relieve a temporary situation, obtain an experienced operator if required, or call in an analyst to assist them. The shifting of temporary overloads to the service centers standby equipment is facilitated and it should be noted that the center will have a built-in additional capacity for weekend or emergency work.
- 4) The proposed arrangement is useful in establishing control over data-processing equipment to be used within the company.
- 5) It allows departmental management to concentrate on their prime objective with the assurance that records vital to the department's functions will be properly maintained. The system analysis

group within the service center is provided a means of reviewing departmental reports to assure themselves and the company that costly and unnecessarily redundant reports are not being maintained.

- 6) This plan also provides a means for giving the technically-trained employee management and administrative experience which will help to assure a pool of prospective management talent. The service center will be benefited as this plan provides a line of advancement for their superior employees.

Precedents for the proposed plan are not too difficult to find. For example: The timekeeping organization, although reporting to one authority, provides services to many areas. Transportation units often operate from central pools while maintaining specialized services in remote departments. Purchasing normally concentrated in a center provides associated operations to service outlying branches. In fact, wherever overlapping services are a requirement, such organizations are not uncommon.

It seems probable that recently devised equipment combined with advanced techniques and organized in this manner will permit another step toward the goal of truly integrated data processing.

Developing a Long-Range Plan for Corporate Methods and the Dependence on Electronic Data Processing

NORMAN J. REAM†

INTRODUCTION

I HAVE been asked to speak to you on the subject of the impact of electronic data-processing innovations on corporate systems planning. This subject matter could be a recitation of how we have approached our planning effort at Lockheed followed by a recitation of how it has been adjusted from time to time by innovations announced by various manufacturers of electronic data processing equipment.

However, I feel that this subject can best be approached by first spelling out some of the major problems facing all industry, pointing up some areas that are lacking in development. Then I shall attempt to discuss what appears to be a logical approach to these difficult management problems, what contributions electronic

data processing has made to date, and what contributions future innovations in electronic data processing will or will not make to the solution of this multitude of problems.

While my remarks are directed to a corporate administrative systems planning effort, we all realize that the subjects that are under discussion at this conference have broad social significance and we must stand ready to assume our responsibilities.

Our economic system is designed in a manner in which a majority of the decisions affecting it are made by thousands of independent managements. This is an advantage to our country and to industry, but it also poses heavy responsibilities on the shoulders of members of management. As Americans, we are convinced that this freedom of action awarded these managements will, when working within the proper social framework and business environment, result in the greatest good for our

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citizenry. As a nation, we have flourished under the concept of individual freedom and I believe that it holds the only promise for our future.

You are all aware that at the present time we are engaged in an economic "cold war." Khrushchev has publicly announced that it is the Russian intention to bring the United States to its knees by means of economic war. He has also announced that at the end of their latest seven-year plan, Russia will have surpassed the United States in production and that the living standard of the average Russian will be better than we Americans now experience or will be experiencing at that time.

Fantastic claims? Perhaps, but we are engaged in a life or death struggle and the boasted intent of our economic adversary must be taken seriously, for these same intentions were first announced by Karl Marx over one hundred years ago. Therefore, the seriousness of our responsibility cannot be overstated. We must seek ways and means of increasing our over-all productivity and continuing the elevation of our living standards.

To maintain our cherished world position ahead of other world political doctrines will require that the thousands of independent managements in our country provide initiative and leadership in the use of the resources at their command. They are charged with the responsibility of securing greater internal efficiencies within their individual organizations and at the same time maintaining and improving their satisfactory relationships with employees, customers, stockholders, and others.

Drucker¹ stated in a recent article that one of the major problems of business is "the lack of any bridge of understanding between the 'macro-economics' of an economy and the 'micro-economics' of the most important actor of this economy, the business enterprise." He said that the only micro-economic concept to be found today in our economic theory is that of profit maximization which may mean short-run immediate revenue or long-range basic profitability of wealth-producing resources that may have to be qualified by a host of unpredictables, such as managerial power drives, union pressures, technology, etc. But this fails to account for business behavior in a growing economy.

According to Drucker, profit maximization is the wrong concept. The relevant question is: "What minimum does a business need?" not "What maximum can it make?" Companies that have attempted to think through the risks of business have found that the survival minimum exceeded the present "maxima" in many cases.

Drucker further pointed out that another crying need is the development of an integrated organization. Twenty years ago it was possible to see a business enterprise as a mechanical assemblage of functions, but today we know that when we talk of business, functions

simply do not exist. We speak of business profit, risk, product, investment, and customer relationships. The functions are irrelevant to any of them, yet we also recognize that work has to be done by people who specialize because no one knows thoroughly the ins and outs of a given function today, let alone all functions of a business. A basic problem then is how to transmute functional knowledge and functional contribution into general direction and profitable general results.

To my knowledge the problem of integration has escaped solution and will only be answered by devoted research and development. This will not be easy for we must recognize we are faced with the problem of developing a means of measuring and controlling a complex assortment of interacting groups of variously motivated entities in a flux of decision-making situations that comprise a normal company. The degree of the complexity involved is usually in direct proportion to the size of the organization.

RESPONSIBILITIES OF MANAGEMENT

Let us turn for a moment to a discussion of the responsibilities of management, for certainly the administrative systems planning effort of any company must be addressed to the responsibilities of management.

In the broadest sense we could define the responsibilities of management as the guidance, leadership, and control of a group of individuals toward a common objective. This broad definition indicates a purpose, but fails to give us an insight of how results are obtained. Therefore, it is necessary to define the responsibilities of management by defining their five basic processes:

- 1) *Planning*—that is, determining what shall be done. As used here, planning covers a wide range of decisions, including the clarification of objectives, establishment of policies, establishment of programs, and determining specific methods and procedures.
- 2) *Organizing*—or grouping the activities necessary to carry out the plans into management units and defining the relationships among the executives and workers in such units.
- 3) *Assembling resources*—that is, obtaining for the use of the business the personnel, capital, facilities, and other things needed to execute the established plans.
- 4) *Directing*—i.e., issuing management directives. This includes the vital matter of indicating plans to those who are responsible for carrying them out.
- 5) *Controlling*—or seeing that operating results conform as nearly as possible to the established plans. This involves the establishment of standards, motivation of people to achieve these standards, comparison of actual results against the predetermined standard, and initiating necessary corrective action when performance deviates from the plan.

¹ P. F. Drucker, "Business objectives and survival needs," *J. Business*, Univ. Chicago Press, Chicago, Ill., vol. 31, pp. 81-90; April, 1958.

All management engages in the processes I have enumerated, and it is clear that various individuals who comprise management spend varying amounts of time at each.

The different members of management are divided into their functional specialties, such as sales, research and development, engineering, manufacturing, finance, industrial relations, etc. Each of these may in turn be divided into the five basic processes of management previously enumerated. These are then established as two different approaches to the same management activities. For example, the vice-president of engineering must plan, organize, assemble resources, and direct and control in the same manner as any other member of management. His problems may differ in degree, but they are interrelated and interdependent upon those problems of the balance of the management echelons.

The increase in the scope and complexity of modern-day business has resulted in management recognition of the necessity of further development and increased use of scientific management techniques. Management recognizes that our simplifying processes must move forward in balance with business complicating processes. Unless our simplifying processes keep pace, we will become a casualty of our self-developed economic and business complexity.

The next few years will see a tremendous increase in the use of data-processing systems in the development of new management methods; however, I wish to emphasize that in my opinion they will only be a tool of management in the over-all improvement of the management abilities.

OBJECTIVES OF CORPORATE SYSTEMS PLANNING

In any corporate systems planning effort, it is axiomatic that we direct our attentions to the problem of determining what information is required to operate business in a coordinated and profitable manner.

Good communication aids in coordinating the known activities of management. For instance, management must know promptly whether operations are proceeding in accordance with plans so that adjustments can be made when required. Moreover, there are a wide variety of activities, particularly those of a detailed nature, that are impractical to plan too far in advance, and coordination of these is achieved only when the personnel directing and performing them have current information upon which to base decisions.

Management has awakened to the realization that a business is essentially controlled and directed by decisions based on information supplied by its data-processing system. It has realized that major policy evolves from a whole series of day-to-day decisions based on the information currently at hand. And it has awakened to the bare fact that much desirable information is not available.

Further, management is realizing that it is much

simpler to set down the logic of problems in the field of physical sciences than it is to set down the assumed logic of a business executive when he is making a decision based on incomplete data.

Having established that the communication of essential information within a company is paramount in developing an integrated approach to management problems, it is necessary that we turn our attention to the administrative systems that are used to supply management intelligence.

The basic objectives in the development of an integrated approach to administrative systems are:

- 1) Development of improved management intelligence for use in decision-making processes.
- 2) The reduction and control of time spans.
- 3) Improved accuracy.
- 4) Increased productivity.
- 5) Reduced costs of operation.

None of these basic objectives are new, but the advent of electronic data-processing systems has given new life to this whole area. We are now and will be seeking the proper application of data-processing devices in order to take full advantage of interrelationships between the data problems of various segments of management and to recognize appropriately the dependence of a number of these segments on the same basic input information.

PLANNED IMPROVEMENT

In attempting to devise a planned administrative systems improvement program for Lockheed, we recognized we could not realize the desired results merely by studying, appraising, and converting our existing systems and procedures. We were faced with a research problem of considerable magnitude, and it could only be solved by an analysis of the requirements based upon a knowledge of systems parameters.

We found we had to solve this logical problem: *How can we best take the basic information from our day-to-day operations and process and distribute it so as to maximize our profits and minimize our costs?* The problem required that we devise a well-planned program to be carried out by creative people acquainted with research methods.

The most difficult part of any complicated problem, whether administrative or scientific, is the devising of a clear formulation and the establishment of a systematic manner of proceeding. The administrative-systems problem being primarily concerned with the processing and flow of information has three basic parts:

- 1) *Formulation of the problem*—We must determine here what inputs are required and what outputs are required.
- 2) *Logical design*—In this part of the study, we set up the internal relationships and describe the detailed information flow so given inputs will produce required outputs.

- 3) *Detailed systems design*—This part is concerned with the techniques and the tools of the system and spells out how the operations required in 2) will be accomplished.

We found that we had to attack these in their order (although at times it is possible to accomplish some of the logical design and the detailed system design in parallel).

Again, I emphasize that the most difficult area is the proper formulation of the problem. Until this is accomplished, little return can be expected in attempting to attack small pieces of the existing system.

The basic requirement is to tie the various segments of management into an effective whole through proper flow of information. It is binding the entire organization together into an effective, integrated whole through this flow of information that permits the information pipelines to serve not only as a means of improving day-to-day operations, but the projected operations as well.

Regarding this as a logical problem we realized that it is not necessary that *each* person working on the formulation of the problem or the logical design have a detailed knowledge of the existing systems, accounting, manufacturing control, etc. The actual requirement is an ability to use research techniques and an objective attitude which will not necessarily be influenced by existing administrative systems.

EFFECT OF ELECTRONIC DATA-PROCESSING INNOVATIONS

In attempting to discuss the effect of equipment innovations on the systems planning effort of a corporation, I would like to preface my comments by stating that in my opinion industry in general has not learned to use efficiently the logical abilities of existing data processing systems. I do not mean to discount the tremendous contribution that electronic data processing systems have made to management, but I wish to emphasize that in my opinion, we are only on the frontiers of exploiting their potential values.

Certainly the advent of solid-state systems will increase considerably the over-all productivity of equipment systems and will improve their reliability. However, until we improve our ability to use the logical designs of such new systems, we shall be using them as inefficiently as we are using existing systems, and our costs will undoubtedly be proportionately higher than they should be.

Since the delivery of the first Univac system to the Census Bureau in March, 1951, we have seen tremendous strides in the development of equipment systems. For instance, in the 700 series we have seen the 702 and then the successive introduction of multiple versions of the 705. Unfortunately, companies that have followed the trend of accepting all equipment changes that have come down the pike have done so at a tremendous cost.

I believe changes of electronic data processing systems must be dictated by management's ability to use them efficiently after all costs have been considered. Too many times equipment changes have been made without recognizing the multiple of such hidden costs as site preparation, turn-around costs, reprogramming effort, etc. A word of caution—evaluate any proposed equipment change carefully.

With the rapid introduction of more advanced data-processing systems by various manufacturers, many managements are utterly confused and are continually pressed to answer the supposed problem of equipment obsolescence. It seems to me that equipment obsolescence falls into four categories:

- 1) Economically obsolete—It would be beneficial economically to discard equipment and replace it with equipment of more advanced design.
- 2) Technically obsolete—Better equipment is immediately available. It is not warranted to discard presently installed equipment, but if new equipment were being acquired, it would be more feasible to acquire the latest design.
- 3) Technically obsolescent—Better equipment is in the design stage, but is not presently available.
- 4) Conceptually obsolete—Better equipment is theoretically possible, but has not yet been designed.

If you will reflect for a moment you will recognize the four stages of obsolescence and realize that all equipments proceed from the stage of being conceptually obsolete to the point of being economically obsolete. However, the point of becoming economically obsolete is usually a long time after they become technically obsolete, because the marginal cost of operating and maintaining them is small. If we were in a detailed discussion of leased or purchased equipment, then we would have to concede that when equipments are being leased, the point at which they reach economic obsolescence is much earlier than when they are purchased.

There are two major reasons for a change in electronic data-processing systems:

- 1) It is desirable to decrease the unit cost, or
- 2) It is desirable to do jobs that are not possible of accomplishment on existing equipment.

One of these two must be the basic reason for change to equipments of increased speed or increased memory capacity.

The physical difficulties as well as the economic problems of changing equipment, both for the manufacturer and the user, acts as an inertia or a brake on the introduction of too many new models, each being a slight improvement over the old. In my opinion, an order of magnitude of three to five times in improvement is needed before a going machine can economically be supplanted.

Because of the long cycles and lead times involved in

the development in the new data-processing systems, there is an upper limit to the speed with which new electronic data-processing systems can be introduced by any one manufacturer. However, as additional manufacturers start at varying places on the time scale, the result for the consumer is a practically continuous curve of increased technological advantage. The management problem then becomes one of choosing at which point to make the change and of assessing the reliability of the various manufacturers' claims.

Another factor that must be considered is whether or not the user of the proposed new electronic data processing system actually has a fully developed requirement. In other words, you can find operations where electronic data processing systems have been changed only to learn that they have acquired too large a system for the amount of work to be processed.

To date, most of the attention of management has been directed towards gathering historical information and not too much progress has been made in the area of development of management information for determination of a company's objectives. The advent of electronic data processing systems makes possible the application of techniques that had hitherto been impossible by manual or electromechanical means. We can look forward to great strides in this area in the next few years in the development and application of mathematical techniques (operations research) to the problems of management.

The area of financial planning and control is wide open, for example, in the applications of scientific management techniques. I am sure that electronic data-processing equipment will be a major contributor to the eventual solution of many existing problems. However, the equipment will only be a means of developing an answer after we have determined what information is required and how it can be developed. Here again, I would like to emphasize that progress will not come about merely by having the equipment, but must be preceded by a fully developed definition of the problem and the logical design of the system required.

In my initial work in the financial forecasting area, the first unforeseen difficulty was the problem of language. As a simple example, discussion with people in financial operations activities revealed instances of several distinct concepts answering to the same name and a multiplicity of names applied to essentially one concept. As a result, it was considered necessary to establish for the accounting aspects of the problem a structural framework which was reasonably complete, self-consistent, and within which the problem could be formulated with some assurance that the terms employed were clearly defined. Eventually it was determined that the problem could be solved in four steps. First, obtaining a mathematical model for the entire accounting feature of the forecast. Second, a study of prediction techniques used in obtaining basic information for the various inputs to

the accounting structure. Third, a study of the procedures necessary to make certain quantities of the output a maximum or minimum, while others are held under specified restrictions. Fourth, the application of high-speed data processing equipment to the results of the three previous studies.

I might add that work in these areas does not lend itself to rapid solution but is a result of long and arduous effort on the part of persons who are dedicated to researching this type of management problem.

Information retrieval is another problem area that holds promise of solution. However, data processing equipment cannot make a contribution until such time as the problem is defined and a logical retrieval system is designed.

These latter two are only representative of a host of management problems that must be sought out and solved to insure eventual management survival.

SELLING ELECTRONIC DATA PROCESSING

Those of you who are in the data-processing area of your management are faced with a real challenge to sell your ideas to management as well as to employees. You not only have the problem of selling the use of electronic data-processing equipment, but you ultimately will have the responsibility of proving that the introduction of these systems has reached or exceeded the break-even point. The break-even point of electronic data-processing systems is still most dubious; in fact, many existing installations are not economically sound. You are faced with the challenge of the control of costs after installation and of the continuous effort of insuring that the programming effort is of prime efficiency.

ORGANIZATION CHANGE REQUIRED

One of the most difficult problems which faces the advocates of the use of electronic data-processing systems is to awaken managements to their responsibility of insuring that they are using the systems to their best abilities. I agree that computers have been the impetus behind the tremendous interest that is now being focused on the development of improved administrative systems, but at the same time most managements have failed to recognize the necessity of integrating their organization in a systematic and purposeful manner. Usually these changes just happen over a period of time, arise from temporary expediency, or emerge as a solution to a crisis situation. However, in most instances functional reorganization has not kept abreast of the technological change.

The management organization structure is not inviolate and should be treated accordingly. In many cases changes in the organization structure can eliminate many of the procedures that complicate an administrative system, thus reducing costs and contributing to the simplifying process.

CONSOLIDATION OF SCIENTIFIC AND ADMINISTRATIVE ELECTRONIC DATA-PROCESSING OPERATIONS

One of the most interesting and promising developments in the application of electronic data-processing systems in business is the apparent determination of most manufacturers to develop a data-processing system that can be used for both business and scientific data processing with equal effectiveness. Also, the trend towards the development of these all-purpose data-processing systems in the medium scale field, with an ability to expand, opens the door for the economic use for computers in many smaller industries. It also gives good reason to speculate that large companies will find that the use of these dual-purpose systems will decrease considerably their over-all data-processing systems rental costs by consolidation of scientific and business data-processing operations and maximizing available computer time.

The establishment of two definite data-processing groups within a given area of a business to handle independently scientific and administrative data-processing operations is a very costly venture. The now recognized means to handle many independently programmed operations simultaneously, that is, business, scientific, or both, eliminates many of the arguments that were formerly used to substantiate the independence of the two establishments referred to above. From the standpoint of the future economics of data-processing systems installation, I believe that this is a major step forward.

PRE-ANNOUNCEMENT OF EQUIPMENTS

One of the most disturbing factors in the application of electronic data-processing equipments to management problems is the continued practice of some manufacturers of announcing new equipment innovations far in advance of their actual design completion or availability. I think that manufacturers would serve their purpose well if they would withhold announcements of new equipment until such time as they were able to discuss these new equipment systems with the support of factual information.

I recognize that the industry is extremely competitive and that various companies are jockeying for the best possible position. However, I believe that many of their sales practices have done much to retard progress by throwing many managements into a state of utter confusion by moving equipments into a business enterprise long before the planned installation is ready for their use.

I know of instances where certain manufacturers have attempted to have management withhold decision on equipment in order to deliver their own new system many months in the future when full economic justification of immediately available equipments has been documented. Also, some manufacturers' sales efforts have attempted to replace a competitor's equip-

ment with their own equipments when there is no economic justification to the user.

Usually the sales tactic behind these equipment pre-announcements has been to prove to a potential customer that the manufacturer in question has a corner on the knowledge and abilities in the data-processing equipment field. In my opinion, there are many reliable manufacturers and I know of no company that has a corner in the area of development or know-how.

LACK OF DEVELOPMENT IN THE INPUT AREA

Just as in the usage of punched-card equipments, the weakest area of electronic data-processing systems development today is in the input areas, *i.e.*, the collection of input data at the point of origin. It is true that this area is one of the most difficult to define—and perhaps has been side-stepped by both the users and the manufacturers because of this. Yet, I have the feeling that some manufacturers have long recognized the problem but have been more interested in protecting their investment in equipments and card plants than in making a definite contribution to the state of the art.

ELECTRONIC DATA-PROCESSING SYSTEMS CONTRACTS

I would also like to comment briefly on the present type of contract normally available for the lessee and the lessor of the equipments. Up to a short time ago, the rental contracts were certainly all vague and meaningless and were written solely for the benefit of the lessor. However, recently there has been a trend on the part of some lessors—that is, the manufacturers of the equipment—to write more definitive contracts than were previously available to the user. Even these are not definitive enough. It is time for the users to demand an even more definitive contract, one that charges the manufacturers with performance responsibility. I can see no reason why any manufacturer should make fantastic performance claims for given equipments during his sales efforts and then fail, if they are valid claims, to put these into a leasing agreement. Refusal only means that the abilities of the equipments have been overstated.

The present type of contract, as I previously stated, is a lessor's contract, and I believe that its continued use through the years has caused the user to absorb many costs due to equipment malfunction that should have rightfully been borne by the manufacturer.

DEVELOPMENT OF PROGRAMMING TECHNIQUES

Charges have been levelled at the manufacturers of data-processing equipment that they have failed to develop means of using the logical ability of existing systems to the fullest extent through neglecting to furnish advanced programming aids and techniques. To a degree it is a valid criticism. However, I feel that this is buck-passing, and to date our failure to exploit more fully the use of presently available data-processing

equipment in business is caused by the lack of the development of logical systems that will fully exploit the logical abilities of the equipment available. Too much effort has been expended on trying to transfer available human systems to these equipments rather than attempting to develop a proper definition of the logical system required.

CONCLUSION

Electronic data processing is becoming a byword in the evolution of the techniques of a scientific approach to the problems of management. The equipments are not an end in themselves and cannot be considered a panacea for the ills of management. Rather they are a tool of management. Their contribution to the improvement of management is entirely dependent on how well the problems of management are defined by the indi-

vidual practitioners and how ingenious they are at developing means of formulating information for management review and decision-making processes.

Again, we are only on the frontiers of the potential we seek. Hard work and ingenuity will bring success.

We must move carefully and at all times must be in a position to justify our activities. The introduction of improved electronic data-processing systems will undoubtedly contribute to the advancement of the state of the art, but the feeding of bad inputs into faster and more capable equipments will only generate more bad information at a faster pace.

I have tried to point out some of the difficult areas we are encountering to avoid overoptimism. Yet, there is no reason to be overpessimistic. Our eventual goal can be attained, and with the high stakes involved, the significance of the results warrants the all-out effort.

A General Approach to Planning for Management Use of EDPM Equipment

GOMER H. REDMOND†

DURING the past decade we have all been aware of, or have played a part in, a maximum effort on the part of certain dedicated people. The objective of this informal effort seemed to be to convert all clerical and computational work efforts into an automatic, "fire-all-the-clerks, we-can-do-anything" approach to all known business practices. These dedicated people were mainly comprised of data-processing manufacturers, management consultants, scientists, engineers, and administrative line and staff executives and assistants. They usually had a good grasp of a specific problem and felt that this problem or series of problems were sound EDP applications and by extrapolation, proceeded to teach a number of management executives the economics of EDPM installations.

The influence of this effort and the span of time over which it took place were both beneficial. Decision-making management level executives encouraged and at the same time discouraged the advance of clerical automation. Equipment marketing people were forced to compete in areas that they frankly knew were not practical. "If I don't submit a proposal for this application, competition will get the business and it's a rough row getting back in," were frequent comments that we

all have heard upon questioning EDP salesmen regarding doubtful or submarginal installation.

Management consultants were asked into the clerical automation area by top executives who respected previous neutral and objective work assignments, many of these management consultants accepted work assignments with the assumption that old and proven "standard" techniques would serve their purposes in this area as they had in many others; others went in with good staffs and did a "down town" yeoman-like job. Still others capitalized on the confusion and helped equalize mass optimism by forecasting dire results if EDPM installations were contemplated and planned without specific help from *their* firm.

Not to be outstripped, many business and newspaper writers and reporters joined in and began to point out the miracles of electronic hardware and its possible effect upon American business organizations and operations. Articles in magazines, in newspapers, in trade journals praised use of EDP equipment as a new industrial revolution and played up the hardware and its speed with almost no references to planning and application problems and costs. Other articles damned the rapid acquisition of EDP equipment. These write-ups blew way out of proportion some pioneering marginal commercial installations, threw serious doubt into management's mind as to the capabilities of their EDP planning

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