TOTAL SYSTEMS

DATA PROCESSING LIBRARY SERIES

TOTAL SYSTEMS

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Preface

WITH THIS BOOK American Data Processing, Inc., launches one of its most ambitious editorial projects: the Data Processing Library Series. It is the intention of the Editors of the Series to provide a library of basic reference books, each covering in detail an important data processing subject. All of these books are directed primarily to management personnel in organizations employing or considering electronic data processing systems. The Series should thus be of use, also, to the serious academic researcher into this most dynamic field.

That the field of electronic data processing is dynamic is attested to by the choice of TOTAL SYSTEMS as the first book in the Library Series, and by its contents. There are few subjects that excite the interest of knowledgeable management personnel in business and government to a greater degree than the idea of a totally automated, fully responsive, truly all-encompassing information system embodying the collection, storage and processing of data and the reporting of significant information on an as-needed basis. With the possible exception of some operational military systems, which are not considered in this book, we do not believe any organization exists anywhere which has achieved this ultimate systems goal. But one, a few, or many may do so at any time. If they do, they will undoubtedly follow some of the approaches outlined in this volume.

In setting out to collect the most authoritative opinion available about the total systems idea, the Editors sought out well known systems experts and asked for their recommendations. The lists of authorities thus compiled bore a striking but not surprising resemblance to one another. Those who are at the forefront of total systems development know their peers. They are not misled by the vast and somewhat appalling array of recently published material dealing casually or directly with total systems but saying nothing.

There are no parrots among the authors who have contributed to this book. Each has something original to offer, gained through experience and hard work. We are pleased to be able to present the writings of so many of the top level researchers in total systems development.

Much of the credit should be given to the two Coordinating Editors of TOTAL SYSTEMS, Enoch J. Haga and Maurice F. Ronayne. Mr. Haga is Senior Publications Engineer at Lockheed Missile and Space Company, Sunnyvale, California; Editor of the *SABE Data Processor,* official publication of the Society for Automation in Business Education; and Contributing Editor for the *Journal of Business Education.* His position with SABE, begun while he was Assistant Professor of Business at Stanislaus State College, California, is particularly significant in that it has given him access to much of the current academic research extant in total systems.

Maurice F. Ronayne is Digital Computer Systems Analyst with the Division of Management Assistance, U. S. Federal Power Commission, Washington, D.C. He is vice president of the Washington, D.C. chapter of the Systems and Procedures Association. Of especial interest is his recently completed project as Editor of *An Annotated Bibliography for the Systems Professional,* part of which is included in this book.

In addition to supplying articles of their own, both Coordinating Editors also made use of their knowledge of persons engaged in advanced systems studies and solicited and edited a number of the manuscripts which form the contents of TOTAL SYSTEMS. They reported a common reaction among data processing systems authorities which was also found to be universal among the authorities contacted by the Editors of this book: a desire to see publication of a realistic treatment of total systems ideas and experience.

Such a treatment is given in this book, which begins, as all definitive works must, with discussions of varying points of view about the basic concept of total systems. The authors of these first 10 articles bring into this discussion backgrounds in consulting, business, government, the military, and universities. We are again indebted to the Systems and Procedures Association for permission to include William B. Worthington's article, "Total Command, Management, and Administrative Systems," which had appeared in the proceedings of their eleventh International Systems Meeting titled *Ideas for Management.*

TOTAL SYSTEMS continues with six articles dealing directly with the planning effort required in any total systems project. Again, the authors bring varied and significant experience into their discussion. Next is a series of four articles dealing with aspects of the implementation of total systems — a most difficult subject, since so little real experience exists.

The next section of the book is a most important one. In it are case histories of five companies engaged in the quest for a total system. One is a medium sized insurance company that decided to ease into electronic data processing by replacing its punched card system with a small card input/output computer, and found itself forced into an integration of many of its procedures. Another is a manufacturer whose mathematics research group is involved in the study — and application — of automatic control over the entire manufacturing process. A third is a giant transportation company which has consistently pioneered in the use of computers and communications systems to guide and correlate its far flung operations. A fourth is a missile manufacturer now setting up integrated procedures for its widely separated divisions and their computer centers. The other is a chemical firm which has used the marketing activity as its avenue toward total systems.

The approaches of these five companies are radically different. From them may come answers to the problems still standing in the way of our systems people in their attempts to do a comprehensive job. It is our hope that this will be the case.

The Publishers

By Douglas J. Axsmith
McKinsey & Company, Inc.

A Management Look at Data Processing: Promise, Problem, and Profit

AFTER MORE THAN 10 YEARS of management experience with electronic data processing, the early enthusiastic promise of the new technology has only in small part been realized. As a matter of fact, attempts to apply new data processing approaches have in many cases generated unforeseen difficulties. As a result, in company after company the advantages that were anticipated have only recently begun to be achieved.

That such is the case should not be surprising, for on reflection it was unrealistic to expect management to be able to anticipate the difficulty of re-defining business problems in the terms required to take fullest advantage of the capabilities of the new data processing technology. At this point, substantial progress has been made not only in thus defining these fundamental problems, but also in identifying the enormous number of substantial and often subjective subordinate decisions that are required to use data processing effectively as a management decision making tool.

The growing awareness of these problems on the part of management defines on the one hand the realistic limits of what should be expected from data processing. On the other hand, it substantially expands the horizons of its capability.

Looking ahead, the challenge to management lies in extracting more and more from this increasingly potent management problem solving tool and the related information system techniques. For, while what we have learned is valid, there is much more to be learned in applying the computer to the increasing number of variables and accelerating rate of change with which every business will have to deal in this dynamic decade.

Technology, concepts and practices are developing with great speed and on many fronts to match the pace of developments in the business environment. Some of the changes have significance chiefly for the scientists who design equipment. Many concern the growing corps of specialists who design and operate complex data processing systems. But most, in some measure, affect the general business executive, whose responsibility it is to see that his company is served profitably and well by the new technology of information handling.

TRANSITIONAL STAGE FOR COMPUTER

The computer today is in a time of transition from initial acceptance to intensive exploitation by business. It would be difficult indeed to find a large corporation that neither has nor uses at least one electronic computer. It is becoming increasingly hard to find medium size and smaller corporations that do not have modest installations of their own or do not occasionally use computer service bureaus.

Those executives who adopted a wait-and-see attitude have, for the most part, liked what they have seen. Those who first thought of the computer as an expensive toy now think of it as a powerful tool. Those who called electronic data processing a fad now acknowledge it as a fact of corporate life. The computer has been accepted, but its acceptance is yet to be followed by full realization of its potential.

This is also a time of transition from the single, self-contained computer to complex electronic systems of which a computer is only one part.

In early installations, a single computer received information from a human operator, processed it and produced output that then had to be carried away by the operator. Today, however, more and more linkages are developing which make it possible to collect a wide variety of data from many points, to produce output in many forms and in many places, and to join individual computers with others to form extremely powerful and versatile systems.

A third transition is in the kind of data being processed. From early preoccupation with accounting data and record keeping, systems designers are now turning their attention to a far broader range of management information needed for effective decision making.

Finally, there is a transition in the expectations of management. Initially, most computers were installed on the strength of anticipated clerical cost reductions. There is now a shift to the broader concept of profit improvement.

This shift in no way signals a relaxation of requirements for adequate return on the substantial investment in a complex data processing system. It is simply a recognition that the return will increasingly come, not from reductions in the clerical payroll, but from better decision making and control throughout the organization.

How an executive reacts in a time of transition depends largely on his ability to distill the most important developments of the past and to discern the principal changes that lie ahead. In the case of electronic data processing, a backward look of 10 years covers its entire history, and a look 10 years ahead encompasses as much of the future as seems relevant to the types of decisions that must be made today.

THE FIRST 10 YEARS

The overwhelming characteristic of the first decade is growth. Not until April, 1951, had business data ever been fed into a computer. Not until three years later had a corporation installed a large scale unit. But from 1954, growth has occurred at an explosive rate. During the three years 1955-57, 200 large scale computers and more than 800 medium scale machines were put to use in business. Now, five years later, some 8,000 installations of various sizes are on record and the number continues to grow.

Many things have contributed to this phenomenal growth. The equipment itself has been vastly improved. And the men who design and manage computer systems have learned much from the mistakes and successes of the past 10 years.

ADVANCES IN DATA PROCESSING TECHNOLOGY

From the early 1950's, new designs in computer hardware have followed one another rapidly.

Most of the technological advances have had the effect of increasing the speed and storage capacity of computers and of substantially reducing the cost per unit of work performed. New memory devices, such as ferrite magnetic cores, have enormously increased the speed with which information can be handled within the computer.

These and other devices make it possible to go almost directly to particular addresses for particular information instead of having to plow sequentially through magnetic tape, one character at a time.

Today, highly reliable transistorized logic and arithmetical elements for computers are common, and the trend toward modular design of computers permits users to adjust a given system to their needs.

Input and output devices have also changed and improved. Input bottlenecks were broken by high speed sensing of tapes and cards. Input costs were lowered by semi-automatic collection and transfer of information from sources to computers. Magnetic ink and document reading machines, in some very important applications, did away with much key punching work.

On the output side, printing speeds increased by a factor of six to one. New methods of printing evolved. The charactron tube, for instance, assembles a whole page at a time for instantaneous photographing and later printing. Graphs and engineering drawings can now be produced directly by the computer.

Meanwhile, computer software (the codes or programs through which computers work) was going through a similar evolution. As companies programmed more engineering problems and accounting procedures to computers, they began to realize that certain formulas, accounting routines and other business processes appeared repeatedly. Rather than reprogram them many times, these companies began setting the special subprograms or subsystems aside so they could easily be reached and tossed into a larger program as needed. They began to build up libraries of such common routines.

An obvious next step, to avoid repeating work that had been done long ago, was to borrow and adapt existing subsystems from another library. This, of course, required that the material in different libraries be in the same language or be easily translatable from one company's language to another's. This was not often easy or possible, since every machine used a code of its own. But a number of cooperative libraries did gradually build up.

Equipment producers themselves assembled large libraries because they found that extensive preprogrammed subsystems were an important sales tool.

COMMON LANGUAGE SOUGHT

To make programming easier and less expensive, manufacturers also tackled the job of coding routines in English. This way, instead of writing programs in English and then coding them into machine language, programmers could give the computer instructions in English that it would recognize as commands to assemble designated routines in specified sequences. Each manufacturer's language was highly stylized and understood only by his own computer, but inevitably these various manufacturers' programs developed striking similarities.

Then the U. S. government, the world's biggest computer customer, stepped into the picture as referee. Because its hundreds of computer systems encompass so many computers of so many different types, the government has a constant giant-sized programming headache. Especially in the defense area, where it is obviously important to have computers that can transfer information back and forth between themselves, the government's need for common computer language was acute.

In May, 1959, under department of defense auspices, a number of manufacturers and users of computers met to try to achieve a common language that would make computer programs interchangeable between various types of installations. The expanding product of these efforts is COBOL (COmmon Business-Oriented Language), which, while following precise and formal rules in order to be intelligible to the computer, looks and reads very much like English.

The ultimate savings from common language systems will be very great. This is because it costs several dollars to program and code each new instruction in a computer system, and even programs as simple as most payrolls involve tens of thousands of instructions. COBOL, plus adequate subsystems libraries, will make it possible to program complex systems that, under old techniques, would have been prohibitively expensive.

CONCENTRATION ON ACCOUNTING DATA

Some who scanned the horizons during the past 10 years saw computers revolutionizing the practice of management. But initially those who sold the machines and those who put them to work saw them primarily as a means of reducing the clerical work force.

The early uses of electronic data processing were largely an extension of tabulating systems already in use. The machines were programmed to handle routine, repetitive data processing tasks. Their own costs were to be justified by displacement of clerical personnel and reduction in the cost of accounting paper work.

These were not, of course, the only applications, but were the predominant ones. In its 1958 study of business electronics, The Controllership Foundation compiled extensive data on business uses of the computer. More than 12 times as much space was required for its listing of payroll applications as for applications in operations analysis, simulation and linear programming combined.

EARLY EXPLORATION OF ADVANCED SYSTEMS

During the 10 years just ended and especially during the last few, there have been pioneering explorations beyond handling of conventional accounting data.

Advances in computer technology and operations research techniques have reinforced each other. Much of the mathematics that applies to business problems involves far too many calculations to be handled economically by a tabulating machine or by hand. The computer made some very powerful mathematical approaches practical.

One well known development was linear

programming, which has produced guides for gasoline blending in petroleum refineries, analyses for physical distribution management and assistance on facilities planning and production scheduling problems.

At the same time the computer was making applied mathematics possible, mathematics was itself multiplying the value of the computer. For example, early computer based inventory control systems were little more than the simple accumulation of large quantities of individual transactions. With the addition of some mathematically developed decision rules, however, it became possible to process individual pieces of data in such a way as to produce inventory control guides far superior to the ordinary exercise of judgment.

Another development of far-reaching significance has been the emergence of integrated data processing. Many computers had been loaded with one task after another, each developed and processed very largely without reference to another. The result inevitably was lost time and duplication of effort.

In recent years, however, substantial efforts have been devoted to integrating the various data processing tasks into what ideally would be a single, unified system of data processing. Accomplishments in this area are relatively meager, but they have been sufficient to demonstrate the feasibility and value of much greater progress in this direction.

CHANGING ORGANIZATION FOR DATA PROCESSING

When computers first began to appear in industrial corporations, they were almost invariably placed under the care of the company's chief financial officer. The decision, although practically automatic, was usually sound. The computer was perceived as an ultra high speed development of the conventional tabulating machine. Its principal application was thought of as more rapid processing of the same data that had been prepared in the past.

There was another reason for locating computers in the financial officer's area, and that was his leading role in the feasibility study that typically preceded the installation. This study was, in most cases, chiefly concerned with drawing a comparison between the heavy expenses of the new equipment and the clerical cost reductions that it could be expected to produce. This kind of financial analysis is, of course, properly a function of the financial officer, and most of the cost elements and savings were within his own field of responsibility.

But the initial placement of the computer has not always turned out to be a permanent home. The range of computer applications has far exceeded the limits of the accounting system. The management of a computer service within a corporation has extended far beyond the technical problems of converting older methods to computers or of providing machine time for various parts of the corporation that have their own programs. And the attention of management has begun to shift from computers themselves to the integrated systems that computers make possible.

This growth of the management-information systems concept has extended the organizational impact of electronic data processing from the machine room to the board room.

In companies with extensive computer experience, several shifts in organization have typically occurred. Almost without exception, responsibility for computer-based services has risen in importance within the financial officer's organization. The establishment of a separate computer department has been only the first step. Usually the increasingly technical services required to take advantage of the rapidly growing potential in EDP have soon led to the creation of a key position near the top of the financial organization structure.

Lately, some corporations have decided that the task of designing and operating business information systems is one that deserves a top level place outside the financial organization structure. And so there is emerging a new kind of corporate staff concerned exclusively with systems and analytical methods for decision making. Management services is a name frequently used to describe this new function.

GROWING MANAGEMENT SOPHISTICATION

Good things are often oversold and sometimes solid accomplishment is dimmed by unreasonable expectations. This has certainly been the case in the first 10 years of business data processing. The earliest installations were expected to yield savings that would pay for the equipment within a period of months. The conversion of manual or tabulating methods to electronic techniques was expected to be swift and painless, for only the simplest procedures like payroll accounting were involved. The fruit turned out to be not quite ready for plucking.

A number of companies began to discover that even a simple payroll application was much more difficult than anticipated. Those who had spoken most proudly (and sometimes loudly) of the savings and efficiencies their new installations were expected to accomplish, suddenly lapsed into silence.

For the first several years, tales of trouble were quite as common and as well founded as reports of success. But these years of trial contributed greatly to management sophistication and produced a wealth of insights that will certainly accelerate exploitation of computer potential in the future. Some major lessons learned include:

1. *Finding the profit-producing applications.* The difficulties and disappointments were, almost without exception, not attributable to any limitations in hardware capability. Rather, they resulted from misuse of hardware; that is, failure to identify and cash in on the more dynamic, profit making applications.

   For example, many executives have learned that the major potential value of the computer lies in its management use, not in its replacement of clerical labor. Little benefit has been gained from merely substituting the computer for punched card equipment or other less complex office machines.

   Those who have profited most have focused on the design of applications that help to improve management decision making and control of operations.

2. *Hammering out clearly stated objectives.* In the first decade of experience with electronic data processing, managers have learned that it is not enough that technicians and executives seem to understand each other. What is required is a statement of the electronic data processing program's objectives in the form of specific operational or economic goals. Moreover, these objectives must be documented if they are not to be blurred by time or distorted by individual interpretation. Implicit in this sort of goal setting is the requirement that an audit be made periodically to determine whether the specific objectives are in fact being achieved.

3. *Recognizing the magnitude of the undertaking.* The effort and cost involved in carrying out most computer applications were typically underestimated — often quite badly.

   Managers learned, for example, that computers themselves represent only one element of the overall data processing system. Initially, the costs and systems design effort associated with data collection and data transmission were sometimes treated almost as incidentals.

   It came as a shock that creating source data and transmitting them to the processing point could be substantially more costly than the computer itself. One large electronics company found that the cost of developing and maintaining its nationwide data collection, data communication system would equal the yearly rental of three large scale computers — roughly $900,000.

   While these unpleasant facts were coming to light, the discrepancies between estimates and actuality did more to undermine management's faith in electronic data processing than did anything else. Now, experience-wise executives and systems designers are much more realistic in scheduling completion dates and estimating conversion costs.

4. *Choosing the right people.* Finally, management learned that in one important respect data processing is exactly like any other business function. The single most important determinant of success is the capacity of men who manage it.

DATA PROCESSING IN THE YEARS AHEAD

The main lines of development in data processing seem clearly indicated by events of the past 10 years. There is a sufficient time lag between technical developments and commercial application to permit rather confident forecasting of equipment advances over the next few years. And the changes in the general patterns of business usage seem now to be indicated by early but unmistakable signs.

EQUIPMENT OF THE FUTURE

There will be continued rapid advances in the design and manufacture of electronic data processing equipment, encompassing an ever widening array of both general and special purpose devices concerned with every aspect of data handling. Large computers will become larger, faster, more expensive, and more efficient per unit of work handled. Those who see only these developments will be impressed with the inevitability of super-centers for data processing. But small computers will become better and more efficient, and those who are philosophically attached to decentralization will take comfort in these developments.

Some of the most dramatic technical advances will occur in devices for getting information to and from the computer itself. The result will be the development of huge intracompany communications networks, of which some early forerunners already exist. Lockheed recently began the operation of a multimillion-dollar, 100,000-mile, nationwide communications network, which ties together its widespread locations. Sylvania's early 20,000 mile communications system was a prototype of such a network. North American Aviation pioneered in the interconnection of computers with microwave lengths when it leased from Pacific Telephone and Telegraph Company a microwave system that linked two large scale computers in California.

Frederick R. Kappel, president of American Telephone and Telegraph Company, believes that by 1970 at least half the communications volume carried by the Bell System's associated companies' leased lines will be in the form of business machine communication. Donald Powers, chairman and chief executive officer of General Telephone and Electronics Corporation, expects that within a decade business data communications in the U. S. will exceed all other communications.

FURTHER GROWTH OF INSTALLATIONS

Over the next 10 years, computer installations will change in several dimensions. First, more and more companies will employ electronic data processing of some type. It is perhaps conservative to estimate that the number of such companies will double over the next five years.

Installations will not only grow in number, but individually they will grow in size and complexity. Large scale computers will supplement or supplant medium scale computers. Single computer systems will expand into multiple computer systems. Computers themselves will be linked to more and more peripheral equipment.

Finally, corporate installations will assume much greater diversity. In the beginning, one payroll installation looked rather like another. But these systems similarities will tend to disappear. No two businesses have the same information content or the same information need. The great variety of control units and special purpose devices, and the trend toward modular design, both seem to be leading to a unique configuration for each complex data processing system.

RISING LEVEL OF APPLICATIONS

Whether these new and more complex installations make more money than they cost, and solve more problems than they create, will depend on the way they are used. The search for fruitful applications can be expected to develop along four main lines.

1. *Accounting data processing:* Although accounting data processing was the mainstay of early computer installations, the potential in this field is by no means exhausted. There are opportunities to bring other accounting tasks into the accounting fold. There are perhaps far larger opportunities to integrate separate accounting tasks so that more useful things are done with a single piece of information.
2. *Process Control:* Computers, usually highly specialized, are now used to position machine tools and to control certain industrial processes. These uses will grow substantially in number and importance as sensing and actuating devices become more generally available, and particularly as technicians and managers are able to establish decision rules to guide the computers.
3. *Decision models:* Mathematical formu-

lations for solving difficult one time problems and for simulating complex events will be much more frequently employed by managers. Several such models already exist, particularly in production and physical distribution operations. These will multiply and to them will be added models for making decisions on marketing, finance, facilities and other strategic questions.

4. *Management data processing:* By far the most extensive and important advances will take place in the development of integrated management information systems for decision making and control.

   Such business intelligence systems will go far beyond the limits of classical accounting information to process and analyze a broad range of data — non-financial and financial — that are needed by top management to run the business. The ultimate achievement would be a system that not only encompassed all information handling requirements, but processed each piece of information instantaneously.

   The ultimate is certain to prove attainable, of course, for every advance will undoubtedly reveal still greater opportunities. There will, however, be giant strides forward in providing up-to-the-minute information for better control of marketing, production and distribution, and in providing incisive analysis for longer term tactical and strategic decisions.

   As computerized accounting and finance systems are tied in more closely with simulation and mathematical models, management judgment will become increasingly fact founded across the whole spectrum of corporate decisions.

   "At the bottom of the decision spectrum, practically no judgment is needed: Certain basic facts produce certain specific answers. As we move up the spectrum, more and more human judgment is injected into the decisions.

   "There is one common thread, however, that runs through the entire spectrum and that is the need for good, accurate, timely information. Nor is the information at the top independent of that below.

   "Just as the finished product of an assembly line is a reflection of the characteristics and interrelationships of the parts, materials and skills that went into its design and manufacture, so do the decisions of top management reflect the interrelationships and characteristics of the routine operations of the business.

   "In a truly integrated management information system, the basic data inputs will be combined, changed in form, merged, consolidated and analyzed so that the information needs of every level of management are met in a timely, accurate and useful fashion, with minimal duplication of input data. The interrelationships of the various functions and operations will be so accurately reflected that every decision in the spectrum will optimize over-all company goals rather than those of any particular part or function."*

IMPACT ON MANAGEMENT

Some of the effects that new data processing systems will exert on management will be primarily continuations of changes already begun. Others will be largely or wholly new.

Organizational changes that can be foreseen will stem mainly from the broadening objectives of data processing. The computer based management information system of the future will be designed primarily to meet the needs of operating management.

Clearly, it must encompass a vast body of operating data as well as data generated by the accounting system. It must provide information for planning or decision making and not merely for record keeping. It must embrace external economic information and competitive intelligence as well as internal corporate data.

Whoever has the responsibility for the design and operation of management data processing systems must have the understanding and capability, and the status within the

*AMA Management Report Number 41, Some Organizational Effects of Integrated Information Systems, Charles Stein, Jr.

organization, that will enable him to develop and to apply a fundamental top management viewpoint to a swiftly moving, highly developed technology. We can anticipate, therefore, a growth in stature of top analytical and planning executives, reflecting their larger contribution to corporate welfare.

Along with the growth of computerized systems will come a growth in the staffs that manipulate and interpret the information flowing through a company. Because an integrated system involves constant interactions between many sections of the business, these design and study staffs will contain people with experience and understanding of many departments and phases of the business. They will be hard to find, hard to train, and sometimes hard to keep.

There are spirited arguments today about the long-term effect of advanced data processing systems on corporate centralization or decentralization. New computer system capabilities will permit certain kinds of decisions, now widely diffused, to be made more efficiently at a single point. It will be possible to make a larger quantity of information available for decision making further down in large organization structures.

Specialists have a way of thinking exclusively in terms of their own specialties. It is not surprising that computer technologists see the shape of organizations determined largely by information technology. But this does not appear to be likely, at least in the foreseeable future.

In the years ahead, general patterns of centralization or decentralization will be matters not of technical necessity, but of management decision. In fact, management's freedom to implement either philosophy will be considerably enhanced.

New data processing systems will, however, profoundly affect the content of managerial jobs, as some decision making responsibilities are redistributed. If machine tools can be better loaded by computer than by judgment, then production scheduling decisions of this sort will no longer be a regular part of the manager's job. If the distribution of product and logistics of supply can be better managed electronically than by present methods, then the jobs of men who now perform these functions will be materially changed.

But decisions of this sort are not the whole of management. Almost certainly, for every problem that the computer solves, 10 more will arise to plague the men who run industrial corporations.

Finally, one far reaching impact of management data processing involves the time span of executive decisions. Two things will happen. First, there will be increased responsiveness to internal and external change. Top executives will be aware of changes more quickly and will be in a position to react far more rapidly. Secondly, they will be able to look further into the future. Their ability to forecast more accurately and to explore alternatives with greater precision will permit longer planning and decision making.

TOP MANAGEMENT RESPONSIBILITY TODAY

In this time of transition, an executive can take six precautionary measures to be sure his company neither lags nor moves in the wrong direction.

1. He can make sure that every major move is taken against a broad and sound concept of corporate information needs. Only with an over-all plan can he be sure he is moving in the right direction. And only with an over-all plan can he protect himself against the delays and inefficiencies of piecemeal progress.

2. He can insist on planned flexibility, even though flexibility may become more difficult as it becomes more essential.

   A data processing system is the adaption of technical capabilities to the information needs of the corporation. Technical capabilities change constantly and so do information needs. The needs change as the corporation molds itself to its own environment. New organization structure, new product lines, new competitive situations, new relationships with government, new markets both domestic and international, all present different information needs.

   But the growing complexity of electronic systems and the integration of many different data processing activities tend to introduce serious rigidities. The executive's insistence on flexibility is his insurance that what was meant to be a support does not turn out to be a restraint.

3. He can insist on equipment and systems uniquely tailored to his own corporation's needs. The most effective systems are likely to be those developed by a partnership of executives and technicians. The role of the executive in this partnership is to make sure what is designed is not a technical triumph alone, but a commercial success in his own company.
4. He can focus attention on the large and growing potential in management data processing as contrasted with accounting data processing. Because he himself is the man who will use it, he can force a concentration on information for executive decision.
5. He can anticipate the organizational impact of advanced data processing systems. Systems now in being and yet to come will alter working relationships and job content. Unanticipated, these changes can be corrosive. Anticipated, they can add to executive capacity.
6. Finally, he can give his principal attention to the new managerial skills and decision making patterns made possible by management data processing. The potential of the machine can be exploited only by the system in which it operates. The potential of the system can be exploited only by changes in executive behavior. The planned change of executive behavior is uniquely a responsibility of top management.

Managers and technicians have learned in the last 10 years the basic lessons of electronic data processing. They have learned from the mistakes that invariably accompany innovation. They have learned from the computer's successes as well.

The promise of electronic data processing is now achievable. Its problems can be handled. What electronic data processing contributes to profits in the future depends on the skill with which management applies the lessons of the past. The contribution can be great. The responsibility is clear.

By J. W. Haslett
Shell Oil Company

Total Systems – A Concept of Procedural Relationships in Information Processing

LIKE THE PHRASE "operations research," the words "total systems" are applied without too much discrimination to a concept which is scarcely new, but whose practice and accomplishment are for the first time finding general support and recognition among those who have to do with managerial record keeping.

For as long as mercantile operations have existed, record keeping of one sort or another has attended all business transactions. In modern times the word "paperwork" has come to represent the output of the vast clerical group which comprises a major segment of the labor force and is occupied with recording information so that business and industry may operate in a systematic way.

With the advent of electronic business machine systems the word "paperwork" was supplanted by the phrase "data processing," to distinguish between manual information handling and machine manipulation.

More recently the words "integrate" and "total" have become adjuncts to the systems analyst's vocabulary. By inexact definition, their usage with other special methods words such as "data" and "systems" has broadened their scope of meaning to comprehend all company administrative operations rather than those confined to segments of a company.

Thus, integrated data processing and total systems convey the idea that the area of interest takes in the recording work of all departments of the company, with particular reference to the relationships among similar or similarly used information.

To many top executives the concept of total systems is new; to the student of advanced management principles and practices only the phraseology is novel.

The philosophy of a total systems approach has long been understood by seasoned methods analysts. But the concept could not be realized in actuality until the numerous basic company practices were systematized and standardized, numerical coding systems established and made uniform, and the entire organization's recording processes recast into a logically related mold.

With these preliminaries attended to, the comprehensive approach became practical, and in today's highly competitive climate, imperative, since a reduction in the cost of doing business is a determinant of industrial survival.

Conceptually, the relationships and particularly the similarities within an information system are the matters with which methods and procedures specialists are now contending. These relationships, and how they should be handled are the major concerns of total systems.

OBJECTIVES

The first consideration in describing the total systems concept is, of course, its objectives. They can be simply stated:

- To organize administrative work flows from the viewpoint of the company as a whole without regard for barriers of organizational segments.
- To develop an information system whereby source data are recorded once and thereafter perpetuated in various summary forms to meet departmental operating and financial needs without repetitive processing.

Although these two aims can be accomplished to a limited extent by manual methods, automated data processing has proven a more feasible technique in the total integration of clerical and accounting work.

As to the first objective, the company-wide