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Changing concepts in EDP feasibility studies

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A computer feasibility study should develop answers to two major questions:

What is the best way of utilizing EDP?

Which computer, if any, best meets the company's requirements?

The factors that govern the development of the answers to these questions are subject to continuous refinement and change.

Technological improvements are being developed continuously by the computer manufacturers.

Equally important developments are being made in application concepts. Gradually, users are learning that full utilization of EDP requires extension beyond routine bread-and-butter applications. Broad, company-wide applications are beginning to materialize. These cross departmental lines and mechanize decision processes that previously were performed more or less intuitively by human beings.

As a result of these improvements, feasibility studies today are apt to develop positive conclusions that could not have been developed a few years ago. Many companies that initially were merely bystanders now find they can profitably apply EDP to their business needs. The purpose of this paper, therefore, is to review current trends in the two factors mentioned above—technological developments and changing application concepts—for these factors weigh heavily in any consideration of computer feasibility.

TECHNOLOGICAL DEVELOPMENTS

The most significant development in the past year or so was the introduction of solid-state computers, the so-called "second generation" of machines. This break-through served as a needed stimulant to the industry, and the computer manufacturers and their customers were quick to respond. Several hundred machines have already been delivered, and several thousand more are on order, counting the smaller systems that do not use magnetic tape.

The over-all contribution of the new family of machines is obvious—the customer gets more processing capacity for his dollar. More specifically, the machines offer:

- Faster processing
- Greater reliability
- Lower programming costs
- Lower installation costs (less floor space, lighter weight, less air conditioning)
- Lower operating costs (less power, floor space, and air conditioning)

The transistor, of course, made most of the improvements possible. The tiny new device quickly outmoded the vacuum tube, just as magnetic cores outmoded the cathode ray tube a few years earlier. The result: miniaturization, improved performance, and lower costs.

The introduction of the transistor, however, was only partly responsible for the success of the new computers. Equally important was the development of new processing concepts, which, in turn, led to the development of new ways of assembling basic components into more flexible systems over all. The new processing concepts included the following:

- Parallel processing of multiple programs
- Consolidation of the capacities of scientific computers and business data processors into dual-purpose machines
- Expansion of the building-block principle to permit easier transition to EDP
- Simplification of the programming task

PARALLEL PROCESSING

From the very beginning, the designers of business data processing machines have concentrated on techniques of performing more than one processing function at a time. First, buffer storage devices were developed, which enabled the machines to read one magnetic tape record while another was being written out on a second tape. This concept led to:

Simultaneous writing of one tape record, processing of a second, and reading of a third

Simultaneous operation of any two functions, such as:

- Printing a line of a report while reading a tape
- Punching a card while writing a tape
- Reading a card while computing

These developments greatly reduced the time required to process a given computer program. The next step, then, was to design the machines to permit processing of more than one program at a time. The first computer with this feature provided the ability to overlap the processing of one main program with any two of the following so-called peripheral operations:

- Card-to-tape
- Tape-to-printer
- Tape-to-card

This was a significant break-through. It meant, for example, that a lengthy stock-status report stored on magnetic tape could be printed during the same time a pay roll was being processed and written on another tape.

This concept has since been expanded. One computer now has the power to run up to eight programs on a parallel basis, adding significantly to the machine's capacity for work.

COMBINING THE SCIENTIFIC AND BUSINESS MACHINES

Initially it was thought that scientific and engineering problems required a special family of computers. These problems usually involved little in the way of input and output, but required considerable high-speed computing. Perhaps because few companies could afford both types of machines, certain machines are now designed to accommodate both requirements.

Machines of this type provide large (or variable) word sizes, floating-point arithmetic, and binary mode arithmetic primarily for processing the engineering and scientific problems. The same machines provide the following features primarily for commercial applications: fast input and output, overlapping of processing functions and programs, and rapid sorting, file maintenance, and related operations peculiar to business applications. Many other features have been developed which facilitate both the scientific and the business applications. These include larger memories, index registers, and microsecond processing speeds.

THE BUILDING-BLOCK PRINCIPLE

The building-block principle in computers enables a user to acquire a "stripped down" machine for initial requirements. Then, as the business grows or as additional applications are developed, additional machine capacity can be acquired. From a cost viewpoint this makes the whole idea of converting to EDP much more attractive.

There are several ways of expanding the initial capacity of a system:

By acquiring additional internal storage;

By acquiring additional card readers, tape units, and printers;

By exchanging the initial card readers and tape units for faster models;

By acquiring buffer storage to permit simultaneous operations, such as the overlapping of printing with internal processing;

By acquiring an additional machine of a compatible model. Here, compatibility means that the tapes prepared by one machine can be processed on the other, and, to a limited extent, the programs for one machine can be processed on the other.

SIMPLIFICATION OF THE PROGRAMMING TASK

Significant steps have been taken by the manufacturers to simplify the programming task and thus reduce the costs of converting to EDP.

The principal developments of this type are:

Development of more effective automatic programming methods. Under so-called "English language" programming, the program is written in English, following precise rules. The program is then translated automatically into the language of the computer, using a special program furnished by the computer manufacturer.

Development of extensive libraries of programmed routines. The manufacturers now furnish programs for commonly needed routines, such as tape label checking and other imput-output functions, sorting, merging, and the preparation of output reports.

Development of complete program packages for specific industries. A public utility, for example, can now copy appropriate portions of a generalized program furnished by the computer manufacturer. This approach minimizes the amount of original programming required on the part of the customer.

CHANGING APPLICATION CONCEPTS

It is becoming increasingly clear that extensive planning by qualified systems analysts is needed if the full potential of electronic data processing is to be realized. Such planning has led to a new approach to application development, which is sometimes referred to as the *total system* approach or *systems engineering.*

THE NEW CONCEPT

The *total system* approach introduces a new outlook or attitude toward data processing. The analyst begins by viewing a business as a single enterprise composed of related parts. He approaches his task as he would a jig-saw puzzle. First, he studies the picture on the box cover, the end product. Then, he examines each interlocking piece and determines where it fits into the over-all picture and how it relates to other pieces. He does not attempt to work the puzzle merely by examining the shape of each piece. Instead, he observes the flow of color patterns from one piece to another and purposefully builds these patterns into the over-all picture that was preconceived and established in his mind at the outset.

The systems analyst, therefore, endeavors to determine how the component parts of a business relate to one another and how they fit together to form a total entity. The interlocking parts he deals with are the various corporate functions. These include research, engineering, sales, production, finance, and accounting, and the many subfunctions within each of these. And just as color flows link the puzzle pieces, information flows link the corporate functions. The analyst knows that the information needed for one purpose is often needed for several other purposes. His initial objective is to spot the common information and determine who uses it, when it is needed and why it is needed.

This point of view stands in sharp contrast to most of the earlier attitudes toward EDP application development. Here are a few cases in point:

"Our initial objective should be to gain first-hand experience with the new equipment."

The advocates of this approach always started with a simple, well-understood application, such as pay roll. Experience now indicates that this approach seldom produces significant results. Since there is no longer any doubt about machine performance or any fear of programming pitfalls, analysts can now tackle the more complex areas with complete confidence.

"Let's learn to walk before we try to run."

This thinking has merit, of course, but it has often been overemphasized. It led to the once popular belief that an application should be converted to punched-card processing as an interim step toward electronic data processing. The danger here is that if an area can be mechanized in its entirety on punched-card machines, the subsequent substitution of EDP equipment may, again, produce no real benefit to the company.

"Let's move into EDP gradually, application by application."

This is still the favored approach. But most analysts now say that a master plan of the ultimate total system should be developed first. Then, as each successive application is developed, the parts will fit together properly and the final goal will be achieved with a minimum amount of re-programming.

"Let's mechanize our existing tabulating applications and manual procedures."

This goes right to the heart of the problem. The opposite approach is to view the computer as a means of introducing new control techniques and an excuse for starting fresh to build a new and better system.

It is apparent that to date most computer application concepts and practices have not kept pace with technological changes in the machines and devices. But now that many companies have acquired considerable experience with computers, the situation is beginning to change. Computer hardware is being taken for granted, and the systems analysts are realizing that application planning need not be inhibited by hardware. Attention is being focused on the design of ultimate or *ideal* systems. The *total system* concept is one label that is used to describe the new high-order approach to EDP system design.

There is nothing really new about the total-system concept. The true "pros" in systems work have always approached problems on a broad basis in order to uncover the interrelationships that exist with respect to a particular area. The thing that is new is simply this—EDP permits application of the sophisticated systems at a reasonable cost.

The total-system approach can be applied to any company. It is particularly appropriate, however, to manufacturing concerns. The approach in this industry varies from company to company, of course, but there is a mainstream flow of information that is basic to many of them.

The system begins with the receipt of customer orders. The orders are first edited and coded manually, then converted to computer input media. Usually the media are punched cards. Paper tape is also used, especially when it is feasible to prepare the tape as a by-product of the order-typing operation.

A computer-controlled chain reaction then takes place. Working with magnetic tape files of master information, the computer summarizes the orders by promised delivery dates and prints a report for sales-management purposes. The computer then determines all manufacturing requirements: The production schedule is adjusted; requirements for manufactured parts and sub-assemblies are redetermined; loading schedules are adjusted for the individual manufacturing and assembly centers; production papers are prepared, including process sheets, tool requirements, material requisitions, labor tickets, and production move orders; and the purchasing department is automatically notified of raw material needs.

As materials and purchased parts are received, the computer updates the inventory records and prepares stock-status notices for items needing human action. As manufacturing proceeds, labor-time tickets, material requisitions, and production move orders are fed back to the computer. It reviews the factory work load, and reports on jobs that have fallen behind schedule and jobs that are costing more hours or material than scheduled.

The employee time tickets are automatically costed for account distribution purposes and the data are held for the subsequent preparation of pay rolls. Completed production counts lead to the automatic preparation of shipping documents, which in turn lead to the billing and accounts receivable operations, all performed on the computer. Finally, at the end of the month, the accounting information is rounded up on magnetic tape ledgers, and the computer completes the cycle by printing budget comparison reports and other financial statements for review by management.

In operation, such a system works smoothly and efficiently, with a minimum of human assistance. Each transaction is recorded on input media only once; thereafter it may be processed against several different tape files. Accuracy is assured, since transcription from record to record is eliminated. Basic tape files provide a single source for all requirements, which again insures accuracy.

The daily operation may include fifteen to twenty computer runs, each requiring its own program. The programs, however, are stored sequentially on a single reel of tape. This enables the computer to proceed from one run to the next without pausing for manual selection of program tapes. The only interruption in the processing occurs when the computer notifies the console operator to change a certain reel of tape, to set up a printer, or to perform some other physical task.

Systems such as this require planning and design of the highest order. In designing the inventory-control portion of the total system, for example, the analyst must first consider broad objectives and policies before getting into the specifics. He should consider the following points, among others:

- The company's policy regarding over-all inventory levels
- Means of balancing the costs of carrying excess inventories with the economies of continuous production
- The consequences of being out-of-stock and of being overstocked

Obviously, the development of effective computer systems requires specialized talents. Fortunately, the work is challenging and persons having the required talents are being attracted to the field. These include accountants and others who are strong in business administration, mathematicians and engineers with experience in applying computers to their problems, production and operating personnel who have attained management status, and data-processing specialists of various types. The specialized knowledge these individuals bring to the task is important. Equally important, however, is the breadth of outlook of men of this stature, for perspective, judgment, and imagination are fundamental to the development of new systems concepts.

Some companies refer to the field as *systems engineering*. Regardless of title, there is good evidence that a new field is developing. IBM and other computer manufacturers are actively developing specialists in advanced application concepts. The leading accounting firms are finding an increasing demand for advisory services. And, most importantly, the corporations are recognizing the potential of high-order systems planning and are developing staffs with appropriate qualifications.

Obviously the concept must be applied with discretion. Considerable study is required at the outset, and this requires time, talent, and money. A more customary approach will produce faster results, and factors such as management backing, the likelihood of getting departmental acceptance, and the relative stature of the project leader must be favorable if the undertaking is to succeed.

CONCLUSION

The stream of technological improvements, which has been a characteristic of the industry from the start, is continuing today at a steady pace. Application concepts are becoming more sophisticated, pointing out more effective ways of tapping the potential of the machines. Both factors affect the outcome of feasibility studies. In a growing number of cases, the outcome is a positive indication that a computer can be applied effectively and economically to a company's data-processing requirements.