INTRODUCTION TO AUTOMATED DATA PROCESSING

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PREFACE

If you have little or no knowledge of automated data processing operations but have the desire to become acquainted with some of the data processing devices and procedures that are a part of your daily life, then this book is meant for you. After you have completed this book, you will not qualify as an expert computer programmer, a system analyst, or even a key punch operator—but you will have eliminated many of the mysteries of modern data processing and will have discovered whether or not you are sufficiently interested to continue study and perhaps pursue a career in automated data processing. This book does not present an exhaustive study of specific topics—it serves only as an exposure to some of the basic principles and applications of automated data processing and does not emphasize machine technology. No handling of any equipment is necessary. Generalizations pertaining to basic operating procedures for various automated data processing media are followed by simplified applications of those media. Only when it is desirable to understand the "how" of an operation is any description presented of machine technology. After the introduction to basic understandings applicable to all data processing in the first chapter, the following chapters acquaint you with various systems in which the processing principles are applied. It is suggested that you review the introductory chapter after you have finished Chapters 2, 3, and 4.

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1

INTRODUCTION

> When the history of our age is written, it will record three profoundly important technological developments: (1) nuclear energy, which tremendously increases the amount of energy available to do the world's work; (2) automation, which greatly increases man's ability to use tools; and (3) the computer, which multiplies man's ability to do mental work.*

Before you finish reading this book, two important factors will be apparent:

1. Data processing involves much more than the use of multimillion dollar high-speed electronic computers.
2. There is no reason to fear and evade studying data processing because the subject is difficult.

Twenty years ago, electronic data processing was relatively unknown and was rarely discussed among businessmen. Since World War II, business has developed an exciting new concept in processing data. Yet although we are in constant contact with this new concept (by way of credit cards, utility bills, sales tickets, etc.), very few people are sufficiently acquainted with modern data processing methods to be able to discuss the subject intelligently.

Along with this new concept of data processing has come a new language heretofore unknown to even executive managers in business organizations. The language and its concepts are so revolution-

* Ralph Cordiner, President, General Electric Company, quoted by K. G. Matheson, "The Impact of the Computer on Curricula of Colleges of Business Administration," *Collegiate News and Views*, XIV, No. 4 (May, 1961), p. 3.

ary their descriptive terms are not standardized. Because terms mean different things to different people, we encounter still another block in discussing data processing. Nevertheless, a totally new era in data processing is upon us; and unless we learn to understand these new concepts, we shall find that the advancing business world has left us in its dust. For example, it is almost impossible to glance at a current business or news periodical without finding several advertisements and articles discussing newly developed data processing procedures and equipment. One of the leading and most profitable businesses in the United States today is the development and production of electronic computers and other data processing equipment used in modern business offices.

BASIC TERMINOLOGY IN AUTOMATED DATA PROCESSING

In order to become acquainted with this new concept of data processing, we must understand some of the terminology frequently used in describing specific operations. As the terms are not yet standardized, many of them carry multiple meanings. In this book, the basic data processing words are defined as follows:

Data

Data is generally considered to be the facts and figures extracted from direct observation by the persons using the data. These signs and characters are said to be syntactical—they are isolated numbers, letters, words, and symbols that will later be structured into charts, tables, and reports.

Information

When data is properly combined, a meaningful conclusion called *information* is formed. The isolated numbers, words, or symbols representing data are processed to produce understandable relationships of numbers, words, and symbols on a *semantical* or meaningful level. Data, therefore, is primarily associated with input or the beginning phases of the processing; information is associated with output or the final results of the processing.

Data Processing

Actually, data has been processed since prehistoric times; barter of personal and consumer goods, counting beads, calculating with the Chinese abacus are but three examples. But within the past score of years a comparatively new concept of data processing has arisen. Today, the term *data processing* in business implies (1) acceptance, (2) rearrangement, (3) refinement of data (isolated numbers and words) into a form of information (charts, tables, and reports) to be used by businessmen who are responsible for making business decisions and formulating company policies. Converting data into information often involves many separate processes, such as originating, itemizing, manipulating, presenting, and disposing (see pp. 9–12 for a more detailed description of these processes).

System

"System" is probably the most loosely used word in the new data processing language—a kind of "all-things-to-all-people" word. Basically, a data processing system implies a preplanned combination of operations and procedures, personnel, and equipment by which a prescribed goal or objective may be accomplished. Most definitions of a system assume a degree of interrelationship of the components that make up the organized whole or the goal which is to be achieved.

Perhaps the key word throughout the entire data processing language is "interrelationship." For any specific operation to be efficient, it must fit in with the operations that occurred before it and with those that will occur after. For example, a system (a preplanned method to complete a specific job) would probably not be efficient if data was first typed by a secretary in the order department, another form typed in the shipping department, and still another form typed in the accounting (billing) department. Perhaps it would have been preferable to have had the data typed only once, by the secretary in the order department, but to have had carbon copies made for the other two departments. If such a procedure was to be followed, the interrelationships of all three departments would have to be closely reviewed so that each department would receive all the necessary data it required from the single typing operation—typing the form in the order department.

The one typed form would have to contain all the data needed by each department.

Typing the form in each separate department, as just described, was a "system" because it was preplanned in terms of operations and procedures, personnel, and equipment, but it was a *poor* system because it did not carefully consider the interrelationships of the other two departments. The second, carbon-paper system—and it, too, was a system—did consider the interrelationships of the departments and thereby permitted a reduction of effort and expense and provided an increase in the accuracy of the typed data through eliminating unnecessary typing.

IS&M—Interrelationships of Systems and Machines

In order to look at some data processing operations commonly used in business but not employing certain types of electronic devices, we shall call this elementary group of operations *IS&M*—Interrelationships of Systems and Machines. This term is not as universally accepted as IDP (Integrated Data Processing) or EDP (Electronic Data Processing), terms to be analyzed later; but we should become acquainted with some basic and simplified concepts and operations which cannot be included in IDP or EDP.

IS&M (Interrelationships of Systems and Machines) involve consideration of two factors: (1) the system being followed (the planned method to arrive at a goal), (2) the equipment (machines or devices) being used. IS&M implies that the relationship between the system and the machines should reduce or eliminate unnecessary steps, speed up one or more steps in the process, and increase the accuracy of the information.

Changing office equipment to fit in with an established system may be no better an answer to the problem of improving operations than would be changing a system to fit in with existing equipment. Goals, personnel, and procedures must be reviewed and analyzed, along with an analysis of equipment needed to complete the operations.

Machines or devices generally included in IS&M are pegboards, typewriters, photocopiers, calculators, duplicators, intercoms, television, and other equipment that does not require punched cards, punched tapes, or magnetic tapes.

IDP—Integrated Data Processing

Integrated data processing (IDP) is a relatively new concept in processing business data. Actually, IDP is an extension of IS&M. Various machines are used to eliminate handling data by recording the data only once, generally at its source or origin, and to employ the recorded data in a variety of ways, in a variety of machines, and in more than one department within a business. Recall the previous example, using carbon paper in IS&M to eliminate additional typing of sales data. Both IS&M and IDP attempt to capture all the necessary data at the point of origin; IDP is also concerned with placing the captured data in various media and with using a machine language that is common or understandable to all machines that will process these various media. Some of the common-language media most often used are

Punched cards

Punched-edge cards

Punched tags and tickets

Punched tapes

Magnetic inks

IDP further differs from IS&M in being concerned with the mechanical processing of data, whereas IS&M pertains more to human operations after the original data is recorded. In IS&M, a human being will read and interpret the data typed on the sales order previously discussed. An IDP operation attempts to eliminate human searching, interpreting, and recording of data by supplying the data in a common-language media that can then be fed to various machines as a device that permits the machines to "talk" or communicate with one another. The theory behind an IDP operation is coordination of various data processing machines in a continuous and automatic operation that accepts and processes data from its point of origin to the desired goal. Basically, then, IDP is characterized by three distinct features:

1. The original data is recorded at its point of origin in a complete form so that no additional referrals to the source documents will be necessary.

2. The data is recorded in a common language acceptable to various machines that will process the data.

3. The data is processed by mechanical rather than human operations.

We can now define IDP as a comprehensive procedure of recording data at its point of origin in a common machine language compatible to all machines that will process the data. By definition, the goal of IDP is to mold all related data to be processed into a harmonious and efficient whole.

EDP—Electronic Data Processing

The term *electronic data processing* (EDP) is somewhat misleading, for the equipment used in IDP and some machines in IS&M are also electronic. What, then, is the distinguishing characteristic of EDP? The electronic computer! When a computer is added to the processing of data, the classification of IDP is changed to EDP. We must remember, however, that EDP is not an electronic computer alone but includes all the necessary equipment used in IDP processing plus the computer.

An EDP system is generally characterized by a high rate of speed and by self-containment of various processes to be completed. EDP can complete any combination or sequence of operations that any other group of office machines can complete, but because a computer is included, data is processed at much greater speeds and with less human intervention between the various stages of processing.

Mechanization

Data processing procedures are mechanized when machines which can perform only one or two functions are combined to produce a data processing system; the human operator continues to serve as the communication link between the various machines needed in the system. IS&M is usually mechanized (for example, an electric typewriter) but seldom automated. IDP becomes less mechanized and more automated (for example, an electric typewriter that produces a punched tape which can be used in other

machines to provide data). EDP is usually automated but seldom mechanized (for example, an optical scanner that provides data directly to the computer without human intervention). Thus, as the transition is made from IS&M to IDP to EDP, mechanization and human handling of data decrease and automation increases.

Automation

Automation, as used in data processing, implies a degree of machine control that is self-starting, self-checking, and self-stopping. Whenever a deviation from a prescribed and preplanned pattern occurs, the machine corrects the deviation or prevents the processing from continuing, and the checking or stopping is done by the machine with no need of human supervision. A household thermostat is an example of an automatic device; without human attention, it will start and stop the flow of heat so as to maintain a predetermined temperature. A computer is likewise self-directing, and thus it is classified as "automatic."

> The term *automation* designates one of the most important characteristics of an automatic computer: the ability to guide and control itself during the course of its data processing action. That is, once the human operator has set up the computer to operate, the machine takes over control of itself. . . . The machine is self-directing, but only within definite prescribed limits which must be predetermined by the human operator during the setup of the machine for operation.*

Many persons engaged in data processing prefer to use the term *automated data processing* (ADP) rather than electronic data processing (EDP). Actually, electronics is not always a necessary condition for automation, and the term *electronic* obscures the more fundamental factors of automation.

If we accept the foregoing definition of *automation*, we can see that the term *office automation* so commonly found in business writings is a misnomer. We have not yet reached a stage in data

* Ned Chapin, *An Introduction to Automatic Computers* (Princeton, N.J.: D. Van Nostrand Company, Inc., 1957), p. 7.

processing where, as the term *office automation* would imply, we have a completely unmanned office in which *all* the work is done by machines and no human supervision or effort is necessary. Automation in the office, yes; office automation, no!

Summary of Terminology

From the preceding discussion, the progression of data processing classification would appear as follows:

AUTOMATED DATA PROCESSING

(IS&M) Interrelationships of Systems and Machines	(IDP) Integrated Data Processing	(EDP) Electronic Data Processing
Human-operated machines or devices performing a separate and complete operation as part of a system.	Machines producing a common-language media applicable to other machines in the system.	Machines using a common-language media—one machine of which is an electronic computer.

Note that the term *automation* is not specifically assigned to any one of the classifications, but each of the data processing classifications does contain some element of automation. IS&M, for example, may include an electric typewriter which automatically continues to print underscores so long as the typist keeps the underscore key depressed; it is not necessary to depress the key for each individual underscore mark. Also, the return of the typebars into the cradle position after the keys have been depressed and the letters printed on the paper is automatic because the human operator need not release the key to return the typebar to its correct position; it returns automatically. The new IBM Selectric typewriter applies automation one step further by keeping in temporary storage the sequence in which the keys were depressed and releasing one letter at a time; no tie-up of keys is possible since the machine permits the release of one and only one letter at a time.

DATA PROCESSING CYCLE

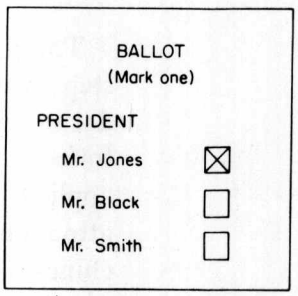
Handling data in office procedures is commonly explained in a series of five steps and is often referred to as the *data processing*

cycle. Most of us are aware of the procedures required to perform simple business transactions, such as the writing of a personal check, but rarely do we categorize the steps involved. We need not be fully aware of what the various steps in our daily routines require; but being able to classify the specific functions will help us to understand, analyze, and evaluate methods and procedures used to process data. The following five steps comprise the data processing cycle:

1. Originating data *in* source documents
2. Recording or itemizing data *from* source documents
3. Processing (manipulating) itemized data
4. Producing a final record or answer (summarizing)
5. Storing (filing) the summary or record for future reference.

Origination of Data

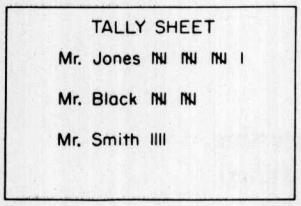
As noted earlier (p. 2), the beginning phases of data processing deal with *data* (isolated facts and figures that will later be classified, sorted, computed, and summarized to represent meaningful information). These basic figures or data are placed on various forms and records that will be used to provide the "raw" or initial data at the beginning of the data processing cycle. The form or record containing the data at the start of the cycle is called a *source document*. What is produced as the final form or answer depends on what data was taken from the document, then classified, sorted, computed, and reported. For example, assume that a group of people wish to elect officers for their organization, and the election to an office requires a majority vote. To conduct the election, de-



signated persons will distribute the proper ballots to members of the organization. After the members have indicated their preference by checking one of the candidates' names listed on the ballot, the inserted "X" (data) on the ballot will then classify the ballot as a source document. From these ballots, or source documents, the data will be extracted, processed, and reported. The first step, the origination of data on source documents, will have been completed.

Itemization of Data

For convenience, data from source documents is often transferred to summary forms to permit easier interpretation and manipulation. Often, the second step of the data processing cycle merely involves tabulating or listing the various data appearing on



collected source documents. Would it not be easier to handle the election procedures if the marked ballots were tallied one at a time on a summary sheet rather than having someone try to retain a running count in his mind? Listing or tabulating ballots in a manner that facilitates the final evaluation of the totals illustrates the second step of the data processing cycle.

Manipulation of Data

The third step of the cycle is the manipulative or computational step. After the original data has been extracted from the source documents and conveniently listed or summarized, the arithmetic functions (addition, subtraction, multiplication, and division) are applied. This step, the computational step, receives the greatest attention within the data processing cycle. Ten-key adding machines, rotary calculators, key-driven calculators, bookkeeping ma-