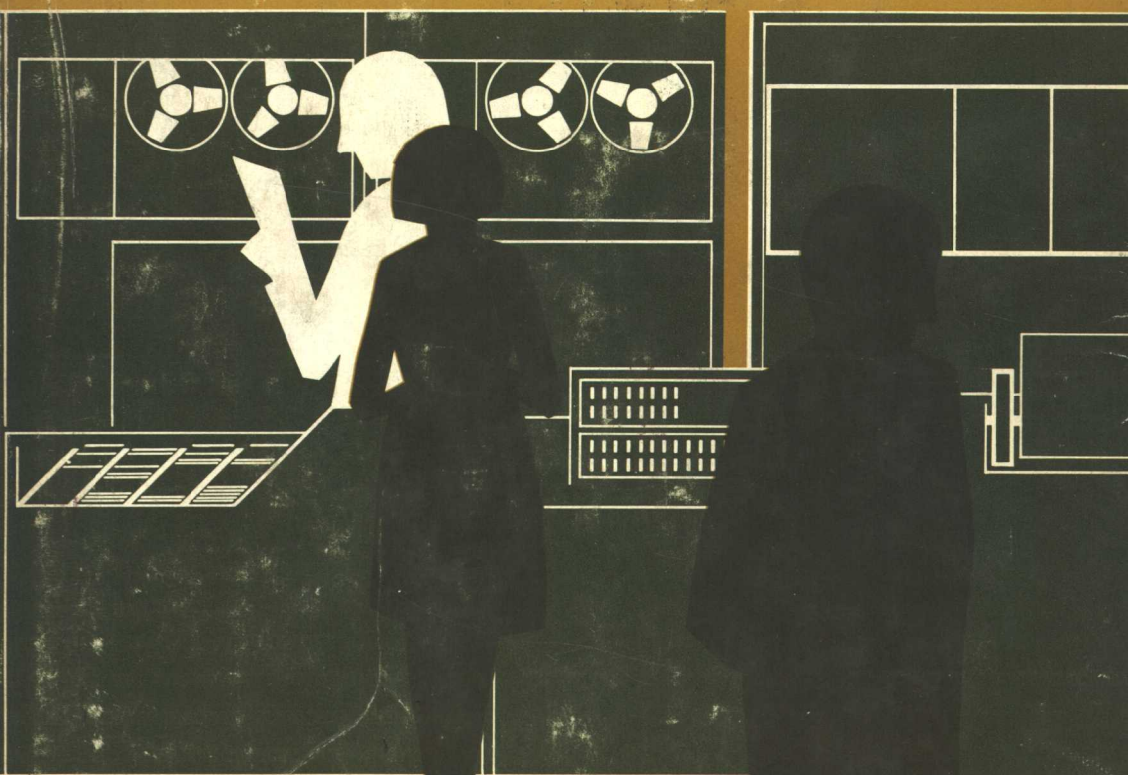
BASIC DATA PROCESSING

Richard W. Lott



A single-volume source to the entire field of data processing, from manual techniques through advanced electronic systems. Generates reader participation through creation of operating situations in presentation of material. Requires no prior training in the field.

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PREFACE

This book is written for the person who wishes to learn about mechanized data processing methods. Although no prior background in the field is assumed, more efficient use can be made of this material if you are familiar with such operations as billing, inventory control, payroll, or some other business application.

This material is intended to serve a variety of users. Specific needs should be served for:

1. Students who wish to become more familiar with data processing techniques.
2. People who are entering the programming and systems analysis fields.
3. Managerial level personnel who wish to learn the capabilities, limitations, and problems associated with computers and related equipment.
4. General workers of an organization who want to increase their ability to communicate with programmers and systems analysts.

The problems in each chapter have been carefully chosen to test your knowledge of the material presented. Many have been designed to motivate you to consider many solutions rather than the one that comes to mind first or one that is related to specific equipment available at the moment. In several cases you will have to go to outside sources to obtain additional material.

Problems In Data Processing has been published concurrently with this textbook. It is recommended that you obtain a copy and work those problems for additional exposure to practical situations.

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CONTENTS

1 DATA PROCESSING

Data is defined as a set of facts or statistics relating to events which can be identified and measured. These events can be things which have already happened or things that may happen at any future time. *Processing* refers to any steps taken, by whatever means possible, to make data usable for a specified purpose.

In a sense every person in an organization does a certain amount of data processing. The factory worker who punches the time clock—the receiving clerk who counts and writes down the quantity of a shipment received—the sales girl who takes a customer order over the phone—the accountant who prepares a report—these people are all processing data.

In the narrowest sense, data processing represents those activities performed in what has come to be known as the Data Processing Department, typified by punched card machines and electronic computers. This use of the term has developed because these two mechanized approaches centralize many data processing functions and tend to create an internal service bureau. In nonmechanized systems, each department is likely to do most of its own work, with the only concentration of activity occurring in the Accounting Department.

This textbook will treat data processing on the broader basis, realizing that there are manual, bookkeeping, conventional punched card, and electronic data processing systems. It is recognized that most readers are somewhat familiar with manual systems; it is my intent to concentrate on the electronic type in this book.

It appears that the need for better data processing is increasing all the time. Some reasons are:

1. Switch from a seller's market to a buyer's market. This has created a "squeeze on profits."
2. Greatly increased variety of products and services handled.
3. More and more internal work for which there is no direct reimbursement of expenses incurred, such as tax reports and employee records.

The very essence of data processing is that you are striving to find a better way to do things.

BUSINESS REQUIREMENTS

Most data processing has been done to satisfy certain historical requirements of a business. Several examples are payrolls, customer invoicing, tax returns, and paying accounts payable bills. It is true that some mechanized systems of this variety have been able to show a data processing profit. But a number of systems have incurred a considerably greater expense under a mechanized approach. Many companies think that the cost of a mechanized system will be considerably less than the former manual system or less sophisticated mechanical system, and these people are often surprised to find this is not the case.

In the early 1960's, it appeared rather fashionable to acquire a computer. It seemed that the only way to keep up with competition was to have one of these electronic marvels. It is now rather obvious that a computer is not an immediate cure-all to a company's data processing problems, let alone all the related problems of production, financing, and marketing. And for the company who merely mechanized an efficient, existing system, it was very likely that a less desirable system resulted. A company that has been in business for 25 years has probably developed a very good payroll system by now. It is difficult to see how that company could install something so expensive as a computer and immediately come up with a more efficient system. Countless surveys have shown that, in most industries, computers are not likely to produce substantial clerical savings.* The people responsible for systems development and installation must be careful so that anticipated or reported clerical savings are not due to the comparison of a computer system to a disorderly manual system. The manual system may have just grown up, whereas some formal program was required to install the computer; the computer system must be compared to the best manual system that could be developed.

A common reason for wanting to mechanize a system or to increase the

*For an example of such an article, please refer to John Garrity, "Top Management and Computer Profits," Harvard Business Review, Volume 41, Number 4, July-August, 1963.

degree of mechanization is to reduce the time lag between the happening of a transaction or series of transactions and the completion of the end result. In hourly payroll systems it has become common practice to pay workers on a Friday for the work of the previous week. It may be nice to get the checks processed faster, but if they are not going to be passed out earlier or if a new processing system is not going to provide them cheaper, then what has the added speed accomplished? Also, what profits could be derived by giving out the checks earlier than Friday? Some systems do print reports so fast that more people have to be hired to read them, and the systems analyst must guard against this happening. He must also take another look at the term "speed" and make a careful distinction between the full elapsed time to get a report and just the time it took for the printing device to physically print onto the paper.

Increased accuracy and the reduction of processing errors may be the benefits of an electronic data processing system. The value of these must be carefully weighed against the cost of providing them. It may be better to put up with some errors rather than to go all out to try to prevent them. It is not possible to eliminate all errors.

Another reason given for mechanizing a system is to obtain information that is otherwise not available. There is generally some question as to how valid a reason that is. A computer can only do those things which have been humanly programmed into it and thus can't produce anything that couldn't be done with pencil and paper. However, the computer does have the advantage of doing some things quickly, particularly with involved mathematics, so that the user can receive the information, analyze it, and use it so as to control the operation to give better results on the next occurrence. A manual system may recognize something too late to do anything about it.

Care must be used when referring to "automatic" data processing systems. In data processing, things don't just "happen" automatically; they are caused to happen. The programmer who has spent three months on one problem certainly has his own opinions regarding how automatically things have been occurring.

INTERNAL INFORMATION SYSTEMS

In the last few years, a new type of data processing system has been emerging. It is sometimes called a management information system or just information system. The term "information" is used to indicate that extraneous material has been wrung from data and only the usable information is retained. This is not so much of a historical system, but it is designed to provide each person in the organization with the information

he must have in order to do his job effectively. Obviously, everyone in an organization uses certain amounts of information and makes some decisions so this type of operation is not for the manager alone. It should be pointed out that in many cases the same raw material can be used for business requirements (data processing) as for information systems (information processing). Examples for several major systems are shown in Figure 1-1.

Activity	*Data Processing*	*Information Processing*	*Comments*
a. Payroll	Print pay checks Prepare accounting entries	Relating worker output to production requirements so that a steady employment is assured	High costs of hiring and layoff can be minimized
b. Invoicing	Printing invoices Maintaining accounts receivable files Relief of inventory accounts	Prepare gross profit analysis by item and by customer Consider cycle billing	Enable company to concentrate on sales activity that is profitable
c. Property Records	Locate and identify fixed assets Prepare depreciation entries	Control preventive maintenance Replacement analysis	Cut the cost of owning and using assets
d. Purchasing and Accounts Payable	Writing purchase orders Writing checks to vendors	Critical vendor analysis	Concentrate purchases with good vendors

Fig. 1-1. Data processing vs. information processing.

In many cases, it is much easier to define the data processing job and to solve the problem than it is to define the information processing job. For this reason most mechanized systems have approached the former and many of those have been so busy on historical record-keeping that they have never advanced to the information processing stage. Many experts feel that more profits are to be earned in the latter case.

Whereas the material in this book applies to both data processing and information processing procedures, the latter requires a deeper understanding of areas such as mathematics, PERT, Critical Path Planning, operations research, and simulation in order to properly use the manual, mechanical, and electronic systems described.

FUNCTIONS INCLUDED

A number of separate but closely interrelated functions are typical of any data processing system. These include all the functions performed

from the time the transaction takes place until, at least theoretically, that transaction has been reflected in the system and the people responsible for the transaction have the opportunity to make appropriate changes in their operation to get better results in the next transaction. This is a general definition but is so intended that you will not feel that the same certain functions must be performed every time in every system.

All these functions are listed in Chapter 2. The various methods of performing them are explained and illustrated throughout this book.

EXCEPTION REPORTING

In recent years the printing speeds of data processing equipment have increased rapidly. This has made it possible to print output almost as fast as the answers are prepared; therefore, there has been a tendency to print everything that has happened because it seems like a free by-product. I feel that greater exception reporting must be done. Paper, especially in multicopy sets, is expensive to buy and expensive to decollate and burst. It is also expensive to file. And the greatest expense comes in furnishing material to people in such quantities that they can't read it or understand it because of the great volume and detail. More meaning must be put into reports!

With the power of the equipment available today, it is not difficult to program most systems to print exception reports—set up reasonable limits on data and only report on those items which fall outside the limits. Of course, this is not practical in preparing employee payroll checks, but there are only a few instances where all transactions must be detailed out as they occurred. Reports themselves may also be rendered on an exception basis. For instance, many daily reports may be changed so that they appear perhaps every three days or just once a week.

By spending proportionately less time on historical transactions and concentrating more on future events, an exception type of reporting is bound to occur.

EXERCISES

1. According to the descriptions of data processing and information systems given in this chapter, determine alternate roles for each of these activities:

a. Inventory control
b. Sales analysis
c. General ledgers
d. Material requisitions
e. Personnel records

2. ABC Company showed the following profit and loss figures for 1966: sales, $200,000; cost of sales, $160,000; gross profit, $40,000; G & A Expense, $30,000; net profit before taxes, $10,000. This company could save $5,000 of G & A Expenses and thus have that much more profit if they would redesign many of their accounting procedures. Based upon the 1966 figures, how much would they have to increase sales in order to get $5,000 more in profits (assuming no increase in selling prices)? Show your calculations!

For any given company, which would be the easier way to realize $5,000 more in profits?

3. Historically, XYZ Company had only a moderate dollar volume of sales but a very high ratio of orders processed to sales dollars. The average value of each sales order was about $50. The controller felt that too much gross profit from each sale was being spent on processing the order to completion. Based upon the company's sales invoice, shown below, can you redesign the form in such a way that fewer invoices will have to be prepared?

Original Invoice to		From XYZ Company 1 Main Street Hometown, U.S.A. 00000		
Part Number	Description	Quantity	Unit Price	Total Price
Customer Order No._____ Customer Order Date_____ Shipped via: Rail ☐ Truck ☐ Mail ☐ For $_____ Express ☐		Taxable at 4% Yes ☐ No ☐ 2% Discount to Apply Yes ☐ No ☐		

4. For many years a company furnished a detailed sales report to its sales manager each week. The format of the report is shown below. What can be done to improve it?

Invoice No.	Invoice Date	Customer	Amount
124	Jan. 9, 1967	Turner Company	$ 142.00
125	Jan. 9, 1967	Wilson Company	12.43
126	Jan. 10, 1967	Austin Company	1,200.00
127	Jan. 10, 1967	Baker Company	.86
128	Jan. 10, 1967	Charles Company	1.85
129	Jan. 10, 1967	Dow Company	96.50
		Total sales for the week	$xxxxxxxxxx

ADDITIONAL READINGS

GREGORY, ROBERT H. and RICHARD L. VAN HORN. *Automatic Data Processing Systems*, Second Edition. Belmont, Calif., Wadsworth Publishing Company, Inc., 1963. Chapter 1.

MARTIN, E. W.,JR. *Electronic Data Processing, An Introduction*, Revised Edition. Homewood, Illinois, Richard D. Irwin, Inc., 1965. Chapter 2.

NEUSCHEL, RICHARD F. Management By System. New York, New York, McGraw-Hill Book Company, Inc., 1960. Chapters 1 and 2.

2 SYSTEMS ANALYSIS AND DESIGN

There are two major reasons why an unsuccessful system may result from your efforts. The first is a system operated according to the design, but the system was poorly designed. The second case is where a good system may have been set up but is now being operated in a manner different from that originally planned. It is the function of the systems analyst to design good systems and to see that they are operated correctly.

A system, even though it may be a minor one, is costly to set up from the standpoint of time and money. Once it is in operation, it is very difficult and costly to change. Specific errors may be difficult to locate and correct, even though they are known to exist. Although it is impossible to prescribe a set pattern to follow in solving a data processing problem, this chapter will point out some of the major things that the systems analyst must provide for. The chapter is concluded with an illustration of how a certain problem may be handled on a manual basis.

FUNCTIONS TO BE PERFORMED IN A DATA PROCESSING OPERATION

A number of functions must be performed in developing any successful system. The major ones are:

Defining the problem
Gathering the facts
Providing for transaction identifying and measuring methods
Determining types of files and their contents

Determining type of processing (batch or real time)
Determining method of generating input
Design of specific processing steps
Providing alternatives
Analyzing cost and timing
Providing for file maintenance
Assuring proper data control
Getting management and operating people acceptance
Scheduling all portions
Installing all portions
Providing for documentation
Feedback and follow-up

Whereas that list may not be complete, it does represent the major efforts required. Each is presented and illustrated at the most appropriate point in this book, and several subjects are so vital and broad that they have received attention for a full chapter. You will notice that each operation is not always required for a specific case, and they do not necessarily occur in the order shown.

DEFINING THE PROBLEM

In an organization which does not have a specific person or group designated as systems analysts, data processing problems are solved by the operating people themselves. The individual operating departments determine their own needs and provide for the actions which will satisfy them. A common consequence of this type of operation is the lack of necessary interrelationships with other departments and the presence of considerable duplication of effort. The organization that has a specific systems department has several possible advantages over the one that does not.

1. There is a greater possibility of interrelating operating departments on a more logical basis when an outsider to all of them is involved.
2. The full-time systems analyst is not tied down to a desk which has eight hours' worth of production to get out each day.
3. Management has greater reason to support the systems effort and to obtain fellow worker cooperation.

It is most desirable that the professional systems analyst conduct himself in such a manner that operating people are free and willing to call upon him for help. Since his purpose is to serve others, he can serve best

when he has the full cooperation of everyone else. By turning out good systems and by not getting the reputation of a "headchopper," he places himself in an excellent position for contributing to the success of an organization.

Probably one of the most difficult things in data processing activities, as in many other fields, is to determine what the problem is. It sometimes becomes necessary to break a situation down into very small components in order to determine this. Often it is important that you think considerably beyond the facts presented and try to visualize events that occur before and after the point in question.

The data processing problem normally goes far beyond the walls of the processing room itself. Consider the following actual situation: a company found that its sales orders flowing in from salesmen in the field tended to bunch up near the end of the month. One-half of all orders were being received in the last three working days of the month. So much overtime was being experienced on these orders in the Data Processing Department that a group was told to study the "problem." The group found that this "problem" had existed for many years—their eventual recommendation was that a certain configuration of specific, faster equipment be procured to handle the "problem."

Fortunately, the company had an analyst who didn't accept everything just because it "had always been that way." He went into the situation in depth and traced the "problem" to the manner in which salesmen were paid. Each salesman had a certain guarantee each month and could also earn a commission up to twice his guarantee. Thus a man who had a $400 guarantee could earn up to $800 commission or a total of $1200 monthly. It didn't take a salesman long to realize that he could juggle his time schedule and earnings according to the manner in which he sent his sales orders into the home office. It was a natural tendency to hold back orders towards the end of the month to see how good a month it was going to be. Then he would send all his orders in if he hadn't reached his maximum quota, or he would send just what he had to if he exceeded it. In the latter case, he would hold the balance until the next month and then might actually be in a position to take several days off from work without reducing his income. Thus, what appeared to be a narrow, data processing job at the home office was actually a matter of better policing of salesmen's activities and a possible change in the method of paying salesmen.

Quite often what appears to be a problem will only be a "symptom" of the problem. In the case just cited, the home office processing and resulting overtime represented a symptom; the sales payment method was the problem.

One company had a "problem" of a great many customers calling in to