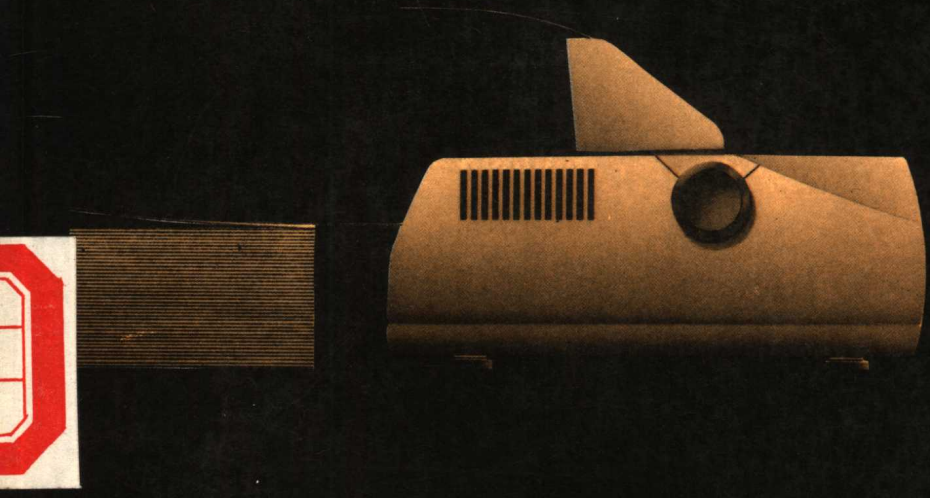
MACMILLAN MASTER SERIES

MASTERING DATA PROCESSING



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PREFACE

The so-called 'information explosion' and 'computer revolution' have combined to raise data processing to a new level of importance in every organisation. New technology, not only in computers but also in data communications and office equipment, has simultaneously made the subject much more technical and complex than ever before. No longer is it possible, however, to leave these subjects entirely to specialists because part of the impact of the latest developments has been to make modern means of data processing available to users throughout the organisation. Minicomputers, microcomputers and terminals connected to remote mainframes have all contributed to this process which seems certain not only to continue but also to accelerate.

The consequence of these developments is that almost everyone working in commerce, industry or government is likely to become involved in using the new technology. It is only by understanding the basic concepts that underlie data processing that it will be possible to take full advantage of the opportunities available. Certainly, no accountant, administrator, banker, engineer, manager or scientist can consider him or herself to be fully prepared for the challenges of the coming years without a thorough grounding of data processing theory, techniques, equipment and practice.

It is to provide such a grounding that this book has been written. Aimed at both the advanced student and the general reader who wishes to broaden his or her knowledge of this important subject, the book covers all the main topics in this fascinating area.

The book is divided into five distinct parts, each dealing with a separate facet of the subject. Part I, An Introduction to Data Processing, examines the interaction between data processing and computers. Part II, The Tools of Data Processing, looks at the equipment, dealing with both the so-called 'Hardware' and 'Software'. Part III, Developing Systems, considers how an organisation can go about the task of analysing its activities to see whether they can economically and practically be performed by computers and details the steps and techniques necessary to achieve that aim. Part IV, Making Data Processing Work, examines the practical problems of data processing in an organisation, and Part V, The Applications of Data Processing, discusses the main uses of computers for data processing and identifies some of the most important systems-design features.

Although the five Parts follow a natural sequence, each may be read separately, in any sequence, if more appropriate to the existing knowledge or course of study being pursued by the reader.

Like all technological subjects, data processing has its own vocabulary which may at first encounter confuse the reader. The most important terms are explained at the appropriate place in the text, but as an aid to the reader a Glossary has been included and reference should be made to this when an unfamiliar term is encountered elsewhere in the text.

ACKNOWLEDGEMENTS

I should like to thank all those who have assisted me in writing this book. In particular my thanks are due to John Cockroft and Gerald Janes, who assisted in aspects of my research; Geoff Carrington and Bob Jarvis, who reviewed and commented upon material within the areas of their special competence; and, above, all, Ron Breeden, who reviewed the entire draft and made numerous valuable suggestions about both content and presentation.

My greatest debt is, however, once again to my wife Mollie, who not only typed the entire manuscript, but also carried out much of the research and data collection necessary.

data processing (n.): the converting of raw data to machine readable form and its subsequent processing (as storing, updating, combining, re-arranging or printing out) by a computer; **data processor** (n.).

Webster's New Collegiate Dictionary

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PART I

AN INTRODUCTION TO DATA PROCESSING

DATA PROCESSING AND THE ROLE OF COMPUTERS

1.1 WHAT IS DATA PROCESSING?

Almost any organisation has a certain amount of administrative work that must be carried out: staff must be paid, raw materials or finished goods have to be ordered and customers have to be invoiced for items they have purchased. In addition, records have to be maintained of the personnel employed, the tax deducted from their pay, suppliers, orders placed with suppliers but not yet fulfilled, customers, customers' orders that have not yet been satisfied and a hundred and one other items in order that the organisation may work efficiently and meet its legal obligations.

It was during the 1950s that the term 'data processing' came into widespread use to describe all these administrative processing and record-keeping functions which had, of course, existed since the beginning of commerce as we know it today. Although the activities included in the term 'data processing' were diverse, they nevertheless shared some common features. Among these were:

* the need to maintain accurate records or files
* the need to sort, merge and tabulate the records in the files
* the need to carry out basic calculations
* the large volume of records handled
* the routine and repetitious nature of much of the manipulation performed on the records.

Given these common features it was natural that machines should be developed to help in the processing with the objectives of improving accuracy, reducing tedious manual work, speeding up the work and, above all, reducing the costs involved. The use of machines in what is now called data processing has, in fact, a long history. As early as the 1890s a punched

card machine devised by Dr Herman Hollerith was in use to count responses to questions posed in the American Census.

The machines used for data processing until the 1950s were mechanical or electro-mechanical. It became apparent, however, that the electronic computers that had been developed during the 1940s for mathematical computation and owing their basic concepts to Babbage and his 'Differencing Engine' of over a hundred years before could be adapted for commercial data processing. In 1951 the world's first commercial data processing computer was developed by the British food company Lyons to perform some of the commercial tasks described above. This machine, called the *L*yons *E*lectronic *O*ffice, or LEO for short, was the forerunner of the computers which perform so much of the administrative work of business organisations today. A period of rapid development followed and a significant point was reached in 1959 when IBM introduced the 1401 computer. This machine, designed especially for commercial work, established new levels of cost effectiveness and became to data processing what the Model T Ford had been to road transport – popularising and extending the use of computers many times over.

With the widespread use of computers for data processing work, the terms 'electronic data processing' (EDP) and 'automatic data processing' (ADP) came into use to distinguish data processing carried out using the new tools from that using the (then) conventional tools. Today it is doubtful if this distinction still exists and in most people's minds the term data processing includes the use of computers where appropriate.

The flexibility of computers has also caused the scope of the term data processing to be broadened and today it often includes such activities as scheduling the work to be performed in manufacturing plants, calculating statistics, monitoring the performance of industrial plant or machinery and analysing a wide range of technical facts and figures. The features common to all these activities are, however, the same as those described above.

The question, 'What is data processing?' is probably best answered by stating that it is a term used to describe a wide range of activities which have certain characteristics in common, namely the collection, processing, output and (usually) storage of quantities of data with most of these activities being performed on a routine or semi-regular basis. In modern usage the term data processing usually, though not always, implies the use of computers for at least some of these activities.

The study of data processing is, therefore, the study of the organisation and techniques for the collection, processing, storage and output of data. The data processing practitioner needs skills in addition to those of a computer technician since it is only when the capabilities of the machine are properly integrated into a complete business system that the full benefits of the technology are obtained.

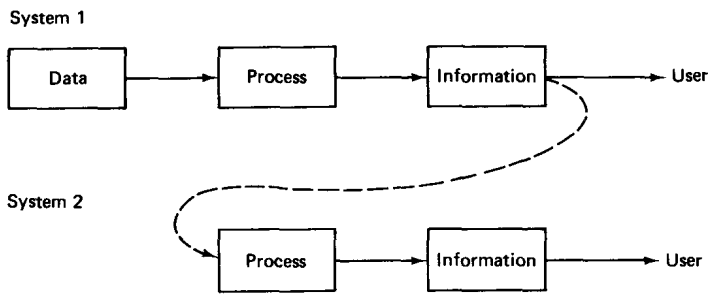
1.2 THE NEED FOR INFORMATION

So far we have considered data processing in the context of the administration of an organisation, but this is not its only use. A second major area of activity is ensuring that the management of the organisation receives the necessary information in order that decisions may be taken on a rational basis rather than on the basis of intuition. Should prices be raised? Should more of product *A* be produced? Should a cheaper raw material be substituted for one already in use? These are all typical decisions constantly facing managers. The right decision in these and hundreds more cases can only be made if the manager concerned has up-to-date and reasonably accurate information.

For decision-making purposes absolute accuracy may be less important than timeliness. Obviously it must be accurate enough to enable the right decision to be made, but information which is delayed is likely to be less valuable than information which is available almost instantly. Moreover, information tends to become less valuable after it has been produced - a point which has considerable importance in the design of systems and one to which we will return when considering the types of system that can be developed.

So far the terms 'data' and 'information' have been used but no explanation of the distinction between them has been given. There is, however, a marked distinction. To use an analogy, data may be likened to a raw material and information to a finished product - the two being separated by a *'process'*. This relationship is shown for system 1 in Figure 1.1. In our analogy the process may be either manufacturing (for example, the machining of a casting into a finished part) or assembly (for example, the joining of a body to the engine/gearbox unit to produce a car). In either example it will be easily appreciated that the 'finished product' of one process can readily become the 'raw material' for another (an engine, for

Fig 1.1 *the data-information model*



example, is a collection of manufactured sub-assemblies which in turn becomes an input or 'raw material' for the complete car). Similarly, with data, the information which is output from one process can often become the data or 'raw material' for another process. This situation is a key characteristic of data processing and information systems. Returning to the model in Figure 1.1 it can be seen that the output from system 1 is both used as it stands by the user and forms input (shown by the dotted line) to system 2. Thus an output from a payroll system which quantifies the direct labour cost of a particular cost centre could become input to a costing system.

The processing which occurs to transform data into information will include manipulation (sorting, merging, tabulating) as well as calculation, and will frequently entail the use of stored data as well as newly collected data.

A more complete model of the data/information cycle is shown in Figure 1.2, while Figure 1.3 gives a highly simplifed example of how a costing system may use input from a payroll system.

Fig 1.2 *the data-information model expanded to show the use of stored data and a subdivision of the processing performed*