

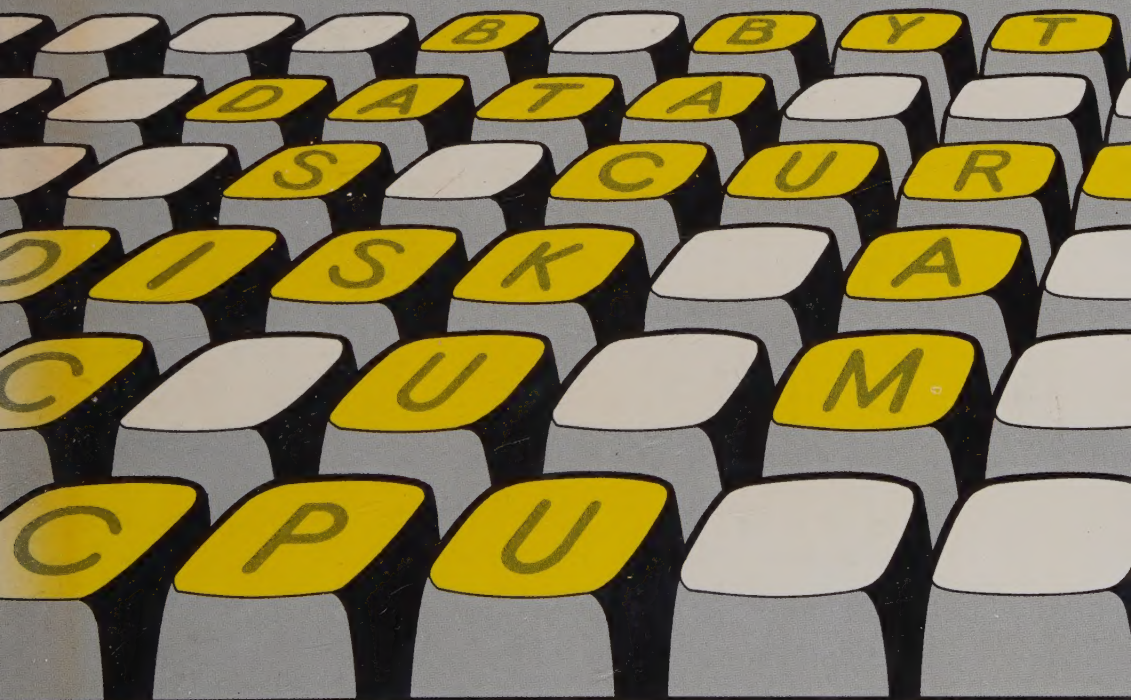
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Managing with Micros

COLIN LEWIS

Second Edition



'Up-to-date, very specific, very practical. This is the best book we have found so far on introducing and using micros in business.'

Wyvern Business Library

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'If you are a manager with a brief to install a micro-computer system running any of these applications, this is the book for you.'

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Managing with Micros has rapidly established itself as *the* indispensable guide. This new edition takes account of all the developments in a rapidly changing field, in particular the implications of the widespread introduction of hardware with vastly improved memory capabilities and the advent of economical text transmission by telephone.

The new edition of *Managing with Micros* is a co-publication between Basil Blackwell and **The Economist Books**, an imprint of The Economist Newspaper Limited.



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MANAGING WITH MICROS

Management Uses of Microcomputers

Second edition

COLIN LEWIS

Basil Blackwell

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Foreword to the Second Edition

In my foreword to the original edition of *Managing with Micros* I said that the principal focus of the book was not so much microcomputers themselves but, more particularly, the use to which microcomputers can be put in management situations. Two years later, in spite of the many technological and market developments that have taken place, the applications for which managers are using microcomputers are much the same and, hence, 90 per cent of the text has fortunately remained current and relevant.

One area of application which has changed considerably, however, is the use of the microcomputer as a communications device rather than as an independent processor. Communication systems such as MicroMail, Telecom Gold and Merlin Tex, which use the telephone network, allow their users to transmit text at very competitive rates compared with traditional text transmission media and they offer many additional facilities, such as automatic dialling, automatic logging of incoming and outgoing calls and so on. British Telecom Business Systems, under the trademark 'Merlin', are using the interest generated in microcomputers as communications devices to market more traditional applications as well, for example, ledger and stock control packages.

The biggest change in the business microcomputer scene over the past two years has been the arrival of the mainframe computer manufacturers. Companies such as IBM, Burroughs, Hewlett-Packard (previously mainly known for its scientific computing), DEC, NCR and ICL have found that the market for large computers has virtually reached saturation point, growing at a rate of only about 10 per cent per year and offering few opportunities for more than the extension and enhancement of existing machines. The microcomputer market offers far more potential, with a current annual growth rate of 24 per cent which could increase to 33 per cent, and an estimated 60,000 UK companies which could improve their performance by using

computers. Perhaps the most significant recent arrival in the UK marketplace has been the IBM PC series of machines which have already captured a quarter of the American market since being introduced there two years ago. Another important factor is that larger companies are purchasing microcomputers and are insisting on a high degree of standardisation. These larger companies have become involved to such an extent that 50 per cent of UK business microcomputer sales (i.e. in the range £3,000 to £15,000) probably now falls within what is termed the National Account market. With its features of bulk buying and corresponding discounts, this market is naturally advantageous to the larger microcomputer manufacturers.

Technologically, the general introduction of sixteen bit machines, as opposed to the earlier eight bit machines (see Chapter 1), has had the biggest impact on the microcomputer market. Sixteen bit machines remove the internal storage limitation of the eight bit machines and will, eventually, permit faster and more efficient management packages. A word of warning, however: some of the packages currently advertised as suitable for sixteen bit machines are in fact upgraded eight bit packages which do not fully utilise the facilities offered by these newer machines. Fortunately this situation will not continue for long.

This new edition of *Managing with Micros* reflects all these technological and market changes as well as indicating where future developments are likely to occur.

Solihull

Colin Lewis

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My thanks are also due to my colleagues at Aston University for allowing me to be *in absentia* for six months.

Finally, my thanks to Jenny Hipkiss for typing the manuscript and to my wife Maven for allowing me to convert our fourth bedroom into a microcomputer workshop.

CHAPTER 1

Microcomputer Systems — Hardware and Software

All microcomputer systems consist of both the physical bits and pieces which make up the computer itself and, arguably of more importance the programs which instruct the computer what to do. Since these two elements are, on the one hand, quite different but, on the other hand, totally dependent on each other, the physical bits and pieces are referred to as *hardware* and the controlling programs as *software*. The software can be further divided into applications software and systems software. *Applications software* consists of programs written for the particular application (stock recording, payroll, and so on) which have to be read into the computer from an external storage source (a disk). *Systems software* consists of programs which translate the applications software (by using interpreters and compilers), organise access to and from disk (by using a disk operating system — DOS) and also control the internal organisation of the microcomputer's whole operating system. In a microcomputer, the systems software can either be permanently stored in the computer or read in from external disk storage.

To put microcomputers into the context of computers in general, at 1984 prices microcomputer systems sold for less than £15,000, mini-computers for more than £30,000 and mainframe computers for more than £100,000.

Hardware

While no single definition of a *microcomputer* has universal appeal, a widely accepted one is that a microcomputer is a computer based on a *single* microprocessor chip which performs arithmetic and logic functions and controls the operation of the central processing unit of the microcomputer. The *central processing unit* — CPU — is effectively the *brain* of the microcomputer. It controls all processing and also communicates with the various *peripheral devices* required to make up the

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hardware of a microcomputer system, namely:

a keyboard through which data or programs can be entered into the system

an external storage device (usually a dual disk drive for most management applications) which can both enter previously stored data or programs into the computer's internal memory and receive and store data or programs currently held in the computer's internal memory

a visual display unit (VDU) which temporarily displays information produced by the computer

a printer which produces a permanent printed record of information produced by the computer

Central processing unit — CPU

Figure 1.1 shows the basic layout of a simple microcomputer system and demonstrates that the CPU consists essentially of four major components (in effect chips) connected by three buses (conceptually a group of wires carrying electrical signals) and synchronised by a clock. The function of these components is now discussed.

CPU chip or microprocessor unit — MPU

The MPU is the most important element in the microcomputer. It not only performs all the arithmetical operations required but also controls the flow of information between the other components of the CPU and, via the I/O (input/output) interface, controls the flow of information to and from the microcomputer system's peripheral devices (see p. 0 below). A typical MPU contains the equivalent of 20,000 transistors in a single chip.

While there are many microcomputer systems on the market, there are relatively few MPUs on which those computers are based, namely:

6502, 6504, 6800, 8080, Z80, 8085, Z80A, 6809 (eight bit)
MC68000, Z8000, NS16032, 8086 (sixteen bit)

The MPU recognises only *binary numbers* (that is, numbers coded as a series of ones — 1s, and zeros — 0s) which are called *bits*. Originally all MPUs were *eight bit processors* since the basic unit of storage (that is, ten numbers 0–9, 26 alphabetic characters A–Z, arithmetic

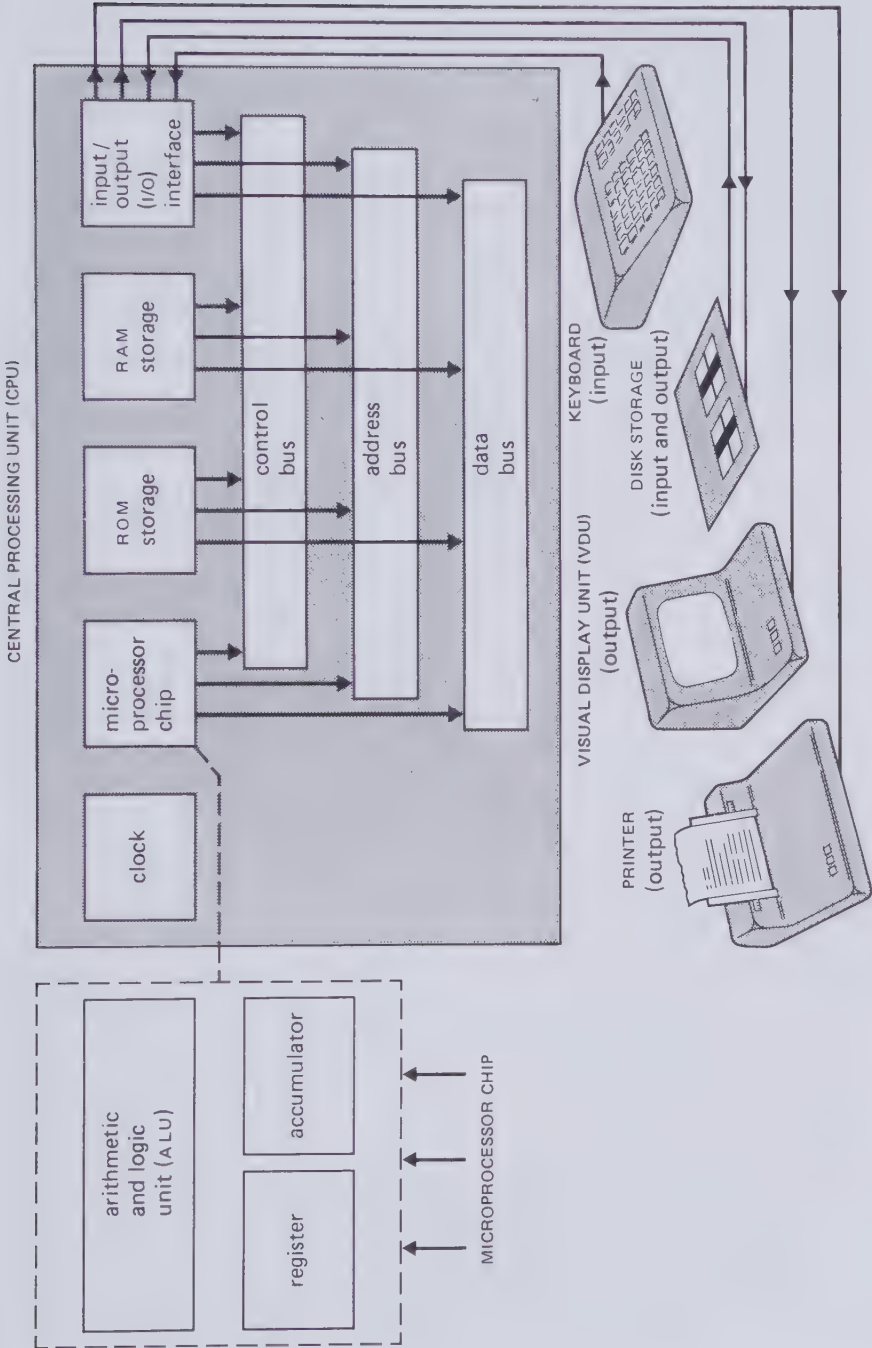


Figure 1.1 Basic components of a microcomputer system.

operators, punctuation marks, etc.) was made up of a code eight bits long and referred to as a *byte*. More recently, however, the majority of business microcomputers appearing on the market have been *sixteen bit processors*. Their main advantage is that they permit a larger internal memory, as will now be explained.

The number of individual locations within a microcomputer's internal memory is controlled by the number of *address lines*. Since there are generally twice as many address lines as bits in a byte, this means that an eight bit processor with sixteen address lines can only control a range of addresses of individual storage locations from 0000000000000000 to 1111111111111111 in binary form or from 0 to 65,535 (i.e. $2^{16} - 1$) in decimal form. Thus at any instant in time the maximum amount of information that can be held in internal memory in an eight bit machine is 64 kbytes, where 1 kbyte = 1024 bytes.

With a sixteen bit machine, however, because there are more address lines, the number of individual storage locations within the internal memory is no longer effectively restricted by this constraint and is limited only by price. In practice, as will be seen later in this chapter, most sixteen bit microcomputers start with a minimum of 128 kbytes of internal memory.

The size of a microcomputer's internal memory is most important and to a very large extent governs the applications for which a particular machine can be used and the speed at which it operates. This is because the internal memory has to accommodate not only the data relating to the particular application in hand, but also the applications programs and the systems software. For management applications 64 kbytes of memory (the amount traditionally available from eight bit machines) was relatively little to meet these three requirements. In practice the machines could only be made to work satisfactorily by retaining the less frequently used elements of the applications program on disk (to be read in off disk as and when required, which slowed the system down considerably) and also by limiting the amount of data. (NOTE: The programs representing the operating system must always be stored in internal memory.)

Since sixteen bit microcomputers generally start with a minimum of 128 kbytes of internal memory, for most applications it is now technically possible to have all the applications programs in memory, together with the operating systems, and hence theoretically have a much faster system. Eventually this will be true of all sixteen bit machines, although at present (early 1984) some of the software on sixteen bit machines has been converted from eight bit machines and does not always take full advantage of the increased memory size. For these microcomputer

systems, management applications are still characterised by the continual movement of programs, and particularly data, between relatively slow *external memory* (usually floppy disk storage) and relatively fast *internal memory*. Clearly the effectiveness of the whole computational process in such situations must depend very much on the speed and efficiency with which such transfer of information is controlled. (See page 30 for a discussion of disk operating systems — DOS.)

Random access memory — RAM

Within a microcomputer the type of internal memory into which data can be written, and from which data can also be read, is known as *random access memory* — RAM — although direct access memory would perhaps be a more meaningful name.

Each *location* within such memory has an *address* and the routing of data to and/or from a particular location is controlled by the MPU via the *address bus*, although the data itself travels along the *data bus* — a bus being a series of copper lines on a printed circuit board along which signals can travel between the various elements of the CPU. Whether data is to be read from or written to the memory is controlled by signals travelling along the *control bus* and, while reading a memory location does not alter the contents held there, writing obviously does.

Random access memory is *volatile*. It can only operate when the computer is switched on; and all information will be lost if the computer is switched off either deliberately or through an accidental failure of the mains supply.

Since applications programs and the associated data are different at each installation, such information can only be held temporarily in RAM during processing. However, programs associated with systems software for a particular microcomputer can be stored permanently. Hence, they can either be read into RAM from disk each time the computer is switched on or can be permanently stored in another type of memory known as *read only memory* — ROM.

Read only memory — ROM

ROMs are memory chips which have information (usually programs) fixed into them permanently at manufacture and such information cannot be altered. This type of memory is known technically as *non-volatile* and is a slightly cheaper form of storage than RAM but, because programs are permanently recorded within the chip during the

manufacturing process, it is only economic to produce ROM chips in reasonably large quantities.

Another type of read only memory chip is known as PROM (programmable ROM). These chips are produced with no program inside but can accept programs which are 'burnt' in using a special piece of equipment, sometimes linked to a microcomputer. Once a PROM is programmed, that program becomes permanent and cannot be altered or erased. Yet another type of chip, known as EPROM (erasable PROM), can have programs 'burnt' into it which can subsequently be 'erased' by exposing the chip to a very strong ultra-violet light for twenty minutes or so. EPROMs, therefore, can be used over and over again to store different programs, and generally have a memory capacity of 2 kbytes or 4 kbytes.

Programs which are held in read only memory, because they represent software which can be considered permanent, are often referred to as *firmware*.

Internal memory in general

Whether a microcomputer's internal memory is made up solely of RAM or of a combination of RAM and ROM, microcomputers using an eight bit processor can, as we have seen, only normally address 64 kbytes of memory — whatever the type. Since, for management applications, one requires as much internal memory as possible, designers of business microcomputers (as opposed to hobbyists machines) have had to decide whether to design a machine with a fixed operating system in ROM, usually leaving either 32 or 48 kbytes of RAM, or to use just RAM and to offer at least the opportunity of a variety of operating systems which could be loaded in from disk.

Historically the cheaper, more popular microcomputers which originated in the 4, 8 and 16 kbyte cassette-based, hobbyist market (such as Commodore/Pet, Apple and Tandy TRS 80) have opted to retain their operating systems in ROM. While such systems are inflexible, they do have some practical advantages: programs are incorruptible; they can be a little faster in operation and are easier to use. However, manufacturing companies without a strong hobbyist background which were not originally making microcomputers in large enough numbers to obtain the economy of scale necessary to make the production of ROM an economic proposition have tended to opt for flexibility by offering eight bit microcomputers with 64 kbytes of RAM and operating systems which have to be 'booted up' (that is, read in)

from disk. By far the most popular operating system for eight bit machines is CP/M (*control program for microprocessors*). Sixteen bit machines use a variety of operating systems such as MS – DOS, PC – DOS and CP/M – 86.

Input/output interface

The input/output interface contains the circuitry required to control and select the various peripheral devices connected to the micro-computer's CPU, namely: the keyboard, disk drive, visual display unit and printer. The basic function of the I/O interface is to ensure that the signals from the various peripheral devices can be made compatible with the CPU. The CPU operates in what is known as a *parallel* mode, while peripherals can operate in either a *parallel* or *serial* mode. So the I/O interface is made up both of chips that can handle serial to parallel conversions, such as UARTs (universal asynchronous receiver/transmitters) or ACIAs (asynchronous communication interface adaptors), and chips that can handle parallel to parallel conversions, such as PIAs (peripheral interface adaptors) or PIOs (parallel input/output devices). Serial data travels a bit at a time on two lines, whereas parallel data travels a byte (i.e. eight bits) at a time on eight lines.

Clock

The speed at which the CPU can operate is limited by the speed of the internal memory, which currently can be written to in about 200 nano seconds (i.e. 200×10^{-9} seconds). The operating frequency of the CPU is controlled by the *clock*, a chip which provides a regular high frequency pulse in much the same way as a chip in a digital watch. However, whereas in a watch the very high frequency (of the order of 4 Megahertz, or 4×10^6 cycles per second) has to be repeatedly divided to obtain a useful time pulse of one a second, in a computer processing does actually take place at a speed very near to that of the original clock pulse.

On average, each CPU instruction takes ten cycles or clock pulses. So, with a clock operating at a typical 4 MHz, a typical CPU can execute something like half a million instructions per second. This is much slower than a modern mainframe computer but, because a microcomputer usually only serves one user, it can appear as fast to

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that user as a mainframe computer does to one of its many users (often over a hundred).

Buses

The various elements of the CPU are connected by three buses, namely the data bus, address bus and control bus. The most popular bus system is the S100 bus, first introduced in 1975 and now widely adopted for eight bit machines.

The S100 bus consists of 100 lines, 16 of which are used in the data bus (equivalent to two eight bit characters), 16 in the address bus, 35 for the control bus and the remaining 33 for power supplies and other purposes.

Amongst eight bit machines the S100 bus predominates and is used with the 8080, Z80 and Z80A processors. With sixteen bit machines a variety of bus systems are offered.

Physical construction of the CPU

The simplest CPUs consist of a single printed circuit board containing the microprocessor, memory, clock and interface chips with the inter-connecting buses etched into the board's copper surface. More complicated CPUs have the individual elements of the CPU mounted on to separate circuit boards which plug into a base circuit board known as a motherboard.

Peripheral hardware

The visual display unit – VDU

The VDU contains a cathode ray tube and the associated circuitry necessary to display information in the form of *alphanumeric* (that is, A–Z and 0–9 etc.) or graphic characters on a screen. While many hobbyist machines have only 40 characters per line, it is generally accepted that business applications demand 80 characters per line (that is, 80 columns). When operating typically at 9600 baud (that is, 960 characters per second) a screen of 80 columns and 25 lines (a total of 2000 characters entered sequentially) can be filled completely in just over two seconds.

Whilst most VDU screens use green characters on a dark background, amber characters on a dark background are increasingly preferred as it is claimed they cause less eyestrain.

The keyboard

The microcomputer's keyboard is usually based on the same layout of keys as a typewriter (QWERTY). In addition to the normal keys, all microcomputer keyboards include certain control keys such as RETURN (which is pressed at the end of each instruction), DELETE (DEL), ESCAPE (ESC), etc. Some keyboards are also furnished with special control keys whose function can be controlled by the operating program and this facility is particularly useful in word processing applications. Increasingly, microcomputers intended for business use are fitted with a separate 'numeric pad' consisting of keys representing a decimal point and the numbers 0 to 9. This additional facility is particularly useful if large quantities of numeric data are to be entered via the keyboard. Where a numeric pad is included in a microcomputer keyboard, the number '5' key often has a raised nipple to assist touch typists. Similarly, on better keyboards the keys representing 'f' and 'j' may be sculpted slightly differently to assist touch and blind typists to locate the first fingers of both hands.

All alphanumeric and other characters entered at the keyboard have to be translated into a code of zeros and ones for sending to the CPU. The standard code for this is known as ASCII (American Standard Code for Information Interchange) which represents each letter, punctuation mark or other symbol as an eight bit word (that is, one byte). The full ASCII code consists of 128 characters of which 96 are printing characters and the remaining 32 control characters. Being an American system, the one character the ASCII code does not accommodate is the pound sterling sign (£). Thus in place of the £ sign one often has to use a \$ sign (not to be taken literally at the current rate of exchange) or a 9 (hash) sign.

Microcomputer keyboards can be physically integrated with the CPU and VDU, but there is now an increasing tendency for designers to retain keyboards as a separate unit, usually linked to the microcomputer by an extendable connector for flexible location in the work environment.

Disk storage

Although a few management applications packages can be operated using a cassette storage medium, it is generally accepted that, for the vast majority of business situations in which microcomputers are used, some form of disk storage is essential. While cassettes can be used to store a great deal of information, it is stored serially and can be read

only at the relatively pedestrian pace of 250 baud, that is, 25 characters per second (cps). Typical read/write speeds for disks, however, range from 100 kbaud for 5 $\frac{1}{4}$ floppy disks to 8000 kbaud for a 'Winchester' hard disk. To read and load a 16 kbyte program from cassette at 250 baud would take eleven minutes, whereas the same program at 100 kbaud from floppy disk would take just 1.6 seconds. At the present stage of development most users find that floppy disks represent the cheapest form of storage in relation to performance.

5 $\frac{1}{4}$ inch floppy disks. The most popular disk currently used with microcomputer systems is the 5 $\frac{1}{4}$ inch floppy disk (sometimes referred to as a mini-floppy). At present the majority of microcomputer installations use 5 $\frac{1}{4}$ inch disks which, depending on whether the disks are single, double or quadruple density (quadruple means double density and double sided), can store from 100 kbytes up to about 800 kbytes each. A 5 $\frac{1}{4}$ inch floppy disk looks much like a smooth 45 rpm single record encased in a cardboard case. A slot exposes the surface of the disk, thus allowing the head of the disk drive's system to read information from and write information to the 30 to 70 individual tracks on the disk's surface. With 5 $\frac{1}{4}$ inch disks a *write protect* slot is also provided which must be covered with a protective adhesive strip to ensure that a programmed disk cannot subsequently be written on but can only be read. The Adler Alphatronic microcomputer flouts this convention by insisting that a *write enable* slot is covered to allow the disk to be written to. In 1984 5 $\frac{1}{4}$ inch floppy disks cost from £1 to £4 depending on the type and quantity purchased.

8 inch floppy disk. Similar in appearance to the 5 $\frac{1}{4}$ inch floppy disk, the 8 inch floppy disk, being considerably larger, can store more information at the same relative density. A double sided, double density 8 inch disk can typically store 1 Megabyte (i.e. 1000 kbytes). 8 inch disks are not yet quite as common as 5 $\frac{1}{4}$ inch disks for microcomputer applications, but do tend to be standard for dedicated word processors (see p.51) where large amounts of text have to be stored. The convention with 8 inch disks is that they are normally write protected and the write enable slot therefore has to be covered before they can be written to. In 1984 8 inch floppy disks cost from £2 to £5 depending on the type and quantity purchased.

3 $\frac{1}{2}$ inch floppy disk. Recently introduced by several manufacturers, the so called *micro-floppy* is not only physically smaller than the 5 $\frac{1}{4}$ inch disk but is housed in a rigid plastic container rather than a flexible

cardboard envelope. In addition a metal slide is incorporated in this container which protects the read/write slot. Claimed to be more reliable and storing 315 kbytes in a single sided configuration, micro-floppies are expected to be available at much the same price as the better quality 5¼ inch disks.

Floppy disks in general. As far as the life of the disks themselves is concerned, a figure of 3.5 million passes per track can be interpreted in more practical terms as 160 hours of continual access to the same track. Another figure often quoted by disk manufacturers is that disks should be able to survive twenty thousand uses (that is, in-and-out) of a disk drive. Currently some suppliers are offering two and five year guarantee periods for 5¼ and 8 inch floppy disks respectively. The higher the density at which the information is recorded on to disk, the higher the quality of disk required. While a single density disk will record at double density, corruption of information is much more likely to occur.

Unlike cassettes, before any information can be recorded on a disk, the disk must be prepared or *formatted*. This is done by loading the new, blank disk into the disk drive and running a special program. This program can take anything from one to eight minutes to complete the formatting of the disk, depending on the disk operating system — DOS — of the microcomputer being used. For disks to be used with the CP/M, MS-DOS and other operating systems, the programs making up that system must be recorded on the disk in advance.

For virtually all microcomputer systems used in management applications, apart from those at the top of the range which use Winchester hard disks, the floppy disk provides the principal medium of permanent external storage for data and applications software. Since such disks can fail, it is essential to produce backup copies of disks at relatively frequent intervals. This can be done by loading the disk to be copied into one disk drive (by convention usually drive 0) and the new, blank disk into the other disk drive (drive 1). (On some microcomputer systems, drive 0 is referred to as drive A and drive 1 as drive B.) A backup program (which can also sometimes format the new disk) is then run to back up drive 0 to drive 1 and, again depending on the DOS (disk operating system), this process can take between two and ten minutes. In some systems it is possible to produce a backup disk with a *version number* which can indicate which of two apparently identical disks was copied from which. Such control of versions of copies can and should be implemented by correctly labelling disks at the time of backup. In all management applications using microcomputers,

backup disks are essential to ensure that, if a disk fails entirely, the data lost on that disk can be recreated without too much bother. What 'without too much bother' means in practice depends on the application and the frequency at which new data is entered into the system, but as a rule of thumb most computer users can expect at least one disk failure per year.

For security, backup disks should always be kept in a different location from the original copy. Further guidelines for the care of floppy disks are:

- always keep the disk in its protective envelope when not actually in use

- do not bend disks to prove that they are indeed floppy and always insert disks into disk drives carefully

- never touch the disk surface through the read/write slot

- do not store disks in extreme temperatures (i.e. lower than 10°C or higher than 52°C)

- do not allow disks to be exposed to any magnetic source — particularly electric motors

- use either felt-tip pens or very light pressure when labelling the disk case itself. Write on the protective envelope *before* replacing the disk

Readers should be warned that the storage capacities quoted for floppy disks are total or gross figures. Because the disk operating system must store additional information, such as the disk directory, the *net* available capacity will often be about 90 per cent of the gross figure.

The floppy disk controller and its associated mechanism are amongst the most sophisticated elements of a microcomputer system. The controller may well possess its own MPU and have an operating program equivalent in complexity to the one in the microcomputer's CPU.

Winchester hard disks. The so-called Winchester hard disk is similar in construction to the type of hard disks used on mini- and mainframe computers, the main difference being that a Winchester disk is permanently fixed in the microcomputer and cannot be removed.

Winchester disk systems cost four to five times more than floppy disk systems but, because the disk is contained in a sealed unit, much higher

densities of information storage can be used. The Winchester hard disks can store typically between 5 and 30 Megabytes of information (that is, 5000 to 30,000 kbytes).

While floppy disks tend only to be rotated at between 200 and 360 rpm, and then only when a read or write procedure is in progress, hard disks run continuously and at much higher speeds, typically 3600 rpm. This considerably reduces the time of access and data transference speeds of up to 800 kbytes/sec are claimed, compared with 100 kbytes per second for mini-floppies.

Although Winchester disks are more reliable than floppy disks, it is still necessary to produce some form of backup copy of the information stored. Because of the comparatively large amounts of information that can be stored, the production of individual backup floppy disks becomes impractical, simply because of the numbers involved. Hence, such hard disks are usually backed up with magnetic tape using a high-speed read/write mechanism or occasionally by a magazine of floppy disks which are loaded automatically, although this latter system is generally associated with minicomputers. Because of the high price of Winchester disks, they are at the moment fitted only to the more expensive microcomputer systems but are becoming increasingly popular as prices fall.

The relative costs, storage capacities and speed of information transference for the various types of disk are summarised in Table 1.1

Table 1.1 Basic operating information of disk storage devices

<i>Type of disk</i>	<i>Storage capacity</i>	<i>Speed of access</i>	<i>Cost</i>
5¼ inch floppy (mini-disk)	100 kbytes to 500 kbytes (per disk)	100 kbaud to 500 kbaud (10,000 cps to 50,000 cps)	£900 (Dual Drive)
8 inch floppy disk	500 kbytes to 1.2 Megabytes (per disk)	500 kbaud to 620 kbaud (50,000 cps to 62,000 cps)	£1300 + (Dual Drive)
5¼ – 8 inch Winchester Hard Disk	5 Megabytes (5¼ inch disk) to 30 Megabytes (8 inch disk)	8000 kbaud (800,000 cps)	£3000 + (with facilities for producing a backup tape)

Packaged microcomputer systems

With one or two exceptions (the OK800 microcomputer being one), printers are not generally physically integrated with the other peripheral components making up a microcomputer system. While some microcomputer manufacturers do produce their own printers, many more either come to an arrangement to stick their label on some other manufacturer's product, or simply allow the user to choose whichever printer seems appropriate.

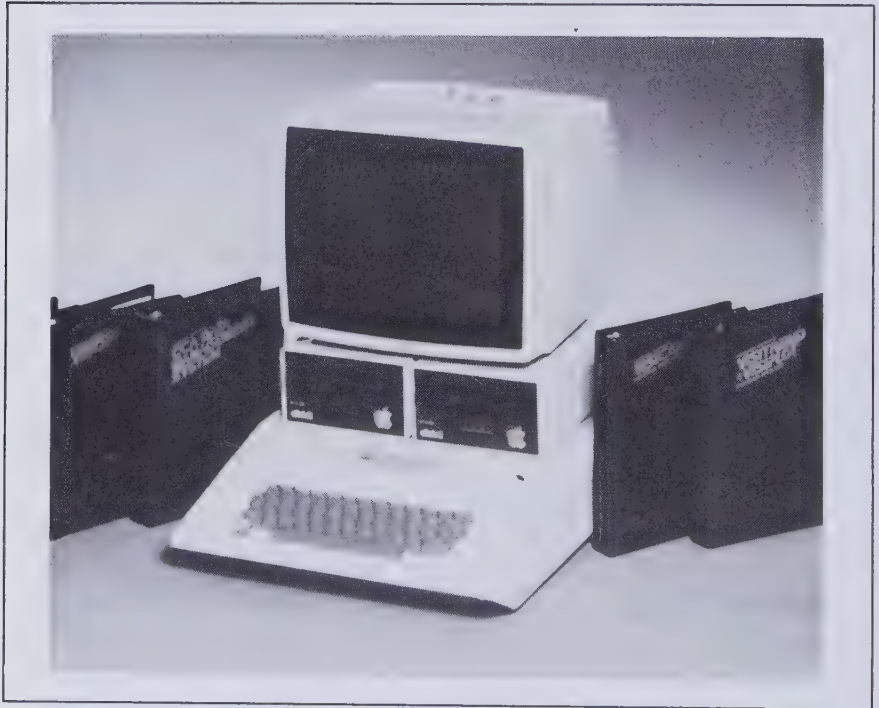
Thus, *excluding* the printer, a business microcomputer system consists of:

central processor unit

visual display unit

keyboard

dual disk drive unit



*Figure 1.2 Apple II computer, two disk drives and Hitachi video monitor.
Courtesy: Apple Corporation (UK) Ltd*

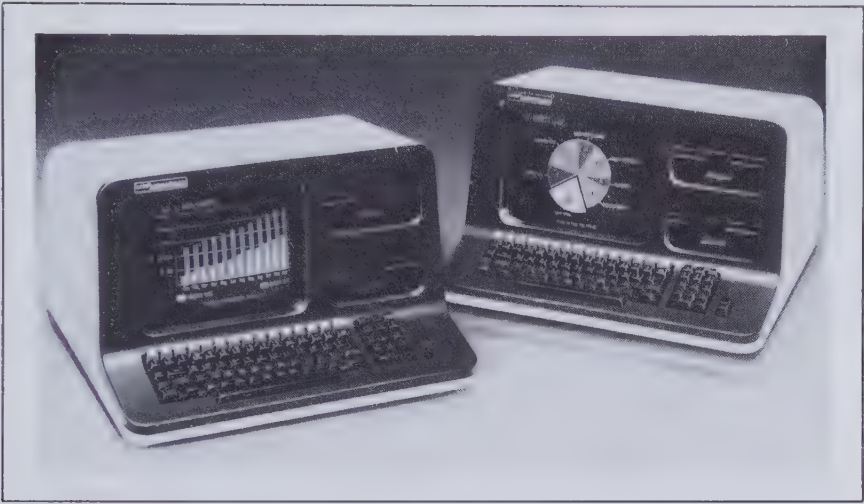


Figure 1.3 North Star Advantage microcomputer with dual 5¼ inch floppy disk drives (360 kbytes each). Business Graphics package featured.

Courtesy: Comart Ltd

and these four major components can be packaged in various degrees of physical integration as illustrated in Figures 1.2 to 1.9.

The Apple II machine shown in Figure 1.2 demonstrates the lowest degree of physical integration. Only the CPU and keyboard are integrated, the two disk drives and VDU monitor all being separate units. The Apple II represents the early stages of microcomputer design. In many ways the development of microcomputers has mirrored that of domestic HiFi systems which were originally made up of separate components such as the tuner, amplifier, etc. and then all these elements were integrated into music centres. Although by modern standards a rather antiquated machine, the Apple II still accounts for 80 per cent of Apple's sales and has recently been enhanced to ensure compatibility with the IBM PC. The various elements of the microcomputer are a little more integrated in the North Star Advantage shown in Figure 1.3. This, like the Apple II, is an eight bit machine which is therefore starting to show its age.

Figure 1.4 shows the Sirius 1 microcomputer, the first sixteen bit machine to be widely available on the UK market. This illustration shows the physical separation of the VDU and keyboard from the main unit of the microcomputer, a design feature now generally adopted. A particularly interesting concept within the Sirius, unfortunately not



Figure 1.4 Sirius 1 sixteen bit microcomputer starting with 128 kbytes of RAM.

Courtesy: ACT(UK) Limited

adopted in subsequent manufacturers' designs, is the variable speed disk drives which allow information on the outer tracks to be recorded at the same density as that on the inner tracks, making it possible to store as much as 600 kbytes on a single sided floppy disk.

Figure 1.5 shows the Apricot microcomputer, claimed by ACT to be the 'first of the fourth generation of personal microcomputers', incorporating such features as 3½ inch micro-floppy disk drives, a microscreen — a unique two line Liquid Crystal Display (LCD) and six associated touch sensitive keys — and an internal modem. The latter enables the Apricot to act as an intelligent terminal or work station into

a larger computer system or communications system using a high speed asynchronous communications package. While not portable as a single unit, the Apricot can easily be carried as two separate units and does provide a 9 inch screen which is intermediate in size between the standard 12 inch screen and the minute 5 inch screen of the early portable microcomputers such as the now obsolete Osborne 1.

The 'revolutionary' Lisa, Apple's great hope to counter the impact on the microcomputer market of the giant multinational IBM, is illustrated in Figure 1.6. The result of a \$50 million investment and two years research, at £7000 the Lisa is aimed at the top end of the personal business computer market. Much of the special software developed for this machine is operated by pointing to pictures on the VDU screen with a 'mouse' which controls the position of the cursor. This feature, it is claimed, enables senior managers to operate the machine in a



Figure 1.5 The Apricot personal computer with 3½ inch micro-floppy disks.
Courtesy: ACT(UK) Limited



*Figure 1.6 The Lisa microcomputer with detachable keyboard and 'mouse'.
Courtesy: Apple Computer (UK) Ltd*

masterful way and thus avoid appearing to be a 'typist'. Less cynically, the Lisa certainly incorporates a large amount of software using a unique approach and may well be establishing new standards in this field.

Figure 1.7 illustrates the TRS-80 Model 16 microcomputer, Tandy's latest offering to the UK business market. Unlike most other microcomputer manufacturers who use independent dealers to sell to the 'end user', Tandy own 227 high street shops in the UK which sell home computers and 26 of these are dedicated computer centres selling business systems. The Model 16 represents the top end of the Tandy range of microcomputers. It offers powerful multi-user capabilities and is fully upgradable from the earlier Model II, thus protecting the expansion path of existing users. Up to three terminals can be run simultaneously, handling different applications at high operating speeds, and memory capacity can be expanded from 128 kbytes to 512 kbytes. With up to 8.4 Megabytes of hard disk, Figure 1.7

shows the TRS-80 Model 16 operating under the TRS-XENIX multi-user system together with a slave terminal.

The machine which has had the largest impact on the UK business microcomputer market, the IBM PC (Personal Computer), is shown in Figure 1.8. Already claiming up to 40 per cent of current UK sales, in spite of an apparently very confused marketing strategy, the IBM PC is offered in its cheapest version with a single disk drive unit and 64 kbytes of memory. In this mode it can be used either as a small 'stand-alone' microcomputer or as a simulated IBM 3101 display terminal linked to a 'host' mainframe computer system, an alternative which appeals to the large existing IBM customer base. At the top end of the range, the XT (extended) version of the IBM PC offers up to 640 kbytes of internal memory and two floppy disk drives which, together with a hard disk drive, offer an overall external storage of 21 Megabytes.

The long awaited arrival of the IBM PC onto the UK market has allowed other microcomputer manufacturers to produce IBM PC 'look-alikes' which can realistically claim to offer better performance for the same money. However, the brand image of IBM will ensure that the IBM PC will be the dominant market leader in the UK business microcomputer market for the foreseeable future.

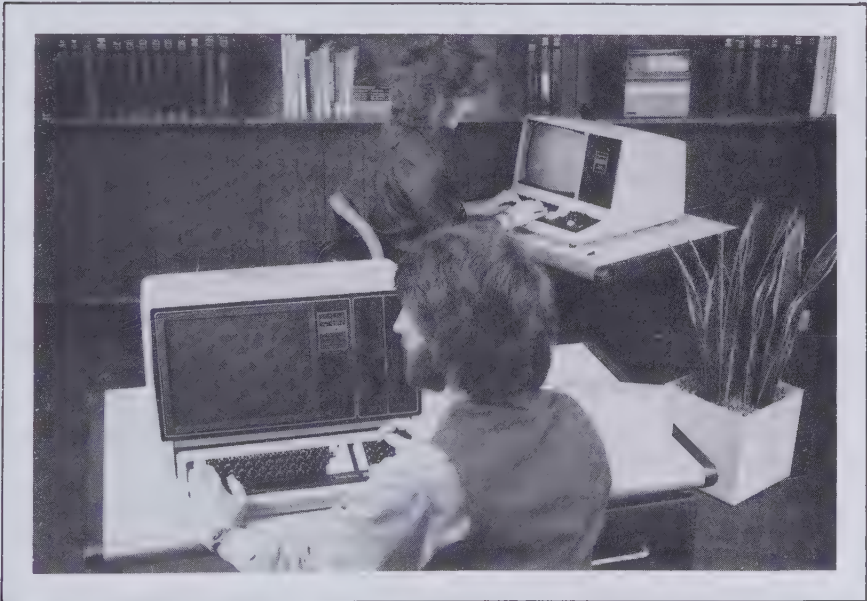


Figure 1.7 The Tandy TRS-80 Model 16 business microcomputer.

Courtesy: Tandy Corporation (Branch UK)



Figure 1.8 The IBM PC (Personal Computer).

Courtesy: IBM United Kingdom Ltd.

The Wang PC (Professional Computer) incorporates an advanced, ergonomically designed monitor which can be mounted either on a pedestal base as here (Figure 1.9) or on an optional monitor arm and desk clamp. Wang is a multinational company based in the USA offering a range of machines starting with an internal memory of 128 kbytes expandable up to 640 kbytes and supports both MS-DOS and CP/M-80 operating systems. Like the IBM PC, the Wang PC can also operate as a 'stand-alone' machine, as a work station within a local network or as an intelligent terminal communicating with a large host computer.

Printers

Since a general discussion on the types of printer used with microcomputers appears in Chapter 3 (which deals with word processing), only a technical summary is included here.

Microcomputer printers can most easily be classified by the mechanism used to produce printed hard copy. On this basis there are essentially five categories of printer, namely:

impact dot-matrix	thermal
daisy-wheel (or thimble)	ink-jet
golf-ball	

Of these five categories, dot-matrix printers represent the vast majority of printers used for business applications where '*correspondence*' quality printing is considered to be adequate. Daisy-wheel printers are used in most business applications where '*letter*' quality is required, and the poorer correspondence quality of the average dot-matrix printer is not considered suitable. (See Figures 3.4a and 3.4b for comparison.)

Impact dot-matrix printers. This type of printer has a print-head formed by a *matrix* of pins individually raised to form the character to



Figure 1.9 The Wang PC (Professional Computer) on pedestal base.
Courtesy: Wang (UK) Ltd

be printed. The printing of the character is effected by physically impacting the print-head against a carbon ribbon as in traditional typewriter technology. Because a dot-matrix printer is usually designed to print 'on the fly' with the print-head moving at a uniform horizontal velocity and also bi-directionally (both forwards and backwards), it can achieve speeds of up to 200 characters per second (cps).

The print quality of dot-matrix printers can be improved by the use of multiple passes, but as this both increases the price and reduces the operating speed, such printers are used only in special situations such as technical report writing, where the ability to change the type font while printing justifies the additional cost.

Dot-matrix print-heads do wear, and under a very heavy workload may need replacing once a year at a cost of 5–10 per cent of the cost of the whole printer, but in less arduous working situations they can last for the effective life of the printer itself.

Daisy-wheel (or thimble) printers. A daisy-wheel printer uses a set of characters embossed on the tips of individual petals of a wheel. The wheel is rotated so that the correct character is positioned in front of a hammer which strikes the tip of the petal when the wheel is momentarily stationary, and thus, via a carbon ribbon, produces an image of that selected print character. Daisy-wheel printers usually operate at about 50 cps and so are rather slow compared with dot-matrix printers but the quality of print is very good. Hence, this type of printer is normally used in word processing applications.

Because individual daisy-wheels are removable, many different typefaces can be offered. One manufacturer offers 72, varying from traditional British Pica 10 to the more exotic Dual Gothic 12/Multilingual A and including, on the way, Canadian Bilingual which is naturally only recommended for special machines!

Thimble printers use the same basic technology as daisy-wheel printers but, whereas a daisy-wheel is flat, a thimble is concave in shape and the manufacturers of this type of printer claim that this permits fewer moving parts.

Golf-ball printers. The now familiar golf-ball printer is relatively slow, particularly compared with dot-matrix printers, and so this type of printer is not used extensively in microcomputer installations.

Thermal printers. Thermal printers use a dot-matrix principle, where the pins are heated to produce an impression on heat sensitive paper. Because the cost of this special paper is quite high, thermal printers are not used extensively in business applications.



Figure 1.10 Epson MX80 impact dot-matrix, economy printer (80 cps).
Courtesy: Taylor Wilson Ltd

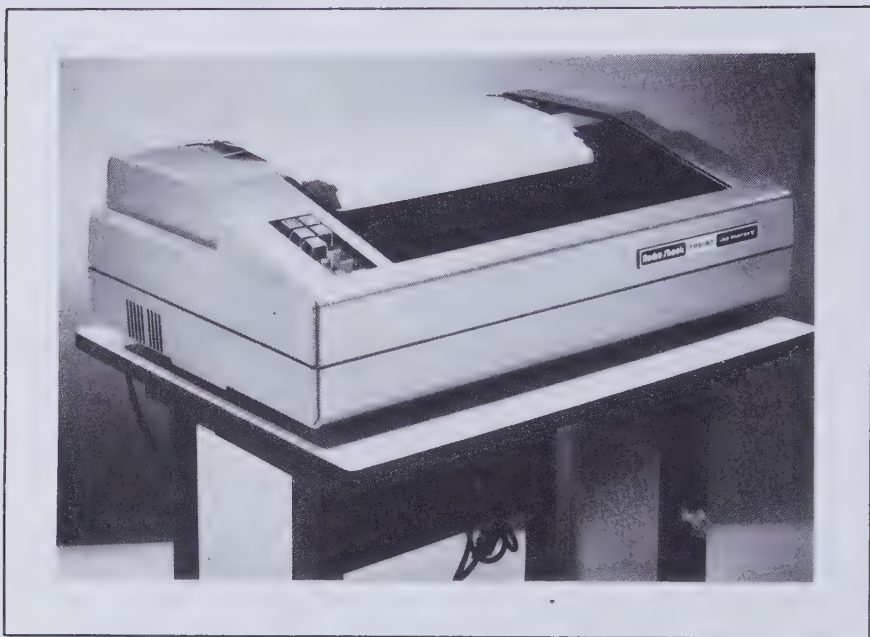


Figure 1.11 Tandy TRS-80 heavy duty bi-directional dot-matrix printer (120 cps).

Courtesy: Tandy Corporation (Branch UK)

Ink-jet printers. Ink-jet printers are a relatively new development and fairly expensive by microcomputer standards. Their main asset would appear to be quietness of operation and speed of printing (210 cps). Their one drawback is that since 'jets' of ink are used to form the printed character there is no physical impact so that multiple printed copies cannot be produced using multi-part stationery.

Printers in general. For most business applications, printers capable of printing up to 120 characters per line are required. Line widths of printers tend to be either 80 or 132 characters per line, so for business use the latter is usually specified.

Daisy-wheel (or thimble) and golf-ball printers can also be made to operate as typewriters (that is, to accept manual input) whereas dot-matrix and ink-jet are invariably produced only as printers (that is, they accept only computer input). Figures 1.10 to 1.14 illustrate some of the printers discussed.

Figure 1.10 illustrates the Epson MX80 dot-matrix, economy printer

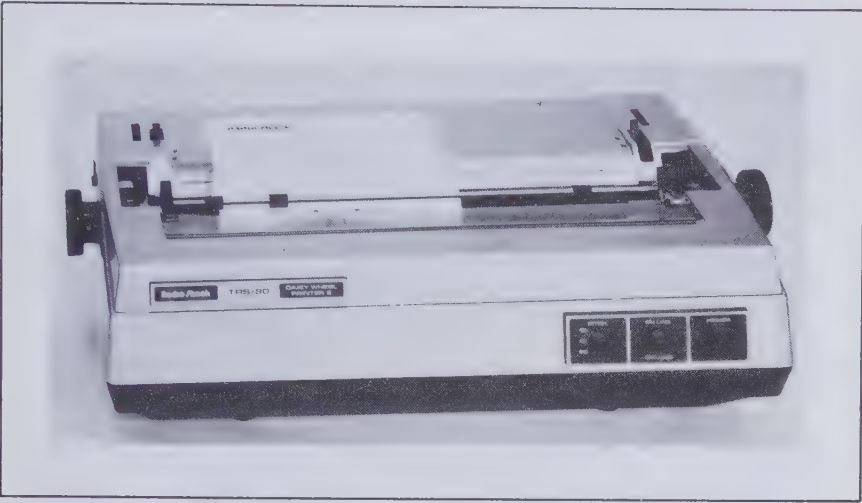
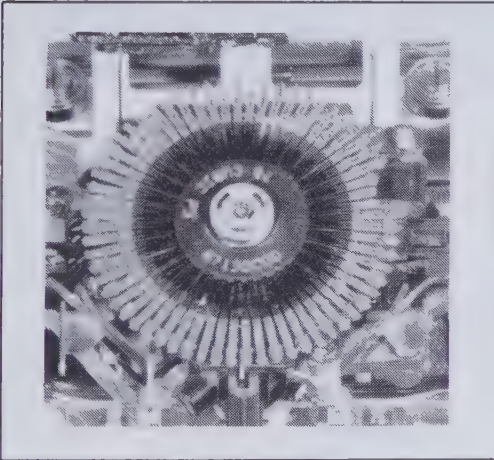


Figure 1.12 (above) Tandy TRS-80 Daisy-wheel II printer with a print speed of 43 cps and 136 characters per line. (left) Print daisy-wheel.

Courtesy: Tandy Corporation (Branch UK)



— in this case with a continuous stationery tray. This is about the cheapest type of printer that could be used for business applications but, with a line character width of only 80, it would not be suitable for most applications packages. This particular machine operates at 80 cps.

Figure 1.11 illustrates a more typical dot-matrix printer of the type used for business applications. The Tandy TRS-80 heavy duty, bi-directional dot-matrix printer operates at 120 cps which, in more practical terms, means that it can print 48 lines per minute. With 132 characters per line at a print density of either 10 or 15 characters per

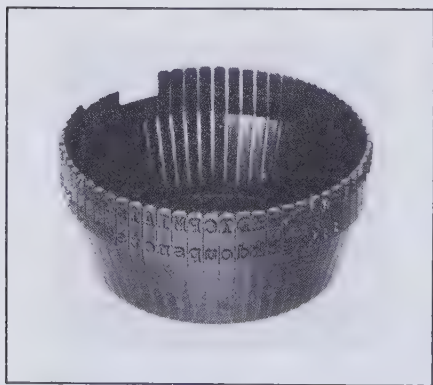
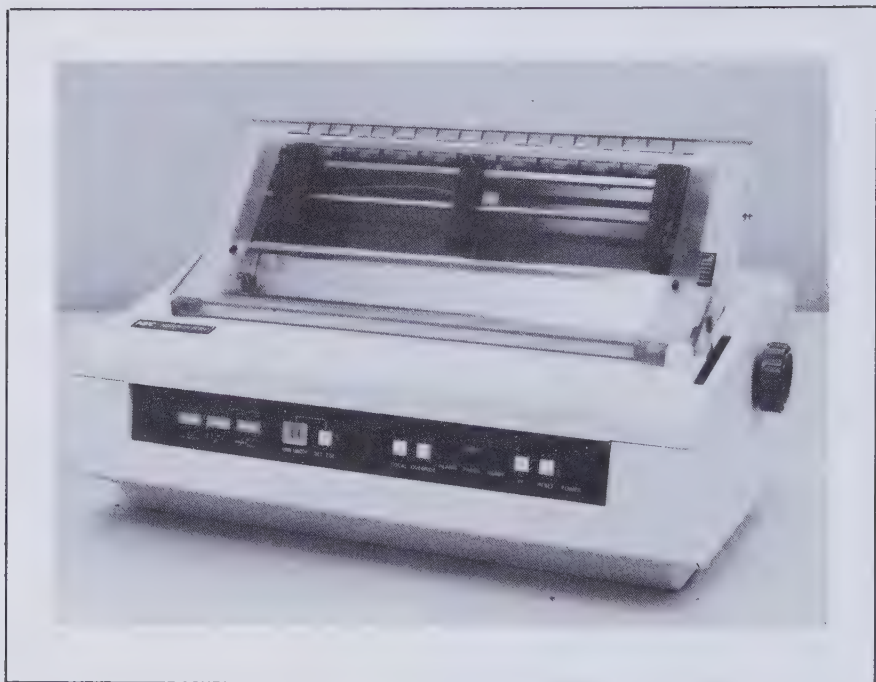


Figure 1.13 (above) NEC spin writer, high quality thimble printer (55 cps).
(left) Print thimble.

Courtesy: Thame Systems Ltd

inch, this type of machine would be suitable for most applications packages.

Figure 1.12 shows the Tandy TRS-80 Daisy-wheel II printer which was developed specifically for word processing applications and has a print speed of 43 cps. An individual daisy-wheel is shown (inset). It can be changed easily to produce different typefaces such as Courier, Prestige Elite and Madeleine Proportional Space Print.

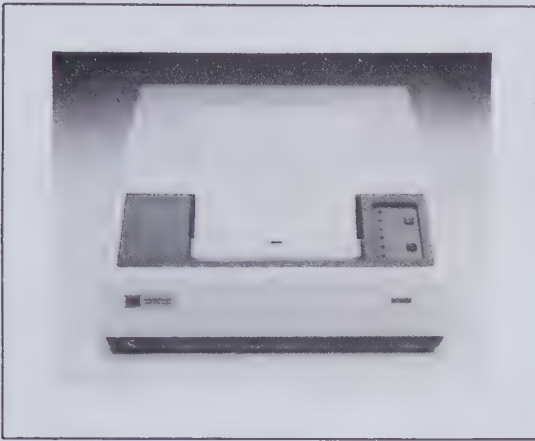


Figure 1.14 (left) The 'noiseless' AJ 650 ink-jet printer (210 cps).
(below) Ink-jet mechanism.
Courtesy: Anderson Jacobson Inc

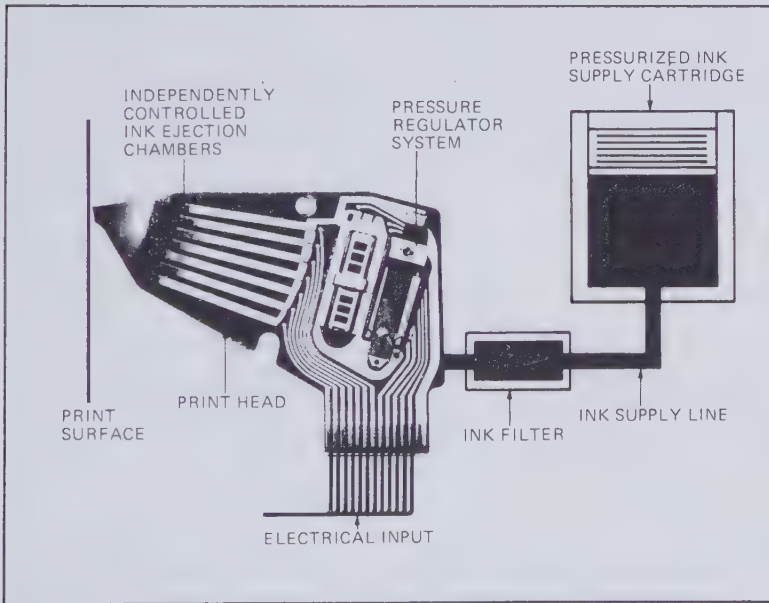


Figure 1.13 illustrates the NEC spin writer, a high quality thimble printer with a print speed of 55 cps. While the thimble uses a similar printing technology to the daisy-wheel, the makers claim that the shape and construction of the thimble allows 128 different characters to be produced compared with the daisy-wheel's 96.

Finally, Figure 1.14 shows, in diagrammatic form, the technology used in ink-jet printing. These printers are relatively expensive com-

pared with the equivalent dot-matrix printer but, at 210 cps and 132 characters per line, this notably quiet printer would be suitable for most applications packages.

As a conclusion to this section on printer/typewriters used with microcomputer systems, Table 1.2 (page 29) summarises the main characteristics of the five principal types.

Software

Software is the overall name given to programs which either provide computer instructions for a particular application (hence *applications software*) or translate a higher level computer language into a lower level language, organise the flow of information between peripheral devices and the computer's CPU and in general control the computer's overall operating system (hence *systems* or *operating software*).

A program is a series of instructions written in a computer language which at the higher level can be understood by the human programmer and at the lower level can be understood by the microcomputer's CPU.

Figure 1.15 shows in diagrammatic form the sources and levels of programming language in a microcomputer and indicates how a higher level language, such as BASIC, is eventually converted into a series of codes of 0s and 1s that can be understood by the CPU.

Systems software

The functions of systems software are mainly technical and, therefore, of little interest to the potential business user. However, in choosing a microcomputer system two features of systems software are particularly important and these will be examined here before we enter into a wider discussion of applications software.

Flexibility versus inflexibility. As we have seen (page 4) the programs representing systems software can either be permanently stored in the computer in a read only memory chip (ROM) or be read in from disk into the computer's main random access memory chip (RAM) using a small program stored in ROM called a resident monitor.

Historically, when cassettes were the only form of external storage medium for microcomputers, it was only practical to permanently record the programs representing the operating system in ROM (Read Only Memory) chips which to all intents and purposes meant that the machine's operating system was fixed, unless one physically inserted different chips.

Table 1.2 Classification of printers by print mechanism

<i>Print mechanism</i>	<i>Speed (characters per second)</i>	<i>Print quality</i>	<i>Line width (characters)</i>	<i>Price range (1982)</i>	<i>Comments</i>	<i>Manufacturers</i>
Impact dot-matrix	30 cps to 200 cps	'correspondence' quality (pseudo letter quality possible with multiple passes)	80 ch. 132 ch.	£400 to £800 £800 to £1500	no 'true descenders' on cheapest versions limited print- head life	Epson Centronics Anadex Microline Texas Tandy Commodore
Daisy-wheel or Thimble	55 cps (typical) 80 cps (maximum)	'letter' quality	80 ch. to 132 ch.	£1200 to £2500	can be used as a typewriter	Olympia, Tandy Qume, Commodore Diablo, NEC, Olivetti, Ricoh, IBM
Golf-ball	30 cps	'letter' quality	80 ch. to 132 ch.		can be used as a typewriter	IBM
Ink-jet	210 cps	'letter' quality	80 ch. to 132 ch.	£2000 +	quiet cannot produce direct copies	Anderson Jacobson
Thermal	40 cps	acceptable	80 ch.	£400 +	no direct copies and expensive paper	Apple

However, with the development of floppy disks which permitted the operating system to be read into internal memory in a matter of seconds rather than minutes, there was a general move towards disk based operating systems. With eight bit machines the predominant disk based operating system was CP/M (Control Program for Microprocessors) and with the more recent sixteen bit machines a variety of operating systems are available, such as CP/M – 86, PC – DOS, MS – DOS and Unix. Many of the more sophisticated business microcomputers can accommodate more than one operating system which greatly increases the number of applications packages that are potentially available to those machines.

Disk operating system – DOS. One of the most important elements of systems software for business microcomputers is the disk operating system (DOS). This is a series of programs which organise how information is stored on disks and which, therefore, control the speed at which information can be written to or read from disk.

In business applications where information is *not* continually being transferred from disk to internal memory, for example, in word processing (Chapter 3) or numerical analysis using electronic worksheet programs such as VISICALC (Chapter 4), the speed of the disk operating systems is not too important. However, in situations where many individual records (such as stock, personnel, accounts records, etc.) are continually being pulled in from disk to be processed by sections of applications programs selected via a menu (a listing on the computer screen of the programs available) which will also have to be pulled in from disk, the speed of the disk operating system can become crucial. Unfortunately, sales demonstrations do not usually highlight the difference in speeds between different disk operating systems simply because such demonstrations usually only involve a handful of records. A discussion with another business user of a microcomputer system operating with a large number of records on a similar application to that intended by the prospective purchaser is the only way of really finding out how quickly one can, for instance, process and update 250 personnel records in a payroll system. The time required to produce a backup disk could also be a reasonable indicator of the operating system's speed.

Applications software

Applications software can either be acquired in the form of a proprietary package ('canned program' in American usage) or can be

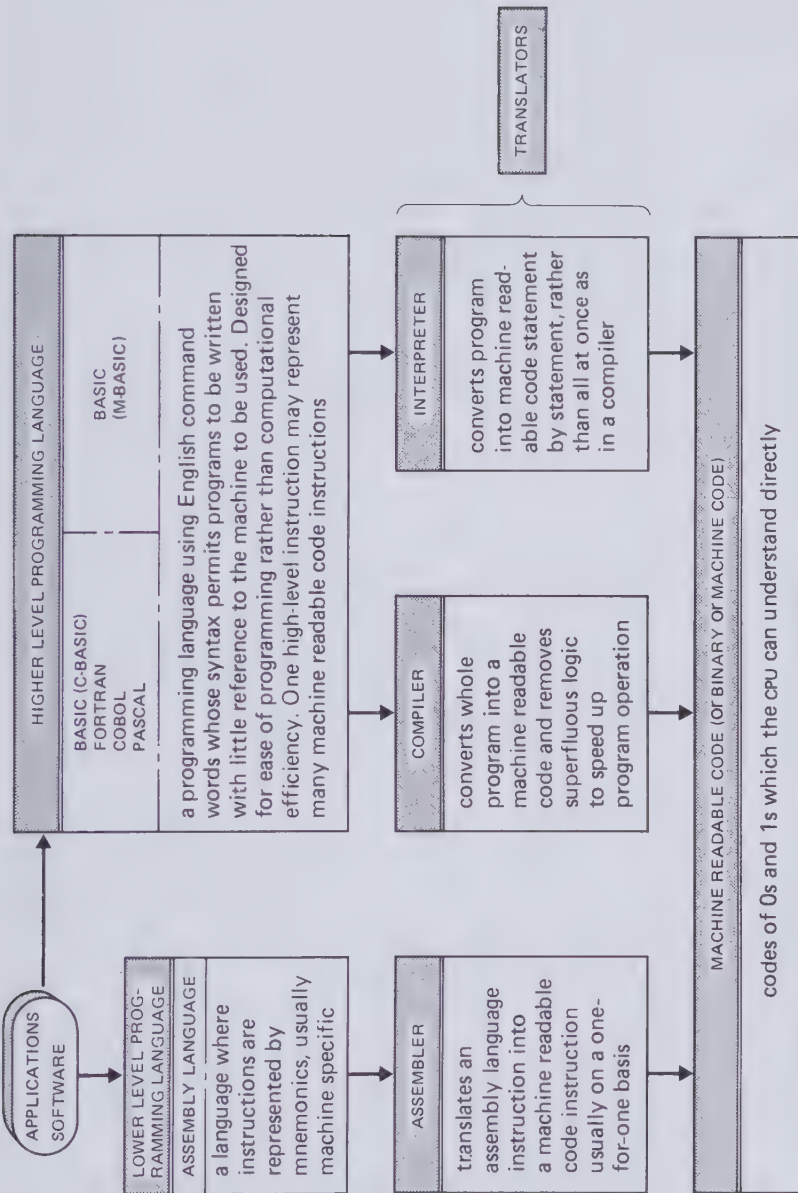


Figure 1.15 Sources and levels of programming languages in a microcomputer.

written specifically for the potential user as a '*bespoke*' package tailored to his or her particular requirements. Because professional programmers cost £20,000 + *per annum* with overheads and the development time is rarely less than six months, bespoke packages tend to be expensive, especially when related to the cost of hardware. Proprietary packages, on the other hand, because their development costs can be recovered over many copies, tend to be priced between £100 and £1000, and for the business applications considered in this book the following range of values applied in 1984:

electronic worksheet (numerical analysis)	£40 – £150
payroll, stock recording	£250 +
database management and information retrieval	£200 – £500
integrated ledger/accounts	£350 – £600
word processing	£450 +

A proprietary applications package usually comes as a set of pre-programmed floppy disks together with an instruction manual and, sometimes, a security device such as a ROM chip or 'dongle' (see page 35). The quality and comprehensibility of instruction manuals is most important for management applications and does vary considerably. Some can baffle anyone whose mind does not work like a professional programmer's; others (notably VISICALC) are excellent.

Programming language

The programs in most applications packages are written in a *higher level language* such as BASIC, FORTRAN or COBOL but some are written at a *lower level* or *assembly language* (see Figure 1.15) which in general terms will tend to be quicker and more efficient than the equivalent higher level language program.

Although BASIC — the most popular higher language used for microcomputers — is much abused by programming buffs, it soldiers on, particularly for business applications, in spite of the rival claims of its nearest competitors FORTRAN, COBOL, ALGOL and PASCAL. Because most BASIC programs are *interpreted* one program line at a time, when microcomputers were first introduced commercially BASIC was the only higher level language that could be used. With the subsequent development of *compilers*, which translate all the instructions in a program into a complete 'compiled' form before the program is run,

FORTRAN, COBOL, ALGOL and even compiled BASIC could also be run on microcomputers. Yet, having been first in the field, interpretative BASIC still has a strong hold on the applications software market.

Applications packages

Figure 1.16 summarises results from the magazine *Personal Computer World*'s bi-monthly 'packages' feature which surveys business packages that are available on the open market and have been used for at least six months in a minimum of five sites.

From this survey it is immediately apparent that a large proportion of the available applications packages on the UK software market fall into five broad categories, namely:

integrated accounts and ledger (various)	31%
stock recording and control	12%
database, lotteries, mailing list	10%
payroll	9%
word processing	8%

One omission from this survey is the electronic worksheet type of package, such as VISICALC and SUPERCALC. The reason these are not included is that, except for a program called SimpliCalc, all the worksheet programs currently on the market have been developed in the USA.

Thus the vast majority of business applications fall into these six major categories and this book provides information on and examples of all of these. Chapter 3 deals with word processing; Chapter 4 with VISICALC, SUPERCALC, Etc.: Chapter 5 with database management and information retrieval; Chapter 6 with ledgers; Chapter 7 with stock recording and control; Chapter 8 with payroll.

Software protection

All software houses that produce applications packages face the problem of software piracy — the copying of programs. Having invested considerable sums of money developing a program, which, incidentally, cannot be patented, it is obviously in the software house's interest to ensure that only registered users who have purchased a package through the normal channels should be able to use it.

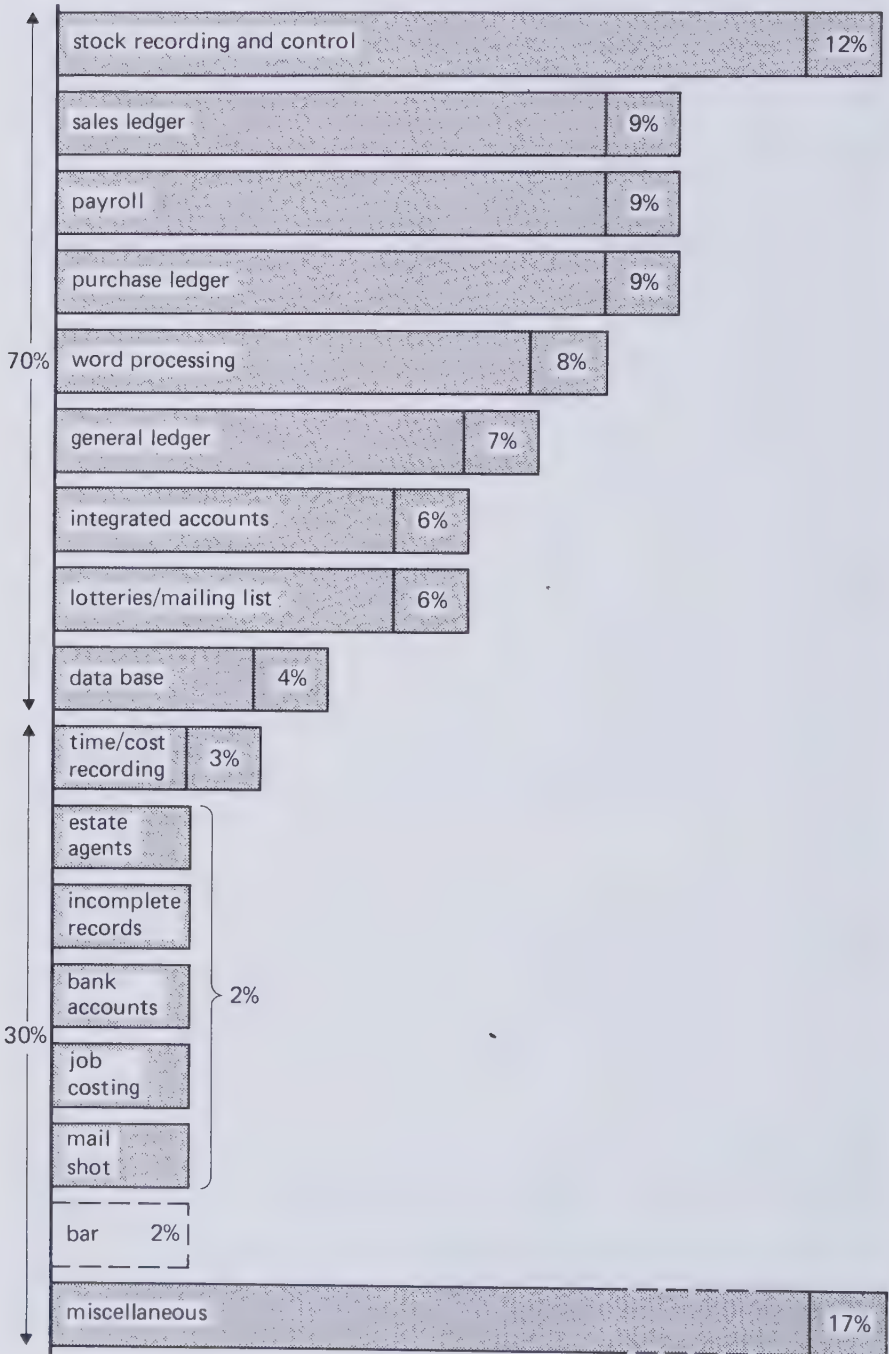


Figure 1.16 *Top 83 per cent of microcomputer applications packages available in the UK for a minimum of six months in a minimum of five sites.*
Source: *Personal Computer World* 1981/82

Several methods of software protection have been developed to counter software piracy and these are now briefly discussed.

ROM protection. One method of protecting a program is to arrange that a small but necessary part of the program is stored in a ROM chip, so that the main program will only operate on a microcomputer with that chip plugged into the appropriate socket inside the machine. Because chips can be copied this method of protection is not foolproof but it will deter the less enthusiastic potential pirate. VISICALC is an example of a well known program that uses this form of protection.

'Dongle' or stunt box protection. With this method of protection a small device consisting of an encapsulated piece of circuitry is plugged into one of the sockets on the outside of the microcomputer (that is, the user- or cassette-port) and the program in question will run only when the device is in position. Because these devices, called variously dongles or stunt boxes, have no rigid design they are not easily copied and this form of protection is therefore more foolproof than the security ROM chip. For the properly authorised user, dongle protection is also more convenient because dongles can easily be moved from one microcomputer to another (of the same type) if the user has several machines on the same site, whereas chips can easily be broken in an attempt to move them. The word processing package *Wordcraft* uses dongle protection.

Uncopiable disks. Although technically speaking no disk is uncopiable, programmers are currently developing methods which make it increasingly difficult for potential pirates to produce usable copies. At the end of the day, if it is more costly in time to break a system of protection than to buy the software, there is no point, in commercial terms, in making the attempt even though the technical challenge may remain. The worksheet program *SimpliCalc* uses an uncopiable disk form of protection and its authors are only aware of one *authorised* user who has managed to crack their code — he wrote to them indicating how it could be improved!

Registered user. If a software house provides a valuable backup service to its users, such as answering queries or providing updated copies of the program, there is little or no incentive to produce pirated copies. All payroll packages are sold on a registered user basis and, because of this, pirating of payroll packages is virtually unknown.

Conclusion

All operating microcomputer systems require both hardware and software. In spite of the great emphasis placed on hardware in trade journals, computer magazines and so on, it is really the software that is more likely to be the deciding factor in the purchase of a microcomputer system.

In 1980 it was claimed that 11,000 microcomputers were in use in the UK and more recently, in 1982, *Dataguide*, a trade directory, indicated that there were well over 100,000 machines in use. Commodore alone claim to have sold in excess of 30,000. While many of these machines are still being programmed in BASIC by individual users for specific applications, an increasing proportion are essentially being used as business machines with dual disk drives, at least 32 kbytes of internal memory and operating with proprietary applications software.

As we have said, the majority of business applications of microcomputers *are* based on proprietary applications packages. The size of this software industry alone is reckoned to have an annual turnover of about £1.86 million, with the average package costing £356 and selling about 18 copies per year. One of the comforts of purchasing a well proven, proprietary applications package is that it should have had most of the operating difficulties ironed out as a result of earlier users' feedback.

Observers of the microcomputer scene have suggested that the market has passed through its first phase dominated by the enthusiastic hobbyist and is currently passing through a second phase where small businesses 'dip their toes' into the possibilities offered by microcomputers with disk drives, mainly with 'stand-alone' applications. It is suggested that the next phase will result from the disillusionment of first time users which may well occur when several stand-alone applications (see page 45) have been developed, but will not be able to relate to each other. This will lead these users on to multi-user, multi-task microcomputer systems with common databases; facilities which are currently only available on machines at the top end of the range of what are considered technically to be microcomputers. Following this phase, some see the development of a network of microcomputers linked to a single large mainframe computer. Such an arrangement would not only cause a reduction in the amount of processing done by the mainframe machine, since it would be possible to do processing locally on the microcomputers, but could also permit analysis to be performed on the mainframe's database for what are now considered non-essential activities.

CHAPTER 2

The Microcomputer Industry and the Choice of Microcomputer System

The UK business micro- (as opposed to the mini- or mainframe) computer industry has grown from virtually nothing in the late 1970s to what is now a multi-million pound market. Technologically it has expanded from the bottom upwards, from hobbyist machines, which typically had 4 kbytes of internal memory, through 8 kbytes and 16 kbytes up to the accepted minimum for a business machine of 64 kbytes. From the applications point of view, however, the market has developed from the top downwards by adopting applications such as stock control and ledger systems, which were previously feasible only on mini- or mainframe computers. The operating differences that remain are caused mainly by the relatively limited external storage devices currently used with microcomputers.

Thus the microcomputer market covers an extraordinary range of expectations. On the one hand is the ex-mainframe specialist who is accustomed to capital investment of £100,000 or more, virtually unlimited storage facilities and hardware and software support thrown in *as of right*. On the other hand, is the upgraded hobbyist revelling in 32 kbytes of internal memory — as opposed to the previous 4 kbytes — and also to the increased speed of access offered by floppy disks as opposed to cassettes. This mixture of upgraded hobbyist and downgraded mainframe specialist may explain to the bewildered newcomer to the market why one group claims that virtually no business problem exists that cannot be solved using a microcomputer, while the other group recounts horror stories or disastrous attempts to use microcomputers in business.

Of course, the true picture lies somewhere between the optimistic and pessimistic extremes. This is illustrated by a survey entitled *Small Computers in Small Companies* made by Lancaster University's Marketing Department (1982) which indicated that out of 100 selected computer users 92 companies considered computerisation was a

success even though 84 had no previous computer experience. While this survey included computers costing up to £30,000 which can hardly be regarded as microcomputers, 17 of the companies had machines costing less than £4000 which certainly can.

Structure of the microcomputer industry

Figure 2.1 provides a diagrammatic representation of the structure of the UK microcomputer industry and, although a gross oversimplification, it does identify the major categories of service company in the industry likely to be encountered by the prospective business user.

Systems houses

Although systems houses obviously vary, both in size and in service offered, a good systems house can probably offer all the services required to implement a business application on a microcomputer system. These would extend from the initial analysis of the situation before computerisation, through to continued hardware and software support afterwards. Such a complete package of services is often referred to as a 'turn-key' package — presumably on the optimistic hypothesis that the user simply turns the key to switch the system on and the system is guaranteed to work — eventually!

Services offered by a good systems house would be:

consultancy advice on the suitability of the proposed application for computerisation and recommendations on any changes required in current procedures before implementing a computer solution

recommendations of suitable software/hardware packages. The software may be a proprietary system of which the systems house has operating experience, or bespoke, specially designed software written by the systems house's own programmers (see p.32). The hardware recommendation will generally be from a range of machines with which the systems house is familiar and may even be labelled with its own name and/or logo

assistance in 'going live' with the microcomputer system and accepting responsibility for ironing out the inevitable practical problems encountered

provision and responsibility for continued hardware and software support and also pre-printed stationery if that is required

training of a general nature

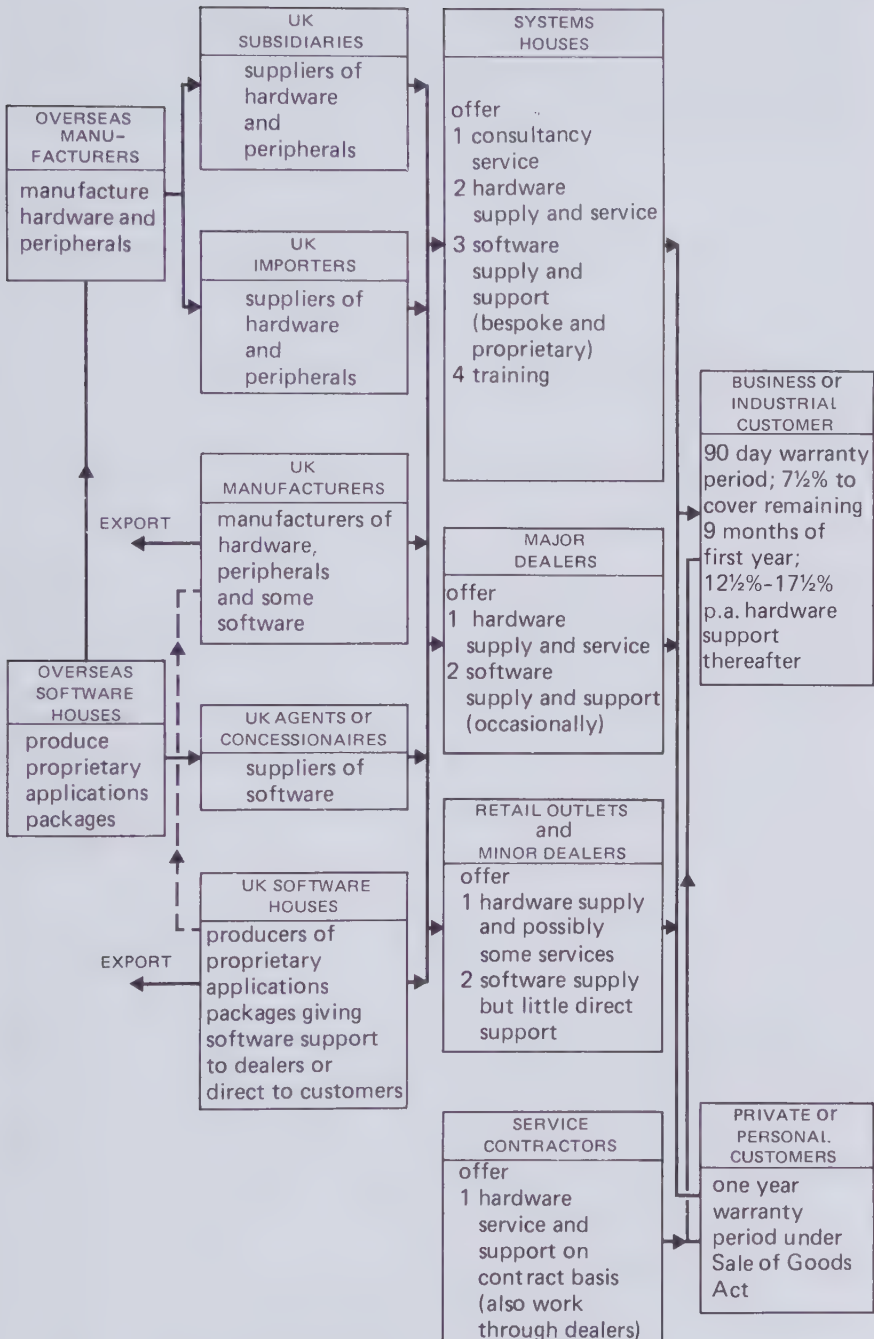


Figure 2.1 Simplified structure of the UK microcomputer industry.

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The services of a systems house are not cheap and generally speaking it would not be worth using one unless the software/hardware system being purchased exceeded £10,000 since the cost of the supporting services offered, although less than the software/hardware costs, will be of the same order of magnitude.

Major dealers

A major dealer in microcomputers is, by contrast, mainly concerned with selling hardware rather than consultancy services. To help sales of hardware, however, he or she has to provide software advice and this advice will usually centre around a series of proprietary applications packages with which the dealer has a reasonable working knowledge. A major dealer should be able at least to demonstrate applications packages although, because the profit margin on packages is very low, the demonstration will generally be at the dealer's site rather than at that of the prospective user.

A major dealer will generally have a service department and so will be able to offer continued hardware support. Only the very largest dealers offer software support on a contractual basis. In addition most major dealers should be able to offer more than one hardware system in a particular price range.

To summarise, the services offered by a major dealer would be:

- a limited choice of hardware systems in a particular price range
- recommendations as to suitable applications packages with limited immediate support and, occasionally, longer term support on a contractual basis

- hardware support (i.e. servicing of equipment) on a contractual basis

Most major dealers have managed to achieve their standing in the industry by offering specialist software which ensures that purchasers are tied to buying the appropriate hardware from the same source.

This state of affairs, on reflection, is a natural reaction to a market situation which price undercutting by newcomers with low overheads is a permanent feature, as exemplified by the fact that many small dealers in the microcomputer market trade for less than two years.

Retail outlets and minor dealers

While systems houses and major dealers cater almost exclusively for

business clients, *retail outlets* and *minor dealers* serve both the home computer/hobbyist market and the lower end of the business market which tends to be made up of small businesses encountering microcomputers for the first time. Although often disparagingly referred to as 'box shifters', retail outlets and minor dealers because of the volume of trade they generate in terms of individual microcomputer systems, can offer very competitive prices.

The services normally offered by retail outlets and minor dealers in the microcomputer market are:

usually only one make of microcomputer in a particular price range

supplies of proprietary software packages but no formal software support

no hardware support, although as agents they can arrange hardware support through a service contractor (see below).

Service contractors

A microcomputer contract servicing company provides hardware servicing on a contractual basis, usually for a limited range of machines. Its services are often limited to a particular geographical region and the degree of support offered and the promptness with which it is provided vary considerably. Some of the larger manufacturers of peripheral equipment, such as printers, offer a national network of servicing.

Software houses

A *software house* essentially consists of a company which employs programmers producing either bespoke software to customers' specifications or standardised, proprietary applications packages. Generally, a company will tend to specialise in one or the other. Most bespoke work is for existing computer users who wish either to enlarge their current system or to develop new systems. The most useful proprietary packages have been developed mainly in the stock recording, sales/purchase/nominal ledger and payroll applications areas (see Chapters 6 – 8) or in a specialisation for which the software house has developed a particular reputation such as hotel booking and account systems, estate agents systems, etc.

Although payroll packages are always contractually supported by the originating software house or its agents at about £100 *per annum*, the degree of support offered for other types of package varies widely.

A software house can vary in size from a single person developing a single package on a single machine to a relatively large organisation with packages running on several different machines at over a thousand installations. The larger software houses offer a range of packages on a range of machines and some offer free training courses.

Table 2.1 summarises, in broad terms, the microcomputer market, showing the types of equipment and support services different kinds of user are likely to be able to obtain. These services are discussed in more detail below.

After sale support

Hardware

Most microcomputer hardware is sold to business users on a basis of a 90 day warranty period. Although 90 days may appear a relatively short time compared with other equipment warranty periods, most incipient faults in a microcomputer system tend to make themselves evident straight away and faults that occur after the warranty period are usually as a result of 'wear and tear' and, hence, not properly the direct responsibility of the supplier.

To obtain hardware service, either from the original supplier's service department or an independent service contractor, will usually cost in the order of 7½ per cent of the hardware purchase price for the remaining nine months of the first year, and from 10½ per cent to 17½ per cent thereafter, depending on the speed of call-out offered.

In microcomputer systems, the electro-mechanical devices are the most likely to fail. Listed according to their relative reliability, these are the central processing unit (CPU) (the most reliable), visual display unit (VDU), printer, keyboard, and floppy disk drive (the least reliable).

Although routine maintenance of microcomputer hardware by servicing engineers does not yet appear to be a feature of the market, some basic preventative measures can be taken by the user.

These are:

do not switch the microcomputer on and off if use is intermittent but leave it on all day — power consumption is very small

try and keep the surrounding temperature at a reasonable level — neither too hot or too cold — and ensure that if fan cooling is provided no obstructions prevent the cooling system from functioning efficiently

Table 2.1 Overview of microcomputer users in the UK

	Users of microcomputers		
	Home, hobbyist and personal market	Main industrial and business market	'Heavy' end of the market
Hardware (price range 1981/82)	£300 to £2000	£2000 to £6000	£6000 +
External storage medium	cassette	floppy disk	floppy and hard disk
Applications	games, domestic systems, hobbies	stock control, sales ledger, payroll, purchase ledger, word processing,	general ledger, lotteries/ mailing list, database, time/cost recording
Software (price range 1981/82)	self written, from magazines/ books etc, pre-programmed cassettes (£10 to £100)	mainly standardised software purchased through dealers/retailers (£200 to £1000)	standardised software and specialised or bespoke software written by software/ systems house (£1000 +)
Hardware support	no	usually	yes
Software support	no	payroll – yes others – perhaps	yes

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if dust is a problem, ensure that dust-covers are fitted when the machine is not in use

be particularly gentle with disks (see page 11) and disk drives. If it is relatively easy to gain access to the read/write heads, clean them regularly following the service engineer's instructions

Software

Where software support is not included in the overall package (as it is, for example, in a 'turn-key' arrangement offered by a systems house), only very limited software support is offered by either software houses or major dealers. Such support is on a contractual basis after an initial warranty period of one year.

The one exception to the general rule is a payroll package which is always supported. For about £100 *per annum*, users are provided with the following support services:

- a telephone 'hot-line' during normal working hours for sorting out operating difficulties, queries, etc.

- an update service to cover such things as tax changes issued by the Inland Revenue and national insurance changes issued by the Department of Health and Social Security

- guaranteed sales of pre-printed stationery for pay advice slips, bank giro, etc.

Choice of microcomputer system

Since a microcomputer system comprises both hardware and software, the initial problem in choosing an adequate system is whether it is the hardware or software that should determine the choice. It is now generally agreed that *software* is the more important. Some of the essential considerations in choosing software packages are discussed briefly here.

Software

Although much has been written on the topic of choosing software (see, for example, J. E. Lane's *Choosing Programs for Microcomputers*, 1980, published by the National Computer Centre),

surveys such as the one referred to earlier conducted by the Marketing Department of Lancaster University appear to show that the majority of potential users ignore such advice and simply go out and buy microcomputer systems (both software and hardware) with no formal feasibility study and often without even seeing the machine in action.

I shall not, therefore, enumerate here all the theoretical points one might consider in choosing software. The bulk of this book is in any case concerned with explaining what the more popular packages actually do, which will be of far greater benefit to the potential users. I will restrict myself here to a brief consideration of *stand-alone* versus *integrated* packages (see also page 119).

Well before a potential user reaches the stage of comparing various applications packages, he or she should determine in non-computing terms exactly what it is the company wants to computerise. The particular application may stand alone or may, now or later, need to be integrated with further applications. For example, a small company could well decide to computerise its payroll function and, if this is all they are ever likely to want to computerise, there is absolutely no reason why they should not purchase a proven payroll package and the appropriate hardware from their local retailer and get on with the job — as many small companies have successfully done. However, if at a later stage they discover it would be useful to have the payroll function reporting to a nominal ledger, and they had chosen a payroll package that was not part of an integrated system, it would be impossible to obtain that reporting facility at that stage without changing to a completely new payroll package. A similar argument would apply to stand-alone versus integrated sales and purchase ledgers.

Hardware

If one accepts that the choice of software is of prime importance in deciding on a particular microcomputer system, the choice of hardware is mainly a matter of determining the size of the system in terms of external storage, which then largely determines *price* rather than which particular *make* of computer.

Broadly speaking microcomputer systems can be classified as:

small — 300 kbytes to 1 Megabyte of external storage

medium — 1 Megabyte to 5 Megabytes

large — 5 Megabytes to 15 Megabytes

multi-user — 15 Megabytes to 96 Megabytes

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Table 2.2 Classification of microcomputers by size (excluding printer)

Category	Internal memory		External storage	Principal user languages	Price range (1982)
	RAM	ROM			
Small (personal, desktop, low cost entry etc.)	32 kbytes OR 64 kbytes (i.e. 48 + CP/M)	16 kbytes OR 2 kbytes to 6kbytes	dual 5¼ inch floppy disks 300 kbytes to 1 Megabyte (i.e. 1000 kbytes)	BASIC ASSEMBLER	£2000 to £2500
Medium	48 kbytes OR 64 kbytes to 128 kbytes (incl. CP/M)	16 kbytes OR 6 kbytes	dual 5¼ inch floppy disks up to dual 8 inch floppy disks 1 Megabyte to 5 Megabytes	BASIC FORTRAN COBOL PASCAL	£2500 to £5000
Large	up to 500 kbytes		5¼ inch or 8 inch floppy disk and 5¼ inch Winchester hard disk up to 15 Megabytes	PILOT APL LISP	£5000 to £10,000
Multi-user, multi-task			up to 8 inch Winchester hard disk 15 Megabytes to 96 Megabytes	ASSEMBLER	£10,000 to £15,000

At the top end the distinction between microcomputers and mini-computers does admittedly become rather blurred. Table 2.2 gives some basic information on the differences between these four categories of microcomputer system.

User company size			Maximum stock items	Proportion of the business user market (installations)	Machines
Payroll (employees)	Ledger				
	Customers	Suppliers			
250	500	150	1500	50%	Alphatronic North Star Advantage Commodore/8000 Series Vector Graphic Apple II or III Tandy Model 4 Comart CP-100 Olympia Boss Xerox 820 Epson QX-10 DEC Rainbow Research Machines ACT-Apricot Osborne Executive
400	1000	500	10000	25%	ACT-Sirius Commodore/8000 Series Apple Lisa Tandy Model 16 IBM PC ITT 3030 Wang PC Pertec/Crystal DEC Professional
400 +	1000 +	500 +	10000 +	15%	Cromenco Rair Business Computer ACT-Sirius Sauron Eagle Altos
400 +	1000 +	500 +	10000 +	10%	Accron Cromenco Rair Altos Onyx Vector Graphic

The size of a microcomputer system is perhaps most critical in accounting applications such as operating purchase and sales ledgers (possibly reporting to a nominal ledger) and also stock recording. In these situations each supplier, customer and stock item will require an

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individual record within a file and this feature can be used as a basis for estimating the overall size of the files and, hence, the storage required.

J. Mike Eaton has proposed a very simple method of file size estimation in his excellent pamphlet *How to Choose your Small Business Computer* (1981, available with an accompanying voice cassette, from the National Computer Centre, Manchester) and allows 150 bytes per customer/supplier, 90 bytes per service offered to customers and an additional 50 bytes per service which is an item held in stock. The method, having established what is effectively a minimum file space, then takes into account the operating requirements of the applications software and allows room for expansion by multiplying this minimum by a factor of three to arrive at the overall storage requirement.

Thus for a company with 3000 customers and 1000 suppliers, offering customers 2000 items/services of which 600 are stocked, the arithmetic would be:

3000 customers @ 150 bytes/record	450,000
1000 suppliers @ 150 bytes/record	150,000
2000 items/services @ 90 bytes/record	180,000
600 stock items @ 50 bytes/record	30,000
Minimum storage	810,000 bytes

$$\begin{aligned}\text{Total storage requirement} &= 3 \times 810 \text{ kbytes} \\ &= 2500 \text{ kbytes}\end{aligned}$$

Since 2500 kbytes (or 2.5 Megabytes) represents five or more 5¼ inch floppy disks, the potential user in this example will require a microcomputer system in the medium-to-large microcomputer range at a cost (in 1982) of at least £5000, plus £2000 for a heavy duty dot-matrix printer.

A slightly more sophisticated approach to the same problem can be seen in Figure 2.2 which shows for approximately the same input data the printout of the Bytesoft Business System Configurator which is Bytesoft's programmed version of much the same idea. It is interesting that both methods arrive at a similar overall price.

A further example would be a company with only 500 customers, 150 suppliers and 800 items/services all of which are stocked where the total storage requirement comes out by the same calculation at 600 kbytes. This could certainly be accommodated by a small micro-

BYTESOFT BUSINESS SYSTEM CONFIGURATOR

Bytesoft Business System, comprising: 6755.00
 64K system, 2 790K disk-drives ex. VAT
 green-phosphor screen, 24 lines of 80, numeric pad
 120cps dot-matrix printer, 132cm platen, tractor-feed
 all necessary cables.
 one box of paper (2000 sheets), 2 spare printer ribbons,
 2 boxes of diskettes (total 20).
 Bytesoft Business System (Sales, Purchase & Nominal) holding:
 50 nominal accounts,
 500 customer accounts,
 500 supplier accounts
 non-stock invoicing sub-system
 stock sub-system, with full stock-control, sales orders,
 purchase orders, all fully integrated into the ledger system
 capacities: 200 purchase orders, 200 sales orders,
 10 stock categories, and 2000 stock lines.
 4 half-days' on-site installation support
 Mounted in specially-designed system desk.
 and 1 full year's hardware and software maintenance.
 This quote is subject to confirmation and applies for a maximum of 30 days.

Figure 2.2 Estimating hardware size and price for a medium to large system using the Bytesoft Business System Configurator.

BYTESOFT BUSINESS SYSTEM CONFIGURATOR

Bytesoft Business System, comprising: 4750.00
 64K system, 2 390K disk-drives ex. VAT
 green-phosphor screen, 24 lines of 80, numeric pad
 110cps dot-matrix printer, 80cm platen, sprocket feed
 all necessary cables.
 one box of paper (2000 sheets), 2 spare printer ribbons,
 2 boxes of diskettes (total 20).
 Bytesoft Business System (Sales, Purchase & Nominal) holding:
 40 nominal accounts,
 500 customer accounts,
 150 supplier accounts
 non-stock invoicing sub-system
 stock sub-system, with full stock-control, sales orders,
 purchase orders, all fully integrated into the ledger system
 capacities: 60 purchase orders, 60 sales orders,
 1 stock categories, and 800 stock lines.
 4 half-days' on-site installation support
 Mounted in specially-designed system desk.
 This quote is subject to confirmation and applies for a maximum of 30 days.

Figure 2.3 Estimating hardware size and price for a small microcomputer system using the Bytesoft Business System Configuration.

computer system. Figure 2.3 indicates that the Bytesoft estimate for a similar size of system would (in 1982) be £4750, which certainly confirms that the system does fall within the category of small microcomputers (printer included).

Upward compatibility

If a range of microcomputers is available, it is often useful to know whether a package under consideration for one of the smaller machines in the range can subsequently be used on a larger machine, if required. Such a facility is referred to as upwards compatibility and depends on a common *file structure* which is independent of the size of machine.

Conclusion

In spite of the claims of advertisements, microcomputer hardware is becoming more standard in performance, if not in appearance. Prices are largely controlled by the amount of external (disk) storage which is required to retain — in the business environment — the necessary customer, supplier and stock records. For most practical purposes, as we have seen, systems can be categorised as small, medium, large or multi-user. Although, currently, software is much cheaper than hardware, the choice of software should come before the choice of hardware.

CHAPTER 3

Word Processing on a Microcomputer

Word processing packages

Word processing can be performed either on a general purpose microcomputer of the type this book is concerned with, or alternatively on a stand-alone word processor which is effectively a microcomputer dedicated solely to word processing.

While the facilities offered by word processing packages on general purpose microcomputers and dedicated word processors are much the same, there are advantages and disadvantages in each type of system.

Dedicated word processors versus word processing packages

Generally, dedicated word processors support several work stations, whereas a microcomputer-based word processing package will (unless in a network system) usually support only one work station. However, as the word processing market expands and becomes more competitive, some dedicated word processors are now being designed specifically to support only one work station. Conversely with improving hardware and software advances in networking facilities, networks of up to four microcomputers sharing a single disk system and word processing package are increasingly being established.

In both types of system, control commands are effected by single key depressions or a combination of key depressions. On a dedicated word processing system, which by its nature has only one series of control commands, the control keys can be specifically labelled. Thus, to search for a particular combination of characters in a text (for example) in a dedicated word processing system, a single key labelled SEARCH can be provided. However, within a word processing package operating on a general purpose microcomputer, the same command would most likely be a combination of two key depressions, that is, RVS

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and S keyed simultaneously. Obviously the dedicated word processor's control commands are easier to assimilate, but in practice, after the necessary initial learning period, there is little to choose between the two.

In a dedicated word processor, the operating system is usually in ROM (read only memory, see page 5) and, therefore, is available immediately the system is switched on. A word processing package must be loaded from disk, which will usually take a few seconds. Also, because disks do not last for ever, it will be necessary from time to time to produce backup program disks.

Both systems store information on disks and most dedicated word processors use larger 8 inch disks compared with the standard 5¼ inch disk more commonly used on microcomputers. An 8 inch disk can store approximately 500 pages of solid A4 text, whereas a 5¼ inch disk can store up to 250 A4 pages at approximately 2000 characters (bytes) to the page.

A general purpose microcomputer can accept and operate many other packages, which a dedicated word processor cannot. In some cases it is also possible to link a microcomputer word processing package with other packages such as electronic worksheet packages (VISICALC, see Chapter 4), telex preparation packages (Telexprep, see page 66) or database management and information retrieval packages (see Chapter 5).

The initial cost of a dedicated word processor is at least 30–40 per cent more for a similar potential work capacity than an equivalent general purpose microcomputer, with a high quality printer (or typewriter) and word processing package. Because of this, and because several work stations are usually provided, a dedicated word processor requires a much higher workload to justify its purchase financially.

Table 3.1 summarises this comparison of dedicated word processors and general purpose microcomputers with word processing packages.

The role of word processing packages

Because dedicated word processors are specialised and relatively expensive, they tend to be used in relatively large organisations and operated by trained and qualified typists. Conversely, the main role of the microcomputer-based word processing package tends to be in areas where some word processing is required but a dedicated word processor is not an economic proposition, such as:

Table 3.1 Advantages and disadvantages of dedicated word processors and word processing packages

	Advantages	Disadvantages
Dedicated word processor	<p>simple controls via labelled keys</p> <p>operating system in ROM</p> <p>several work stations (usually)</p>	<p>expensive</p> <p>inflexible</p> <p>larger system requires large workload justification</p>
	Disadvantages	Advantages
General purpose microcomputer with word processing package	<p>controls effected by combinations of normal (i.e. QWERTY) key depressions</p> <p>operating system on disk</p>	<p>relatively cheap</p> <p>flexible, can be combined with other packages</p> <p>because microcomputer can be used for other purposes, justification of word processing package can be based on small workload</p>

small companies or organisations

departments within large organisations already operating a dedicated word processor whose departmental word processing workload is intermittent and, therefore, not easily assimilated into the regular word processing system

companies or departments requiring microcomputer facilities for other purposes as well as for word processing.

Some typical users of word processing packages are:

drawing offices and engineering consultants offices which require

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computational facilities for numerical analysis but also produce long reports, specifications, etc. that often differ only marginally from those previously produced

small mail order organisations which use the microcomputer for mail-shots but also require general typing facilities, especially with the advantage of sending the same letter, addressed personally, to a range of customers or clients

solicitor's practices involved in copious correspondence with clients which requires a high quality of presentation (right-hand justification (see p.55), 'letter' quality type font (see p.62), etc.) but does not have the workload to justify the acquisition of a dedicated word processor

estate agents offices involved in correspondence with both vendors and buyers who also require the file and record sorting ability of the microcomputer (see Chapter 5) to identify houses in appropriate price ranges, residential areas, etc.

Editing and presentation facilities

The facilities offered by word processing packages such as WORDCRAFT, Scripsit, Word Pro, Applewriter, Auto Scribe, Electric Pencil, Spellbinder, Magic Wand and WordStar — the last five of which are designed to operate with many operating systems — can be broadly divided into *editing and presentation facilities* and *control or organisational facilities*. The former, considered in this section, will be of primary interest to the typist operating the system and the latter (see next section) to the manager interested in the potential advantages of word processing as compared with conventional typewriting. Of the packages listed, WORDCRAFT, Magic Wand, Spellbinder and WordStar are considerably more ambitious in the facilities they offer than Auto Scribe and Electric Pencil which are aimed more at the individual author rather than at fulfilling a management function.

The following editing and presentation facilities are available on most word processing packages, the better of which display the document being typed on the microcomputer's screen together with additional information for control function.

Corrections. The cursor's position controls where characters are placed and since the cursor can be positioned anywhere on the computer screen, corrections are effected simply by typing over the incor-

rect character. Although the appearance of the cursor varies, in many systems it is represented by the underline character and in some configurations it flashes on and off.

Insertions and deletions. Single characters, whole words, sentences or paragraphs can be inserted or deleted using control keys.

Searching. Where a particular word or series of characters (a name, part number, specification number, etc.) appears repeatedly in a document and requires changing, the operator can specify the word to be changed and the new word to replace it and the word will be replaced for all occurrences throughout the document.

Moving. Where a section of text has to be moved from one part of a document to another, the operator can indicate the starting and finishing points of the text to be moved and the position to which it is to be moved. Such a section of text can be replicated in several different places within a document.

Paging. As soon as one page is full, a new page is automatically initiated, but a new page can be 'forced' at any time if this is required for clarity of presentation, context, etc.

Justification. Justification of the right-hand margin is normal on most word processing packages but can be removed if required. A letter looks more personal without right-hand justification, whereas a formal report appears much tidier with it (compare Figures 3.2 and 3.4a).

Centering, underlining and highlighting. Headings can be emphasised using any of these three facilities. Centering ensures that a heading will remain at the centre of the page irrespective of the page width. Headings can be highlighted by underlining or by overprinting so that the *emboldened* heading appears in more prominent characters. With some more expensive typewriter/printers it is possible to achieve a *reverse* heading, that is, white on black, using a white erasing ribbon. This reverse print facility is reasonably common on dot-matrix printers.

Line spacing. Text is normally stored on a basis of single spacing but can subsequently be printed double or triple spaced.

Proportional spacing. On a printer with the ability to space characters proportionally, the product can look more like print than typing.

Date June/80

Test Document

Page: 1

Instruction Manual Test Document

This document is provided with the WORDCRAFT 80 word processor and is intended to show you how to use many of WORDCRAFT 80's features.

Note that this section of the document is written in the middle of a page. This has been achieved by using the RULER facility so that the left and right hand margins have been reset to column 20 and column 50 respectively.

Headings or sub-headings can be centered using the CENTER facility as demonstrated below:

WORDCRAFT 80
THE word processor for the
COMMODORE range of computers
using the 3040 or 8050 disk drives
and various types of
high quality printers.

Page widths can be altered at any time either for the entire document by changing the total number of columns available or by using the RULER facility.

Note that the document is now limited to 35 columns wide, this was achieved by changing the right hand margin to column 35 and leaving the left hand margin at 5.

The table of numbers below was produced using the TAB settings of the RULER:

500	3000	4000	8000	250
8520	8954	7854	8564	7410
	8974	8965	8520	9630
789	8745	595	25	89521

Note here that a straightforward use of the TAB feature does not align the decimal point; this can be done using the DECIMAL TAB feature as shown on the next page.

*

Figure 3.1 Illustration of some of the facilities available on the word processing package WORDCRAFT.

Narrow characters such as 'i' take up less space than larger ones such as 'm' instead of all printed characters requiring equal (maximum) spacing.

Date	June/80	Test Document	Page: 2
	78.50	2.25	56.32
	2.50	89745.2564	5.0 "
	4568.0	25.0	63
	.5682	.002	32.1
			89.56
			1.2
			75.20

You will notice that all the decimal points have now been aligned - this was done automatically by WORDCRAFT 80.

Besides the normal TAB facilities it is also possible to use INDENTATION as in the example below:

This paragraph has been set to start at column 10 and end at column 50 - this was achieved by resetting the left and right hand margins. We may now wish to have sub-paragraphs within this paragraph, each of which may require a heading.

- a) This has been done by using the INDENTATION feature, so that after the heading letter, the rest of the sub paragraph is indented from the left hand margin.
- b) Here we have a second sub-paragraph complete with its own sub-heading.
- c) These RULER facilities are extremely useful in the production of technical documents and manuals - such as the one you are reading about WORDCRAFT 80.

Returning to the normal RULER settings we can now see how line spacing functions.

Instead of inserting blank lines, WORDCRAFT 80 can be used to SKIP a certain number of lines before commencing the next section of text. In the above space, 3 lines were skipped.

Now, 2 skips later, we will see that not only can we skip lines but we can force the next section of text to start on a new page.

Figure 3.1 cont.

Page width. Word processing packages allow the user to vary the page width. This facility may be necessary for different printers and/or different widths of stationery.

Tabbing and indentation. Tabs can be set in much the same way as on a traditional typewriter. However, an advantage of the word processing package is that the positions of tab settings can be indicated on the screen. Decimal tabs can also be set to ensure that in a column of figures the decimal place remains in the same relative position.

Indentation is, in effect, an automatic tabbing facility which can be turned on and off and is used to indent sub-paragraphs etc. It differs from tabbing, however, in that in subsequent editing the indentation controls the whole paragraph rather than individual lines within that paragraph.

Setting headers and trailers. Particularly for document work, a header (a heading at the top of the page) and or a trailer (a heading at the bottom of the page) can be printed on every page simply by keying in the heading at the beginning. For documents produced in book form, left-hand and right-hand headers can be printed on alternate pages.

Page numbering. For documents containing several pages, pages can be numbered sequentially in addition to the headers and trailers.

Buffered keys. Because key depressions put information into the computer's store, rather than, as in the case of conventional typewriters, directly on to paper via a mechanical or electro-mechanical linkage, there is no effective speed restriction as to how fast information can be keyed into a word processing package. While there might be a delay in the keyed character appearing on the computer screen, the buffer store ensures that all characters keyed in are retained. This allows typists to operate more quickly with the assurance that any mistakes caused by the higher typing rate can easily be corrected.

Example. Many of the facilities of a typical word processing package are demonstrated in Figure 3.1 which was produced by the WORDCRAFT package written by Wordcraft Systems of Derby. Note the high quality of print produced by a daisy-wheel printer (see page 64 for a comparison of types of printer).

Control or organisational facilities

Once a document has been created and stored on disk by a word processing package, the following control or organisational facilities are

usually available. It is these facilities which really differentiate a word processing package from an electric typewriter.

Printing. The completed document, which can normally consist of up to ten A4 pages of text, can be named and stored on disk for future use or, if it is not likely to be used again, it can simply be printed. One document can be printing at the same time as another is being edited. Once stored, the document can be identified from the disk directory (the list of names of documents stored on the disk) and then all pages, or only specified pages, can be printed.

Number of copies. Single copies or multiple copies can be specified either by using multi-part stationery or by instructing the package to print so many copies on single sheets.

Stationery. If continuous stationery is used, printing can also be continuous. For single sheets, the printer will pause at the end of each page for a fresh sheet of paper to be inserted. A slightly more expensive solution is to use a cut sheet feed, a hopper fed device which allows the printing of up to 500 single A4 sheets treated, in effect, as continuous stationery. The use of single sheets allows headed notepaper to be used. For repeated printing of a specific document, such as an invoice, the user can purchase continuous pre-printed stationery. (See Figure 8.6 for examples of pre-printed pay advice slips.)

Fill points. Where a standard letter is stored as a document it is often necessary later to insert small sections of text such as the current date individually. This is achieved by creating, in advance, 'fill' points where such information can be inserted. In the specimen letter shown in Figure 3.2, such fill points are shown by the characters and in the completed letter (Figure 3.4) the two fill points have been used to enter the current date and the date of a telephone conversation.

Address points. So that the same letter can be sent to a number of different people, address points can be specified and filled automatically from a file of addresses. In Figure 3.2 the positions of address points are specified by the characters A, B, C and D. These address points indicate where the address is to be typed so that it can line up with the transparent section of a window envelope.

Greeting points. A separate character E allows for the insertion of the appropriate greeting, formal or informal.

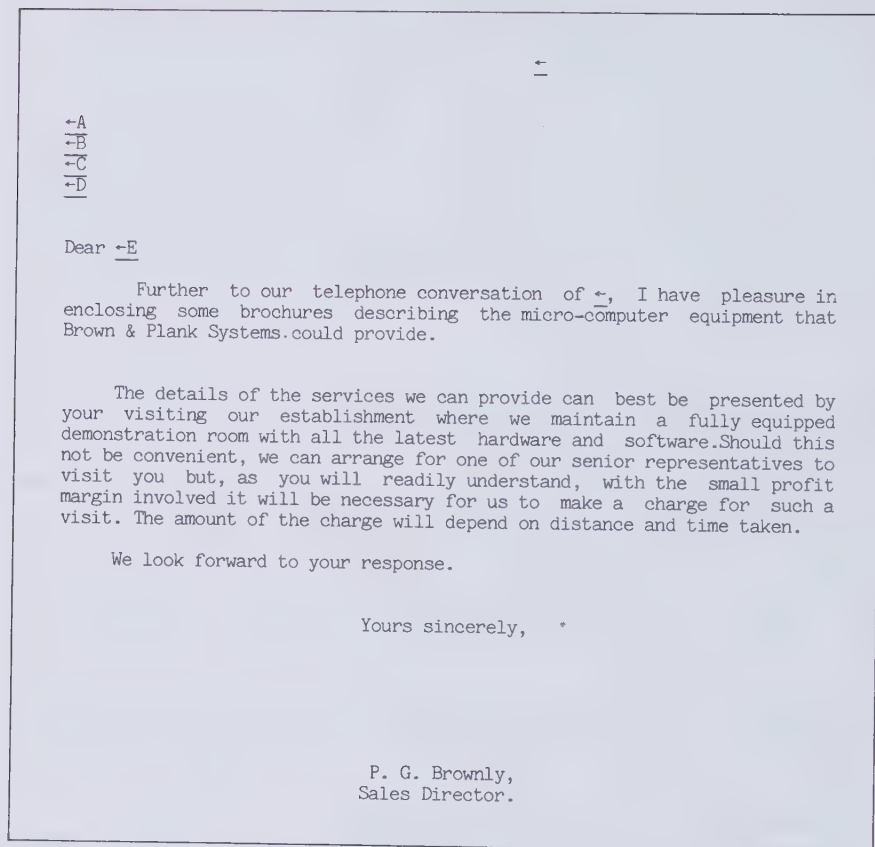


Figure 3.2 Specimen letter with fill, address and greeting points. The letter was printed by an Olympia electronic typewriter using a daisy-wheel.

Lists of addresses and greetings. To insert addresses and greetings automatically into standard letters it is possible to create a file of such addresses and the appropriate greetings as shown in Figure 3.3. Once such a file has been created and stored, letters can be sent either to all addressees, or those specified by number or only those meeting certain criteria (see page 99 for an explanation of search criteria).

Examples of the final versions. Figures 3.4a and 3.4b are completed versions of the letter illustrated in Figure 3.2. The letter has been dated 12th October, 1981; the date of the phone call specified as 2nd October; and then the address and greeting points have been filled

Mrs. Brown,
 12, The Grange,
 Bournemouth,
 Dorset, Dorset,
 Bournemouth,
 Mrs. Brown,

Mrs. Dr. Green,
 25, Barrett Rise,
 St. James Park,
 Hammersmith,
 Mrs. Green,

Dr Colin D Lewis
 25 Oak Leaf Wood Drive,
 Solihull, West Midlands,
 B91 2PH,
 Dr Lewis,

Mr. J. Smith,
 105, Bristol House,
 Euston Road, London,
 Birmingham,
 Mr. Smith,

Figure 3.3 List of addresses and greetings held on file for automatic insertion into a letter. This is done after fill points have been inserted. The printer used is an Anadex dot-matrix printer. Compare the quality with that of the daisy-wheel used for Figure 3.2.

from the third address in the file illustrated in Figure 3.3. The completed letter has been left *unjustified* (ragged at the right-hand margin) which is said to give a more *personal* appearance than the fully justified presentation shown in Figure 3.2. The two different versions shown in Figures 3.4a and 3.4b demonstrate the wide range in quality of print

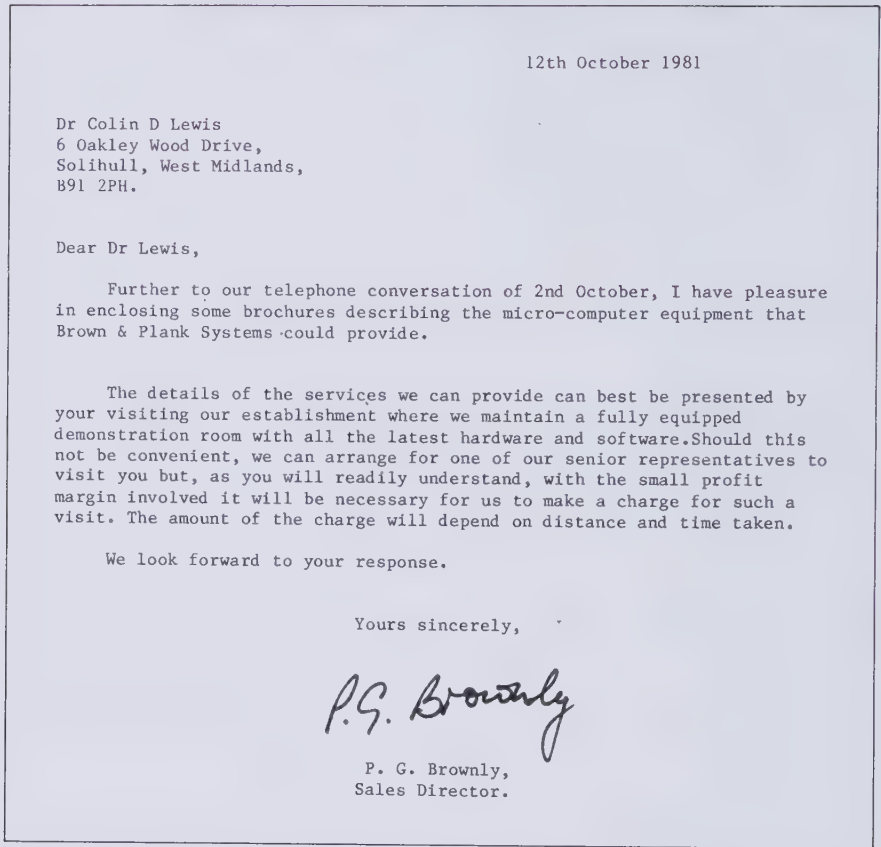


Figure 3.4a Completed letter with fill, address and greeting points utilised. Printed using a high quality Qume Sprint daisy-wheel printer.

from one of the more expensive to one of the cheapest. See the discussion of dot-matrix printers below for an explanation of the curious appearance of lower case p and g.

Printing of labels. Where general publicity material, identical letters, etc. are to be enclosed in plain envelopes, addresses can be printed directly on to adhesive labels mounted on continuous stationery. Such labels, which can be arranged in rows of ones, twos or threes, can subsequently be transferred to the envelopes by hand.

Letters composed of standard paragraphs. Where letters can be com-

12th October 1981

Dr Colin D Lewis
6 Oakley Wood Drive,
Solihull, West Midlands,
B91 2PH.

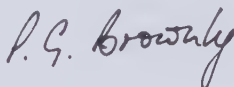
Dear Dr Lewis,

Further to our telephone conversation of 2nd October, I have pleasure in enclosing some brochures describing the micro-computer equipment that Brown & Plank Systems could provide.

The details of the services we can provide can best be presented by your visiting our establishment where we maintain a fully equipped demonstration room with all the latest hardware and software. Should this not be convenient, we can arrange for one of our senior representatives to visit you but, as you will readily understand, with the small profit margin involved it will be necessary for us to make a charge for such a visit. The amount of the charge will depend on distance and time taken.

We look forward to your response.

Yours sincerely,



F. G. Brownly,
Sales Director.

Figure 3.4b Completed letter with fill, address and greeting points utilised. Printed using a low cost Epson MX 80 dot-matrix printer.

posed of standard paragraphs, for example, after an interviewing session, where some applicants are being accepted and others rejected, a file of standard paragraphs can be created and stored and then appropriate paragraphs can be specified and collected to compose an 'individual' letter.

Choice of printer/typewriter

Those considering the purchase of a general purpose microcomputer-based word processing system are likely already to have decided on the microcomputer to be used (see page 45 on choice of hardware). They will then have little choice over the word processing package since most dealers support only one word processing package and, in any case, the market at the moment only appears to have justified at most two or three word processing packages per make of microcomputer, except for CP/M-based systems.

By contrast, the choice of printer/typewriter is wide open. For a table summarising costs and particular features of microcomputer printers, see Table 1.2. Where a large amount of printing is anticipated, which could occupy a microcomputer for several hours a day, the purchase of a *printer buffer* can become an economic proposition. This relatively cheap device allows large amounts of text to be written into RAM storage in a matter of seconds and frees the computer for further work. Printing of the text held in the *printer buffer* can then be arranged independently.

In microcomputer systems, the print mechanism can be any of the following.

Dot-matrix. Here an array of points (often 7×9) is configured to form the shape of the alphabetic, numeric, punctuation and other characters required. These are reproduced on paper by impact via a carbon ribbon. On the cheapest type of dot-matrix printer, the matrix does not extend below the line and hence the lower case versions of g, j, p, q and y have to be configured on the line, looking rather like small capitals. This lack of 'true descenders', to use the technical jargon, can appear rather odd as we have seen in Figure 3.4b. Matrix printers are relatively cheap but do not produce type font of the highest quality. For most practical applications at the moment they are the fastest type of printer at 80 to 200 characters per second (cps), but the print-head does wear and is, therefore, only usually guaranteed for up to one or two million characters. For a heavily used printer this can mean replacing the print-head every year at a cost which represents about 5–10 per cent of the complete printer. Dot-matrix mechanisms are *only* used in printers and *not* in typewriters.

The quality of printing produced by a dot-matrix printer is often referred to as *correspondence quality* which infers that, while the print is acceptable generally, it is not as good as that produced by daisy-wheel printers which is known as *letter quality*.

Golf-ball. Characters are embossed on a print-head looking like a golf ball which is positioned electro-mechanically to present the correct character for printing, and the print-head can be changed to produce a different type font. Because the golf-ball system is electro-mechanical it is relatively slow at about 16 cps, but it produces a relatively high quality of print. In its day the golf-ball mechanism revolutionised typewriter technology, but its slow speed now limits its application for computer printing. Golf-ball mechanisms tend to be used only in typewriters that can also be used as printers.

Daisy-wheel. A daisy-wheel with individual characters embossed on the 'petals' of the wheel is generally made of an alloy or plastic, and the correct character is positioned electro-mechanically and struck from behind with a hammer. Daisy-wheel printers are usually at least twice the cost of dot-matrix printer but, as we have seen, do produce a high quality of print. They occur in both printers and typewriters. The daisy-wheel mechanism can operate faster than that of the golf-ball, and currently daisy-wheel printers can print up to 80 cps, although the majority have a maximum speed of 55 cps.

Ink-jet. A matrix of ink jets is used to squirt characters on to paper. Although a relatively new technology, ink-jet printers are now coming on to the market and speeds of up to 210 cps are claimed. Ink-jet printers operate very quietly and are, therefore, very suitable in environments where noise is a distinct drawback. Sealed, disposable ink cartridges last for 6 million characters and are easy to replace. One possible drawback of ink-jet printers is that because there is no hard physical contact, multiple copies cannot be produced.

To put these speeds into perspective, a good typist can type at 100–150 characters per minute which is an effective maximum speed of about 3–4 characters per second.

Text transmission

As well as providing facilities for word processing to produce printed text, microcomputers can store large amounts of text and can transfer that information rapidly by methods other than by producing print on paper (that is, providing *hard copy*). This section, therefore, explores briefly alternative ways in which the microcomputer can transmit information.

From microcomputer to microcomputer. It is technically quite feasible to send information from one microcomputer to another at a speed of 30 cps via ordinary, voice telephone lines using a device called an *acoustic coupler*. This device converts the computer's signals into sound tones and normally has a padded receptor into which the telephone handset can be placed. Acoustic couplers are relatively cheap but are only used where the amount of data to be transmitted is relatively small, since the rental costs for voice telephone lines are much higher per minute than for dedicated data transmission lines which can operate at up to 960 cps. To transmit computer information along a dedicated data line requires the use of a device called a *modem* which converts the computer's signals into a form suitable for transmission at these higher rates. Compared to an acoustic coupler, a modem is a relatively expensive piece of equipment and, because of this and the cost of installing a dedicated data line, this form of transmission only becomes economic if the amount of data to be transmitted is considerable.

Electronic post. An interesting recent development is the concept of an electronic post box which allows users to send and receive information using a microcomputer linked to public telephone network facilities. With systems such as MerlinTex or Micromail it is possible to transmit a one page, A4 document of 400 words in less than a minute to up to 500 fellow subscribers.

Preparation of telex messages. Where a considerable number of telex messages are transmitted and received, microcomputers can be used to make the whole operation much more efficient and cost-effective. Some of the facilities that are available with such systems as Telexprep, written by Taylor Wilson Systems of Dorridge, are:

- messages can be prepared and edited away from the telex machine and also stored on disk for subsequent transmission

- a whole series of previously stored messages can be automatically punched without operator supervision

- the user's telex call sign can be transmitted using a single key depression, rather than keying in the call sign in full

Such facilities may make it unnecessary to purchase further telex machines as the message workload increases, or may be used to improve the efficiency of an existing situation.

Mailing list. Mailing list packages offer a combination of word processing with data management and information retrieval facilities. (For further information on the latter see Chapter 5.) Mailing list packages allow the user to store several thousand addresses of customers, potential clients, etc. and to produce letters, labels or other printed matter which can be addressed to all, or selected, addressees. Selection can be on single or multiple criteria using record fields such as postal region, job title of addressee, etc. The usual housekeeping facilities of updating, adding and deleting records are provided. Increasingly, organisations which sell mailing lists professionally are providing such lists on disk rather than as printed listings.

Conclusion

A word processing package for a microcomputer offers word processing facilities at about two thirds of the price of a dedicated word processor. While the control commands of such a package are slightly more difficult to learn than on a dedicated system, the facilities offered are very similar and, of course, the microcomputer retains its flexibility to operate with packages other than word processing.

Such packages are therefore often the answer where the workload does not justify the purchase of a dedicated word processor or where the use of other packages is required.

Typical applications of word processing on a microcomputer are to produce:

- documents
- contracts
- mailing lists
- price lists
- accounts
- standard letters to many addressees
- technical reports

Although word processing packages currently on the market offer broadly the same facilities, some are designed specifically for office use and others are orientated more towards the professional author. Those designed more for office use tend to have a wider range of 'mailing' facilities, whereas those aimed more at the professional author tend to allow larger amounts of text to be stored. Thus, when choosing a word

processing package, it is important to check what the orientation of the package is.

One word of caution on the use of word processing may be in order. Because of the ease with which lengthy, perfectly presented documents can be produced, some users have found that there is an overwhelming temptation to overproduce. If the overproduction becomes too extreme, the whole exercise of improving the transmission of information via a word processing system becomes self-defeating, since the recipient is deluged with so much material that he or she is unable to tell what is important and what is not.

CHAPTER 4

Numerical Analysis using an Electronic Worksheet — VISICALC and SUPERCALC

Electronic spreadsheet or worksheet packages

While most microcomputer applications packages are designed for a specific application, such as stock control, payroll or sales and purchase ledger, occasionally a package is developed around a single concept which has applications in many areas. The 'electronic worksheet' is the best example of such a package and this chapter discusses how such a worksheet operates and examines some of the multitude of applications for which a package based on this concept can be used.

Again, although most microcomputer software packages are specific to a particular make of microcomputer, sometimes a package is so successful that its authors find it commercially sensible to make the package available on a wide range of machines. Perhaps the first package to have made this leap into the 'big time' of transportable programs is the electronic worksheet program VISICALC, which was originally developed by Personal Software Inc. in the USA, and is available on most of the more popular types of microcomputer such as Apple II and other early non-CP/M machines. It was reported that 150,000 copies of VISICALC were sold worldwide between 1979 and 1982.

More recently Sorcim Inc. has developed SUPERCALC, which is also based on the worksheet concept but can be run on microcomputers using the CP/M operating system. Other packages modelled around the electronic worksheet theme are Analysis Pad, T/Maker, Business Database, Report Writer and ExecuPlan, all of which were developed in the USA, and SimpliCalc — the only British contender — written by Mark Turner of the Birmingham based Cronite Group. The facilities of some of these VISICALC 'look-alikes' are discussed at the end of this chapter.

However, concentrating on the two packages most readily available

in the UK, both VISICALC and SUPERCALC essentially allow the user to build up an electronic worksheet within which arithmetic manipulations of columns and rows of figures can be performed. Once such a worksheet has been developed, it can be stored on disk for future use, at which time either data can be updated and the effects of the fresh data be computed or the program can be used in an 'IF...WHAT' mode, that is, hypothetical figures can be entered to see *what* results would occur if such figures became reality. Although there are differences between VISICALC and SUPERCALC (for details, see page 82), their basic facilities are much the same.

The versatility of VISICALC and SUPERCALC has led to applications in such areas as:

- planning and budgeting
- market forecasts and projections
- financial analysis and modelling
- financial statements
- stock valuations, etc
- general numerical analysis
- performance analysis of industrial plant

The first-time user of VISICALC, in particular, reaps the benefit of using a package which has sold worldwide since this has made it commercially feasible for the originating software house to produce an accompanying user's manual of very high quality – certainly the easiest manual to use that I have come across.

The VISICALC package is usually protected by having 3 kbytes of the program in ROM (see page 34 on software security) and the remaining 18 kbytes on disk. Thus on a 32 kbyte microcomputer the user has 10 kbytes of storage for the electronic worksheet. With labels, etc, 10 kbytes would allow a user roughly to fill a table of 20 columns by 20 rows.

Basic facilities of VISICALC and SUPERCALC

To give the reader some idea of the types of problem that can be tackled using the worksheet concept, the remainder of the chapter consists of several examples varying from a simple stock portfolio

valuation to a relatively complex leasing plan. An estimate is also given of how long it might take a newcomer to this type of package to achieve the results illustrated by the examples.

The basic concept of VISICALC and SUPERCALC is that both alphanumeric data (that is, labels etc.) and numeric data (that is, numbers) can be stored and manipulated on an electronic worksheet organised as a grid of up to 64 columns, which are labelled alphabetically, and 254 rows, which are numbered. All positions within the grid are referred to by their co-ordinates such as C4, E5, etc. Because of the limit set by the computer's screen size, it is apparent that only part of that worksheet can be seen at any one time. However, data which has previously been stored within the worksheet remains in the computer's memory and can be recalled to the screen by moving the worksheet either vertically or horizontally using normal cursor controls (scrolling).

The entry of data into the worksheet is controlled by the position of the cursor and, to save time when a large movement is required within the worksheet, the cursor can also be made to move directly to any specified coordinate. The basic configuration of the grid in the top left-hand corner of the worksheet, which is where the majority of users will operate, is shown in Figure 4.1. In the normal configuration the cursor occupies nine character spaces horizontally, but this can be increased (usually for labels) or reduced (usually for numbers not requiring nine spaces). On a screen eighty characters wide, eight worksheet columns are normally displayed.

	A	B	C	D	E	F
1	*****					
2						
3						
4						
5						
6						

Figure 4.1 Grid pattern at the top left-hand corner of a VISICALC or SUPERCALC screen or worksheet.

Labels. Columns and rows can be labelled and an alphabetic character is always assumed to start a label. Labels are left-hand justified, which is usually fine for rows but, since numbers are right-hand justified, column labels or headings will usually look tidier if right-hand justified. Numbers can also be used as labels if preceded by quotes (""). Thus "01/10/81 will be recorded as such whereas, since / is used for division (see below), 01/10/81 without the quotes will be recorded as the result of $(1 \div 10) \div 81 = 0.0012345$ which might be very amusing but not what the user intended!

Fixing labels. Normally, if the user moves the worksheet upwards or leftwards, the labels established for the columns and rows would soon move off the screen and would no longer be visible. Because this is most likely to happen when additional rows or columns of data are being entered into the worksheet, it is possible to fix labels either horizontally, vertically or both, so that they always remain on the computer's screen to identify the relevant column or row.

Line drawing. A simple repeat facility is available for drawing lines, etc. by producing rows of a repeated character such as a hyphen (-), asterisk (*) or any other suitable character.

Data entry. Numbers can be entered into the worksheet's grid by positioning the cursor at the desired entry point. Acceptance of numbers into the grid can be achieved (as with all other entries) simply by pressing the return key or by any of the four (up, down, left or right) movements of the cursor. Thus, particularly for a column, numbers can be entered (or altered) successively by moving directly down the column using a single keystroke after each entry, whereas on a normal typewriter at least two keystrokes (carriage return/linefeed and tabulation) would be involved. Where the same number needs to be entered in several positions in a column and/or row, a replicate facility can be used instead of having to key in that number repeatedly.

Arithmetic operations. The usual arithmetic operations of addition (+), subtraction (-), multiplication (*) and division (/) are available.

Automatic replication of formulae. Where an arithmetic operation (formula) needs to be performed successively in a column or row (or both) this can be achieved very simply by using an automatic replication facility. When the replication is introduced, the range over which the original formula is to be replicated must be specified. It is also

necessary to indicate whether or not the variables within the original formula are to change relatively (that is, relative to the grid) in the newly created formulae or whether they should remain the same as in the originating formula.

For example, if the formula $+1+B1$ in cursor position C1 was to be replicated over the range D1 to E1 and, if the variable B1 in the formula was made RELATIVE, the formulae in D1 and E1 would become $+1+C1$ and $+1+D1$ respectively, whereas if B1 was to remain unchanged (NO CHANGE) the formula $+1+B1$ would appear at C1, D1 and E1.

Built-in functions. Special facilities, such as summation of a column or row of figures, are built into electronic worksheet packages. Thus the sum of entries in column B from row 3 to row 10 can be written very briefly as @ SUM (B3...B10) rather than as (B3 + B4 + B5 + B6 + B7 + B8 + B9 + B10). Other built-in functions include: finding the MAXimum or MINimum value in a list, COUNTing, AVERAGing, taking ABSolute, INTEger or SQRT (square-root) values, etc.

Examples

Stock portfolio example

(pessimistic learning time two hours)

Some of the basic facilities already described are incorporated in the stock portfolio example shown in Figure 4.2. The grid's border of letters across and numbers down has been used to set up the example but is not shown (compare Figure 4.5).

The stock portfolio example shown in Figure 4.2 represents a hypothetical holding of shares in beers, wines and spirits, and shows the valuation of the portfolio (using prices published by the *Financial Times*) on Thursday, 17th September, five days later on Tuesday, 22nd September and three days later on Friday, 25th September 1981.

Within this example, any change of any value in either the Qty (Quantity) or Price columns automatically causes a change in the corresponding row of the Value column which derives from the formula $\text{Qty} \times \text{Price}/100$. Any resulting change of an element in the Value column then automatically alters the total which is the summation of the ten Values.

Observers of the Stock Market scene may recall that there was a general drop in share prices at that time since the four main clearing

STOCK PORTFOLIO (BEERS,WINES & SPIRITS)				17/09/81
	NAME	QTY	PRICE	VALUE
1	AllBrew	1000	72	720
2	Bass	700	216	1512
3	Border	50	100	50
4	Bulmer	175	267	467.25
5	City Lon	79	79	62.41
6	Guinness	200	58	116
7	Highl'd	300	87	261
8	IrishDis	1000	50	500
9	Morland	560	190	1064
10	Vaux	120	140	168
TOTAL				4920.66

STOCK PORTFOLIO (BEERS,WINES & SPIRITS)				22/09/81
	NAME	QTY	PRICE	VALUE
1	AllBrew	1000	69.5	695
2	Bass	700	212	1484
3	Border	50	88	44
4	Bulmer	175	265	463.75
5	City Lon	79	75	59.25
6	Guinness	200	58	116
7	Highl'd	300	81	243
8	IrishDis	1000	52	520
9	Morland	560	190	1064
10	Vaux	120	136	163.2
TOTAL				4852.2

STOCK PORTFOLIO (BEERS,WINES & SPIRITS)				25/09/81
	NAME	QTY	PRICE	VALUE
1	AllBrew	1000	68.5	685
2	Bass	700	200	1400
3	Border	50	83	41.5
4	Bulmer	175	245	428.75
5	City Lon	79	71	56.09
6	Guinness	200	54	108
7	Highl'd	300	76	228
8	IrishDis	1000	47	470
9	Morland	560	180	1008
10	Vaux	120	126	151.2
TOTAL				4576.54

Figure 4.2 Stock portfolio example of some basic VISICALC/SUPERCALC facilities.

banks raised their interest rates from 12 per cent to 14 per cent. This caused a sudden drop in share prices overall and, hence, a drop in the value of this portfolio from £4920.66 to £4852.20 to £4576.54.

Incorporated within this example are just a few of the basic facilities already described, in particular multiplication and summation.

Once the original portfolio has been stored on disk, reloading allows the user to update any price or quantity quickly and immediately evaluate the new, current value of the portfolio.

Simple cash flow analysis

(pessimistic learning time four hours)

Figure 4.3 illustrates a typical use of VISICALC or SUPERCALC from which the cash flow situation within a company can be analysed. In this hypothetical example, the management of a small company intend to ask the bank for a two year loan and are analysing their cash flow situation to help decide what size of loan to ask for, and also to help convince the bank manager to make the loan. The table drawn up on the computer indicates the expected income from sales over the next twelve months and also expenditure.

In the example the amount of the loan to be requested can be varied, as can the accompanying interest rate. The total repayment over a two year period is then automatically calculated, and the resulting figure, divided by 24, automatically becomes the monthly loan repayment — the last entry in the expenditure column. The resulting cash flow, the difference between sales income and total outgoings, is then calculated automatically for each month. Yearly totals are also calculated at the right-hand side of the tableau and the percentage these totals represent of total income is also calculated. If either the loan or the interest rate is altered, the resulting changes are computed immediately.

It is apparent that a £10,000 loan at a 14 per cent interest rate (compounded over two years) would cause no cash flow problems, but at the same interest rate a £13,000 loan would create an overdraft situation in period 1. An £11,000 loan at a pessimistic 18 per cent interest rate causes no monthly overdraft situations and, therefore, might be an appropriate figure on which to base the management's loan request.

Another feature of this particular worksheet is that if the company's mortgage were to be increased in period 6, a new entry in that position would be replicated over the remaining periods of the year, that is, from period 7 to period 12.

Since most of the figures are large cash values these are only shown

as integers, except in the percentage column where values are shown to two decimal places. However, the global use of an integer format can cause apparent arithmetical anomalies due to rounding errors (as can be seen here) and should only be used where the requirement for simple presentation overrides that of accuracy.

LOAN: 10000 INTEREST RATE (pa) 14 TOTAL REPAYMENT OVER TWO YEAR PERIOD 12996													
PERIOD	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL PERCENT
SALES	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	120000
MORTGAGE	600	600	600	600	600	600	600	600	600	600	600	600	7200 6.00
UTILITIES	140	140	80	80	40	40	85	85	50	50	100	140	1030 0.86
TELEPHONE	75	75	75	75	75	75	75	75	75	75	75	75	900 0.75
SALARIES	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	96000 80.00
CLOTHING	120	120	120	120	120	120	120	120	120	120	120	120	1440 1.20
RATES	80	80	80	80	80	80	80	80	80	80	80	80	960 0.80
INSURANCE	160						160						320 0.27
POSTAGE	150	150	150	150	150	150	150	150	150	150	150	150	1800 1.50
LOAN REP.	542	542	542	542	542	542	542	542	542	542	542	542	6498 5.42
CASH FLOW	134	294	354	354	394	394	189	349	384	384	334	294	3852 3.21

LOAN: 13000 INTEREST RATE (pa) 14 TOTAL REPAYMENT OVER TWO YEAR PERIOD 16894.8													
PERIOD	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL PERCENT
SALES	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	120000
MORTGAGE	600	600	600	600	600	600	600	600	600	600	600	600	7200 6.00
UTILITIES	140	140	80	80	40	40	85	85	50	50	100	140	1030 0.86
TELEPHONE	75	75	75	75	75	75	75	75	75	75	75	75	900 0.75
SALARIES	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	96000 80.00
CLOTHING	120	120	120	120	120	120	120	120	120	120	120	120	1440 1.20
RATES	80	80	80	80	80	80	80	80	80	80	80	80	960 0.80
INSURANCE	160						160						320 0.27
POSTAGE	150	150	150	150	150	150	150	150	150	150	150	150	1800 1.50
LOAN REP.	704	704	704	704	704	704	704	704	704	704	704	704	8447 7.04
CASH FLOW	-29	131	191	191	231	231	26	186	221	221	171	131	1903 1.59
LOAN: 11000 INTEREST RATE (pa) 18 TOTAL REPAYMENT OVER TWO YEAR PERIOD 15316.4													
PERIOD	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL PERCENT
SALES	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	120000
MORTGAGE	600	600	600	600	600	600	600	600	600	600	600	600	7200 6.00
UTILITIES	140	140	80	80	40	40	85	85	50	50	100	140	1030 0.86
TELEPHONE	75	75	75	75	75	75	75	75	75	75	75	75	900 0.75
SALARIES	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	96000 80.00
CLOTHING	120	120	120	120	120	120	120	120	120	120	120	120	1440 1.20
RATES	80	80	80	80	80	80	80	80	80	80	80	80	960 0.80
INSURANCE	160						160						320 0.27
POSTAGE	150	150	150	150	150	150	150	150	150	150	150	150	1800 1.50
LOAN REP.	638	638	638	638	638	638	638	638	638	638	638	638	7658 6.38
CASH FLOW	37	197	257	257	297	297	92	252	287	287	237	197	2692 2.24

Figure 4.3 Simple cash flow example.

Complex forecasting analysis
(pessimistic learning time seven hours)

Figure 4.4a illustrates a technically more complex worksheet than those of the stock portfolio or the cash flow analysis. The series of calculations shown in Figure 4.4a (taken from my *Industrial and Business Forecasting Methods*, Butterworth, 1982) is of a demand analysis using a forecasting technique known as exponential smoothing. While this analysis is likely to be mathematically more complicated than any the practising manager would get involved in, it is certainly the type of exercise that members of an operational research department might use. Even this level of analysis, however, does not fully extend the facilities of VISICALC or SUPERCALC.

For those readers interested in the formulae on which this analysis is based, the following apply in designated row order:

- 1 d_t
- 2 u_{t-1}
- 3 $e_t = d_t - u_{t-1}$
- 4 e_t^2
- 5 Σe_t^2
- 6 $0.2 \times e_t$
- 7 $0.8 \times \bar{e}_{t-1}$
- 8 $\bar{e}_t = 0.2 \times e_t + 0.8 \times \bar{e}_{t-1}$
- 9 $0.2 \times |e_t|$
- 10 $0.8 \times \text{MAD}_{t-1}$
- 11 $\text{MAD}_t = 0.2 \times |e_t| + 0.8 \times \text{MAD}_{t-1}$
- 12 $\sigma_t = 1.25 \times \text{MAD}_t$
- 13 $T_t = \bar{e}_t / \text{MAD}_t$
- 14 Σe_t
- 15 α
- 16 $\alpha \times d_t$
- 17 $(1 - \alpha) \times u_{t-1}$
- 18 $u_t = \text{INT} (\alpha \times d_t + (1 - \alpha) \times u_{t-1} + 0.5)$

DEMAND ANALYSIS WORK SHEET (SIMPLE EXPONENTIAL SMOOTHING)										
Alpha fixed at 0.2										
	1	2	3	4	5	6	7	8	9	10
1.Current Demand Value	55	50	58	49	86	52	54	49	58	68
2.Current Forecast	50	51	51	52	52	55	55	55	54	54
3.Error	5	-1	7	-3	34	-3	-1	-6	4	14
4.Squared Error	25	1	49	9	1156	9	1	36	16	196
5.Cumulative Sq Error	0	25	26	75	84	1240	1249	1250	1286	1498
6.Alpha*Error	1.00	-.20	1.40	-.60	6.80	-.60	-.20	-1.20	.80	2.80
7.(1-Alpha)*Past Sm Error	.00	.80	.48	1.50	.72	6.02	4.33	3.31	1.69	1.99
8.Current Smoothed Error	.00	1.00	.60	1.88	.90	7.52	5.42	4.13	2.49	4.79
9.Alpha*/Error/	1.00	.20	1.40	.60	6.80	.60	.20	1.20	.80	2.80
10.(1-Alpha)*Past MAD	4.00	4.00	3.36	3.81	3.53	8.26	7.09	5.83	5.62	5.14
11.Current MAD	5.00	5.00	4.20	4.76	4.41	10.33	8.86	7.29	7.03	7.94
12.Current Std Dev	6.25	5.25	5.95	5.51	12.91	11.08	9.11	8.79	8.03	9.92
13.Tracking Signal	.20	.14	.39	.21	.73	.61	.57	.30	.39	.60
14.Cumulative Error	5	4	11	8	42	39	38	32	36	50
15.Alpha	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
16.Alpha*Current Demand	5.50	5.00	5.80	4.90	8.60	5.20	5.40	4.90	5.80	6.80
17.(1-Alpha)*Past Forecast	45.00	45.90	45.90	46.80	46.80	49.50	49.50	49.50	48.60	48.60
18.Next Period's Forecast	50.00	50.50	50.90	51.70	51.70	55.40	54.70	54.90	54.40	55.40

Figure 4.4a Demand analysis using exponential smoothing ($\alpha = 0.1$).

Within this analysis, functions such as SQUaring (row 4), ABSolute values (row 9) and INTEger values are used.

The objective of this particular exercise is to find which value of the exponential smoothing constant Alpha (row 15) produces the best forecast. At the bottom of each column the forecast for the following month is calculated using an exponentially weighted average based on the proposed value of alpha (row 15) and the resulting value (row 18) is carried forward as an integer value to the next month (row 2). On a criterion of minimising the sum of squared errors over the ten periods, the value of Alpha of 0.2 which produces a sum of squared errors of 1556 in Figure 4.4b appears worse than a value of 0.1 which here produces a value of 1498. (Note that the value of Alpha 1 used for smoothing the error and absolute error – rows 6 to 8 and 9 to 11 respectively – is always set at 0.2 and that the grid's border has not been included.)

Splitting the screen using windows

If the position within a worksheet of a value to be altered and the position of the result caused by that alteration cannot both be accommodated on the computer screen at the same time, this can be overcome

	A	B	C		J	K	L	
1					1			
2	DEMAND ANAL				2	Alpha fixed at 0.2		
3					3			
4			1		4	8	9	10
5					5			
6	1	Current Demand Value	55		6	49	58	68
7	2	Current Forecast	50		7	56	55	56
8	3	Error	5		8	-7	3	12
9	4	Squared Error	25		9	49	9	144
10	5	Cumulative Sq Error	0	25	10	1403	1412	1556
11					11			
12	6	Alpha*Error		1.00	12	-1.40	.60	2.40
13	7	(1-Alpha)*Past Sq Error		.00	13	2.71	1.05	1.32
14	8	Current Smoothed Error	.00	1.00	14	1.31	1.65	3.72
15					15			
16	9	Alpha*/Error/		1.00	16	1.40	.60	2.40
17	10	(1-Alpha)*Past MAD		4.00	17	6.64	6.43	5.62
18	11	Current MAD	5.00	5.00	18	8.04	7.03	8.02
19					19			
20	12	Current Std Dev		6.25	20	10.05	8.79	10.03
21					21			
22	13	Tracking Signal		.20	22	.16	.23	.46
23	14	Cumulative Error		5	23	27	30	42
24					24			
25	15	Alpha		.2	25	.2	.2	.2
26	16	Alpha*Current Demand		11.00	26	9.80	11.60	13.60
27	17	(1-Alpha)*Past Forecast		40.00	27	44.80	44.00	44.80
28	18	Next Period's Forecast	50.00	51.00	28	54.60	55.60	58.40
29					29			
30					30			

Figure 4.4b Demand analysis with both border showing grid and window (Alpha = 0.2).

using a WINDOW facility, to split the screen either vertically or horizontally. The resulting two halves of the worksheet either side of the resulting split can then be moved separately to bring the relevant information into view. Thus, if in Figure 4.4a a vertical window were introduced in period 2 (column D of the worksheet) this would leave the row labels (column A), initial values (column B) and the entries for Period 1 (column C) to the left-hand side of that window. If the cursor moves to the right-hand side of the window, that side can then be moved to the left (without in any way affecting the left-hand side) until periods 8 to 10 (columns J to L) come into view on the computer screen. Now, as a result of the introduction of the window, both the

value of Alpha specified for the analysis (column C, row 15) and the resulting final sum of squared errors (column L, row 5) can be viewed simultaneously. Figure 4.4b therefore represents a partitioned form of the table shown as Figure 4.4a, in this case with columns D to H missing. This window facility is useful in allowing the operator to condense a wide table on to the computer screen.

Multiple documents on the same worksheet

A very common problem in management's control of information is that the same information often has to be presented in different ways on different documents. This can be achieved on an electronic worksheet, as shown in Figure 4.5. On the area of the worksheet denoted by columns A to D and rows 1 to 12, a wages department document could be produced. Simultaneously the hours logged by each worker could be transferred to a production planning department document denoted by columns AA to AH without revealing the men's hourly rates. In the example it is assumed that Bentley, Brown, Craddock, Davidson and Eggan work in the machine shop and the others in maintenance. Note that the hourly figures in *columns* in the wages document have been transferred to *rows* in the production planning document. Depending only on the storage capacity of the worksheet, many documents incorporating common data can be reproduced simultaneously at different positions on the worksheet.

Transference of data between worksheets

An additional facility provided by both VISICALC and SUPERCALC, is the ability to store specified data from one worksheet for use in another. Thus a final *column* of figures (such as column D in Figure 4.5) could be transferred as a *row* of figures for subsequent analysis. This facility is a powerful function when condensing data.

Simple financial modelling

Although they were not originally designed as financial modelling packages, it is reported that many of the applications to which both VISICALC and SUPERCALC are put are financial models of one form or another. Certainly, where a specific model is to be tested (if the model is not too complicated) both can prove a very useful vehicle to test financial hypotheses.

One particular feature which has been built into both packages, specifically for use in financial models, is a *net present value* function.

	A	B	C	D
1	Wages Department Doc. 54b			
2	-----			
3	NAME	RATE/H'R	HOURS	EARN'GS
4	-----			
5	Bentley	2.25	35	78.75
6	Broom	2.25	37	83.25
7	Craddock	2.75	40	110.00
8	Davidson	3.00	38	114.00
9	Eggan	2.25	35	78.75
10	Higgins	3.00	37	111.00
11	Logan	2.50	39	97.50
12	Mathews	2.25	35	78.75
13	Morgan	2.25	40	90.00
14	Smith	2.75	40	110.00
15				=====
16		Total		952.00
17				=====
18				

	AA	AB	AC	AD	AE	AF	AG	AH
1								
2								
3	Production Planning Doc.16b							
4	-----							
5	Cost Centre	Operator Times					Total	
6	-----							
7	Machine Shop		35	37	40	38	35	185
8	Maintenance		37	39	35	40	40	191
9								
10								
11								

Figure 4.5 Example of two documents on the same worksheet.

Given a column or row of future expenditure figures, this function accumulates the total of those values discounted over time at a specified rate. Thus, if an interest rate of 10 per cent were to be specified, the initial expenditure figure would be divided by 1.1, the second by 1.21 (that is, 1.1×1.1) etc. and the net present value would be the sum total of the discounted expenditure figures.

Figure 4.6 is an example of the calculation of a typical leasing plan where the *net present value* function has been used to assess the present value of the plan. Thus, while the twelve quarterly payments over the three year period total £15,456, the net present value of that expenditure is only £12,087.98. In this example the rate per £1000 per

quarter, the capital sum and the assumed interest rate can all be altered.

Although there is no direct financial advantage to be gained from this particular leasing plan, since the net present value is only £587.98 more than the cost of a direct purchase, since repayments of such a plan are allowable against tax, it might well prove attractive.

Comparison of worksheet packages

Differences between VISICALC and SUPERCALC

Throughout this chapter, so far, it has been assumed that there is little or no difference between these two packages. Indeed, all the examples included to date could have been produced by either, although it so happens that Figures 4.1, 4.2, 4.3 and 4.5 were produced using VISICALC and Figures 4.4a, 4.4b and 4.6 using SUPERCALC.

While many of the facilities offered are common to both, and indeed many of the instructions even use the same keystroke, there are some differences. The border used to define the rows and columns in VISICALC always appears on the screen, appears in reverse video and cannot be printed; in SUPERCALC the border can be removed if preferred or can be retained and used for printing as can be seen in Figure 4.4b. In SUPERCALC the size of individual columns can be varied, whereas most versions of VISICALC allow all column widths to be altered only to the same value. A very useful facility available only on SUPERCALC is that the contents of the worksheet can be shown either as a display of the results of the numerical calculations (as is standard with VISICALC) or in a form where the equations defining those calculations are displayed. Figure 4.7, a part section of the *demand analysis* worksheet originally shown as Figure 4.4a highlights a section of the worksheet shown in equation form.

Other electronic worksheet programs

Report Writer. This is a modest attempt to provide printout facilities similar to VISICALC and comprises a suite of compact BASIC programs dedicated to the production of tabular reports. Like VISICALC, the program formats and manipulates numerical data as well as alphanumeric labels and headings but, unlike VISICALC, the two do not appear simultaneously. They have to be entered separately and are manipulated through a two-character instruction. Although slightly

***** LEASING PLAN 1981/82 *****												
Period of 3(three) years at 112/£1000 per quarter, Capital = 10000 Assumed interest rate p.a.= 16.00												
YEAR/QUARTER	1/1	1/2	1/3	1/4	2/1	2/2	2/3	2/4	3/1	3/2	3/3	3/4 TOTAL
Repayments per qtr	1120.00	1120.00	1120.00	1120.00	1120.00	1120.00	1120.00	1120.00	1120.00	1120.00	1120.00	1120.00 13440.00
UAT \15%	168.00	168.00	168.00	168.00	168.00	168.00	168.00	168.00	168.00	168.00	168.00	168.00 2016.00
Total outlay/qtr	1288.00	1288.00	1288.00	1288.00	1288.00	1288.00	1288.00	1288.00	1288.00	1288.00	1288.00	1288.00 15456.00
=====												
Net Present Value of Total Outlay "Leasing" 12087.98												
Present value of purchase inc. VAT at 15% 11500.00												
=====												
Cost benefit of using "leasing" -587.98												
=====												
NOTE Assumes that payments are made at the end of each quarter. Repayments allowable against tax.												
=====												

Figure 4.6 Model of a three year leasing plan using the net present value function.

DEMAND ANALYSIS WORK-SHEET (SIMPLE EXPONENTIALLY AVERAGE)										
CURRENT PERIOD	1	2	3	4	5	6	7	8	9	10
1.CURRENT DEMAND VALUE	55	50	58	49	86	52	54	49	58	68
2.CURRENT FORECAST	50	51	51	52	52	58	57	57	55	56
3.CURRENT ERROR	5	-1	7	-3	34	-4	-3	-8	3	12
4.SQUARED ERROR	25	1	49	9	1156	36	9	64	9	144
5.CUMULATIVE SQ. ERROR	25	26	75	84	1240	1276	1285	1349	1358	1502
6.ALPHA*ERROR(Alpha=0.2)	1	-.2	1.4	-.6	6.8	-1.2	-.6	-1.6	.6	2.4
7.(1-Alpha)*FAST SM. ERROR	.60	.80	.48	1.50	.72	6.02	3.85	2.60	.80	1.12
8.CURRENT SMOOTHED ERROR	1.00	.60	1.88	.90	7.52	4.82	3.25	1.00	1.40	3.52
9.ALPHA*/ERROR/(Alpha=0.2)	1	.2	1.4	.6	6.8	1.2	.6	1.6	.6	2.4
10.(1-Alpha)*FAST MAD	4.00	4.00	3.36	3.81	3.53	8.26	7.57	6.54	6.51	5.69
11.CURRENT MAD	5.00	4.20	4.76	4.41	10.33	9.46	8.17	8.14	7.11	8.09
12.CURRENT STD. DEV.	6.25	5.25	5.95	5.51	12.91	11.93	10.21	10.17	8.89	10.11
13.TRACKING SIGNAL	.20	.14	.39	.21	.73	.51	.40	.12	.20	.44
14.CUMULATIVE ERROR	5	4	11	8	42	36	33	25	28	40
15.ALPHA(CONSTANT)	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20
16.ALPHA*CURRENT DEMAND	11.00	10.00	11.60	9.80	17.20	10.40	10.80	9.80	11.60	13.60
17.(1-Alpha)*FAST FORECAST	40.00	40.80	40.64	41.79	41.27	46.78	45.74	45.23	44.03	44.50
18.NEXT PERIODS FORECAST	50.00	51.00	50.80	52.24	51.59	58.47	57.18	56.54	55.03	55.63
	58.10									

	C	D	E	F
61	55	50	58	49
71	B28	C28	D28	E28
81	C6-INT(C7+.5)	D6-INT(D7+.5)	E6-INT(E7+.5)	F6-INT(F7+.5)
91	INT(C8)*INT(C8)	INT(D8)*INT(D8)	INT(E8)*INT(E8)	INT(F8)*INT(F8)
101	C9	SUM(C9:D9)	SUM(E9:F9)	SUM(F9:G9)
111				
121	0.2*C8	0.2*D8	0.2*E8	0.2*F8
131	0.8*E14	0.8*C14	0.8*D14	0.8*E14
141	C12+C13	D12+D13	E12+E13	F12+F13
151				
161	0.2*ABS(C8)	0.2*ABS(D8)	0.2*ABS(E8)	0.2*ABS(F8)
171	0.8*E18	0.8*C18	0.8*D18	0.8*E18
181	C16+C17	D16+D17	E16+E17	F16+F17
191				
201	1.25*C18	1.25*D18	1.25*E18	1.25*F18

Figure 4.7 A section of the demand analysis worksheet shown in 4.4a, demonstrating a facility only available on SUPERCALC.

cheaper, Report Writer does not have the immediate appeal of VISICALC and appears to have achieved only limited sales to companies who primarily require printed results of repetitive tabular work.

T/Maker. At nearly twice the price of Report Writer, this program offers a multi-purpose text editor as well as additional facilities to sort data. Designed to operate with CP/M, T/Maker is a relatively complex program and works like a word processing package with additional facilities for numerical analysis which include sorting in ascending and

descending order. Compared with VISICALC and ExecuPlan which are written in machine-code, T/Maker, despite the variety of its facilities, does appear very slow in operation.

ExecuPlan. This is very similar to VISICALC both in appearance and operation, but can only be run on machines provided with Vector Graphic hardware.

SimpliCalc. SimpliCalc is a British attempt to provide a no-frills version of VISICALC, with the resultant advantage that the complete program occupies 4 kbytes as opposed to 20 kbytes. Thus SimpliCalc can either be offered in cassette form to users of machines with as little as 8 kbytes internal memory or alternatively can offer users with disks considerably more memory for the worksheet. Hence, whereas on a 64 kbyte microcomputer VISICALC offers a worksheet of only 10 kbytes, SimpliCalc offers a potential worksheet size of 28 kbytes. As a guide for evaluation, the demand analysis worksheet, Figure 4.4a, occupies 8 kbytes.

Some of the disadvantages of SimpliCalc compared with VISICALC are:

- the size of the worksheet must be specified in advance
- columns are a fixed width of seven characters
- there are no facilities for fixing labels or providing windows
- calculations are always by column order
- columns are numbered rather than lettered, in order to save space within the program

The author of SimpliCalc argues that most of these amenities are indeed frills and that with a little ingenuity, such as revising one's ideas on the form of tabular layout, very few problems that can be solved using VISICALC cannot be solved using SimpliCalc. However, many problems that could technically be solved by both, in practice require more storage for the worksheet than the larger VISICALC program allows.

On an 8 kbyte machine, SimpliCalc can offer a worksheet of 250 to 300 elements (10 columns by 30 rows) and for a 32 kbyte machine this rises to 2500 to 3000 elements (100 columns by 30 rows) and these figures represent elements which are actually used, as opposed to elements which could be used. Many users do appear to prefer space

to frills as can be seen from the fact that, while originally developed for the cassette-based market, sales of SimpliCalc have increasingly been to users with disk drives. The fact that SimpliCalc is also a third of the price may, however, have something to do with its popularity.

Conclusion

VISICALC (1978) and subsequently SUPERCALC (1980) were originally the first two widely available worksheet or spreadsheet packages and still maintain their lead in the software marketplace. However, the popularity of the spreadsheet concept (300,000 copies of SUPERCALC, it is claimed, have been sold since its launch) has meant that several software houses have tried to break into this very competitive field. Thus a number of new 'super spreadsheet' packages claiming to offer improvements to the basic spreadsheet have recently come on to the market stimulated mainly by the introduction by Lotus of '1-2-3', the best selling software package in the US during 1983. In a comparison by the respected Gartner Group in the US this package was found to be better than Soricim's SUPERCALC I (the original version described in this chapter), Viscorp's VISICALC, Context's MBA and Microsoft's MULTIPLAN.

Soricim have responded to this challenge by introducing SUPERCALC III which claims to offer the following advances over its rivals:

- running with smaller memory requirements

- lower price

- greater variety of graphical interpretation

- more 'usability'

- ability to interact with a greater variety of external files

- better sorting facilities and data management

Whether or not these claims prove well founded, this rivalry between leading software houses striving to produce even more efficient packages with enhanced facilities can only be of benefit to the microcomputer user.

CHAPTER 5

Database Management and Information Retrieval

Flexible versus specific packages

One of the most useful features of any computer is its ability to store large amounts of information and to retrieve specified sections of that information rapidly. Correspondingly one of management's greatest problems is, having accumulated vast amounts of information over the years, then to gain access rapidly to that information as and when required.

Not surprisingly, therefore, the majority of microcomputer applications packages in the business and management area tend to be designed for database management and information retrieval applications of one sort or another, a database being defined as 'a file of data structured to allow a number of applications to access the data and update them without dictating or constraining the overall design of the content'. Such packages can either be tailored to cope with a specific but fairly common area of application or flexible, general purpose packages which allow the user to 'design' a data management and information retrieval system to suit his or her particular problem. These latter are variously termed FMS (File Management Systems), DBMS (Data Base Management Systems), etc.

While this chapter is concerned with the flexible type of package, all the following are, of course, essentially only specialised versions of database management and information retrieval packages:

purchase and sales ledger packages – designed to hold information on the financial transactions of a company with its suppliers/customers for goods and services received/supplied (see Chapter 6)

stock control packages – designed specifically to store information

on stocked items and products, and to permit the normal transactions that take place such as allocations, withdrawals, receipts, etc. (see Chapter 7)

payroll packages — designed to hold information on employees and to maintain and record details of remuneration, PAYE tax contributions and other monetary deductions (see Chapter 8)

Such specialised, proprietary packages have a fixed record design or format and the method by which transactions are performed with those records is correspondingly restricted. Nevertheless, the software houses designing these packages naturally design them to be suitable for as many practical applications as possible.

When such proprietary packages prove unsuitable in a particular situation or when the area of application is so unusual that the software houses have not produced a relevant package, a flexible database management and information retrieval package may well come in useful. Certainly, there are more than enough such packages on the market. Some of those currently available are PETAID, DMS, OZZ, ADMINISTRATOR, FILEPROG, COMBIS, CORP, MANAGER, CONTROL, FMS-80, dBASE II, CONDOR, RL-1 and System Builder.

Most of the earlier examples shown in this chapter were generated using PETAID, developed by Stage One Computers of Bournemouth who claim that 500 copies of the package are now in use since its launch two years ago. Later examples were generated using dBASE II developed by Ashton-Tate Inc. of Los Angeles.

Flexible database management and information retrieval packages essentially allow a user to:

design the format of an individual record

create a file of many records based on that single record format

allow access to and from those filed records for information transactions

produce reports on information taken from all (or some) filed records

allow filed records to be sorted numerically or alphabetically

allow searches to be performed for records meeting specified criteria

Typical applications of flexible database management and information retrieval microcomputer-based systems are:

establishing personnel files in virtually any type of company or organisation with more than fifty personnel

recording students/fees/courses, etc. in universities and colleges

matching clients to jobs in an employment agency or potential buyers to houses at an estate agent

keeping records of patients/treatment/drugs, etc. in hospitals or clinics and establishing appointment schedules

monitoring mailing lists of customers/clients, directories of telephone extensions, etc.

maintaining lists of equipment purchased indicating date of purchase, supplier, current location, etc.

Database management terminology

To the layman intending to use a microcomputer for database management, it is of paramount importance that the relevant terminology first be understood.

There are essentially four levels of information in a database system.

Characters or bytes. These are essentially either alphabetic (A–Z) or numeric (0–9).

Fields. Several characters make up a data field and data fields can be of the following form:

alphanumeric – containing either alphabetic or numeric characters

numeric – containing only numeric characters. Alphabetic characters are specifically prohibited since it is possible that a numeric field will be used for arithmetic calculations

value – essentially a numeric field but, because it is used for sums of money, numeric data is always held to two decimal places. (Many packages simply offer a numeric field and allow the user to specify the number of decimal places required. If no decimal places are specified it is generally assumed that none are required.)

date – a pre-specified alphanumeric format to represent date, conventionally DD/MM/YY (e.g. 10/11/81) (see Figure 5.2) or DDDMMYYYY (e.g. 10 Nov 1981) or American MMDDYY (e.g. 11/10/81)

key – an alphanumeric field which is used to label (i.e. identify) each record individually

Records. Several fields make up a *record*. A typical record can have from ten to fifty fields, which will be a mixture of alphanumeric, numeric, value and date.

Files. Many records (typically five hundred up to a thousand) make up a file. Files, therefore, consist of records with a common subject.

Since several data files, each containing up to a thousand records, can be stored on a single 5¼ inch microcomputer floppy disk, a physical analogy of a database management storage system could be represented as in Figure 5.1.

Designing the record screen layout or format

The first task in creating an information system based on a microcomputer management and information retrieval package is to design the record screen layout or format. In many packages this is achieved by providing the user with an initially blank computer screen and then, following instructions or prompts which appear at the bottom of the screen, he or she can locate the position of individual data fields and also, where required, the position of the labels or headings associated with those data fields within the screen or record format.

Record screen layout

Figure 5.2 shows how a hypothetical personnel record's screen might appear at the end of the record design stage. Features to note are as follows:

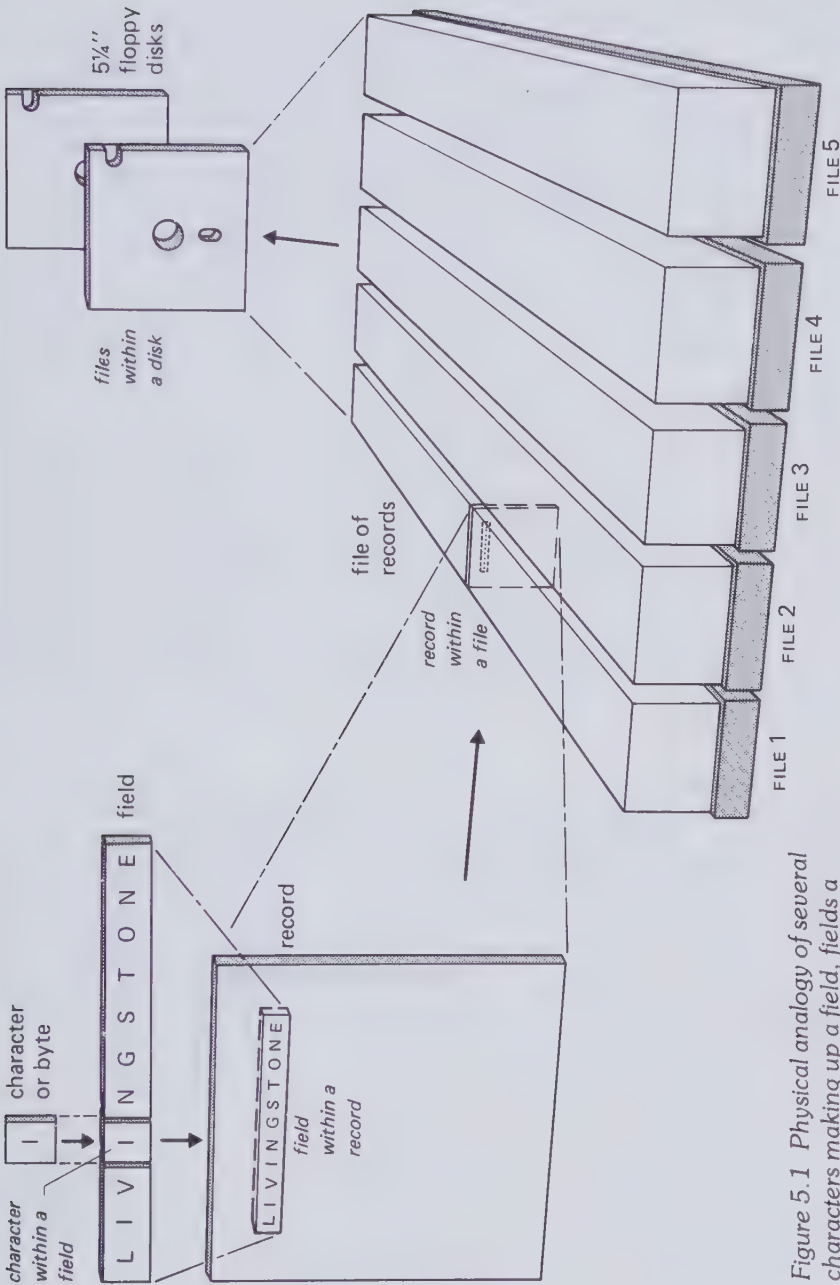


Figure 5.1 Physical analogy of several characters making up a field, fields a record, records a file and files a disk.

Fields. These can be alphanumeric (A), numeric (N), date (DD/MM/YY), value (V) or key.

All records must have at least one *key field*, which is always regarded as being alphanumeric, and is used by the package's management system to identify and, hence, access each record. Depending on the package being used, the key field is either unique, non-unique or the user is allowed a choice. In packages where the key field is *unique*, only one record may have that particular key field (for example, a stock code number). In systems where the key field is *non-unique*, several records may share a key field (for example, a surname). Some packages automatically allocate a number to a record as it is added to the file and use this unique number as the key field.

Titles. While most fields require adjacent titles (or headings) to assist in identification, this is not always necessary. In the example shown, no title is shown for the second and third line of the address. Where titles are shown, it is sometimes possible to show these on the screen either in *reverse video* or at a different light intensity. It may also be possible to expand the reverse video block to improve the overall appearance of the record screen. Whereas normally illuminated characters appear against a dark screen background, in reverse video the immediate background is illuminated and the characters are dark. This produces a highlighting effect on the screen similar to reverse printing on paper, see Figure 5.4.

Multiple screens. Many practical data management systems can operate effectively on records consisting of a single screen. However, in more complex systems, where a considerable amount of information is to be stored per record, several screens may be required to view all the information in a record.

Size restrictions. Within all data management packages there are specified restrictions on the maximum number of:

- bytes (characters) per field

- fields per record

- screens per record

- characters per record

- fields per screen

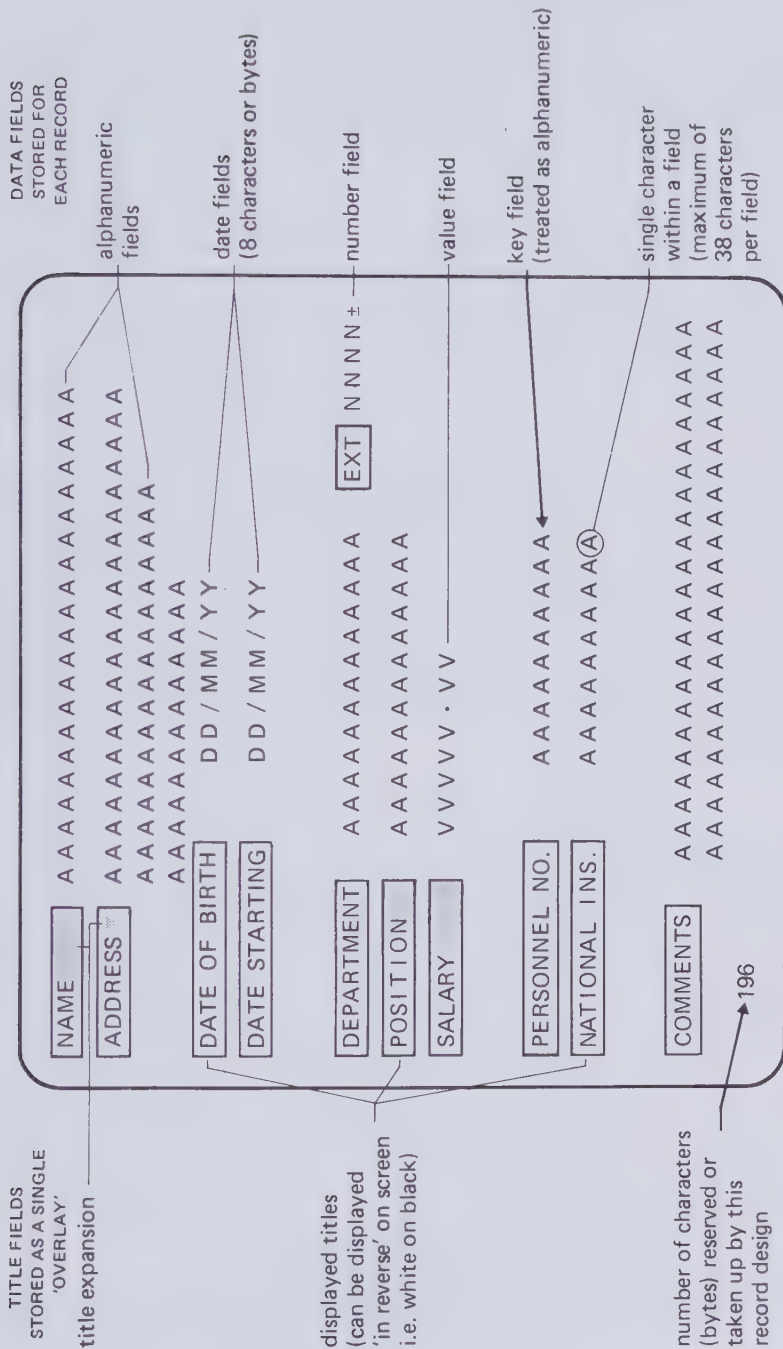


Figure 5.2 Record screen layout.

Size of record. Having completed the design of the record screen(s), it is useful to know how many bytes (characters) have been reserved to represent a single record. For some packages a running total of the bytes used appears on the record screen layout during the design stage, whereas with others it is necessary to calculate the size of the proposed record separately.

Size of file. Because files of records are stored on disk, packages are structured around the size of a disk's *block size* of 256 bytes, and, although in general the bigger the size of record the fewer records can be held per file, this relationship is not strictly linear. When creating a file, the package often calculates the maximum number of records that can be held in the new file to be created using that particular record design.

As an example of this, Figure 5.3 illustrates a simple record design that might be used by an estate agent to store information about houses for sale within a file called Houselist. This particular record design contains 13 data fields (in this case all with titles) and occupies 183 bytes of storage which with the PETAID package, would mean a maximum of 999 records in the Houselist file. Two files of this size could be stored on a 5¼ floppy disk. The user of PETAID has no choice but to create a file capable of holding the maximum specified number of records, whereas in ADMINISTRATOR, for example, a file with fewer records than the maximum can be created.

'Within record' calculations

The estate agent record shown as Figure 5.3 contains 13 fields, all independent of each other, so that information has to be specifically keyed in for each. A slightly more complex record could contain *within record calculations* whereby, for example, the entry in one field could be the product of two other fields. Figure 5.4 is an example of a stock record with four built-in calculations which are:

With VAT = $1.15 \times \text{Sell Price}$

Cost Value = $\text{Cost Price} \times \text{Stock}$

Sell Value = $\text{Sell Price} \times \text{Stock}$

Mark Up = $100 \times (\text{Sell Price}/\text{Cost Price} - 1)$

With such a record design, entries into fields which are calculated as

05/11/81 Example of a record from the Houcelist file

Address :Greenways - "Old Warwick Road
 District :Lapworth
 Asking Price : 76000 Date accepted :09/08/81
 Reception : 3 Bedrooms : 4
 Bathrooms : 2 Garage spaces: 3
 Detached or semi :Det
 Garden(small/medium/large):Large
 Annual rates :865
 Reference No. :S1005 Comments :Rural outlook

Figure 5.3 Example of a simple record design as used by an estate agent (record length 183 bytes).

#####

 #####
 #####
 #####

#####

Green's Pressings Ltd 021-754 6661

: 12.00
 ##### : 13.00 ##### : 14.95

: 65

: 200.00
 ##### : 345.00

: 3.33
 ##### : 00.10.00

Figure 5.4 Example of a record from the file Inventory featuring 'within record' calculations (record length 190 bytes).

functions of other fields are made automatically by the computer when information in these other fields becomes available.

Obviously, in this example, any withdrawal of stock would be entered as a reduction on the Stock figure and would produce an automatic, proportional reduction in the Cost Value and Sell Value figures.

This stock record is marginally larger at 190 bytes than the estate agent record considered previously at 183 bytes. With PETAID, this reduces the maximum number of stock records that can be held in the Inventory file by 37, i.e. from 999 to 962. Readers should note that the number of bytes (characters) occupied by the titles are not stored for each individual record but are held as a single 'overlay' and do not, therefore, effect the size of the file. Thus when designing records, liberal use can be made of titles.

Whilst the calculations which can be performed within a record are not too sophisticated, the following operations are usually available in packages where this facility is provided:

the four standard operators: (+) add or plus, (−) subtract or minus, (/) divide and (∗) multiply

percentage (%) calculates the percentage one field represents of another field

integer part (i) calculates the integer value of a data field

rounding (r) performs rounding on a data field to two decimal places

It was produced on a dot-matrix printer with a reverse printing facility, which in this case has been used for highlighting titles.

Data file on disk and subsequent management facilities

Creation of the data file

Having created a record screen format and appended any 'within record' calculations required, the operator has to create a *blank data file* into which the record information can subsequently be inserted.

If the data to be held on file is confidential, when the data disk is formatted to accept data records, in some packages a *password* to gain

access to the file can be established. This password, which is usually a short alphanumeric field, should not appear on the computer screen when it is keyed in. When creating a password, it is sensible to use an easily remembered set of characters since, although passwords can be changed, one still needs the original password to access this particular facility. With the creation of a data file of the order of a thousand records, each record occupying 200 bytes (or characters), the 200 kbyte file that results will obviously be relatively large and would typically occupy a major portion of a 5¼ inch floppy disk.

In practice, if data from an existing manual recording system is to be transferred to a file held on a microcomputer all at once, it is sensible to estimate in advance how long this is likely to take. A full 200 kbytes of data keyed in at a rate of between 250 and 200 characters per minute (typical operating values) will take 13–17 hours, approximately the equivalent of two or three complete working days!

Sorting

In general, within the main data file, records will be held sequentially in the order they were entered into that file; in other words, the records are held unsorted.

When it is necessary to sort records, one way is simply to create a small *index file* of key fields stored in the order required. Since each record is from the package's point of view identified and accessed by its key field, this is clearly much more economic in storage terms than creating another complete data file with the records sorted. The index file occupies only a small fraction of the storage space required for the related data file. The creation of such an index file called Houseprice is shown diagrammatically in Figure 5.5 and indicates that the key fields (reference numbers) of the records in the data file Houselist are held in the Houseprice index file in descending order of the price field.

Such sorted index files can be based on any field within a record. Where the field being used is alphanumeric, sorting is performed alphabetically. When the value of a field within a particular record is changed and that field has been used previously to create an index file, should the change of value change the sorted order a well designed package will automatically change the order of the index file. New records added to the file can be similarly accommodated. Not all packages are capable of doing this.

Most packages offer a summary printed reporting facility to indicate the sorted order of the index file. This is usually only a very limited report (see page 102 for a description of complete report printing

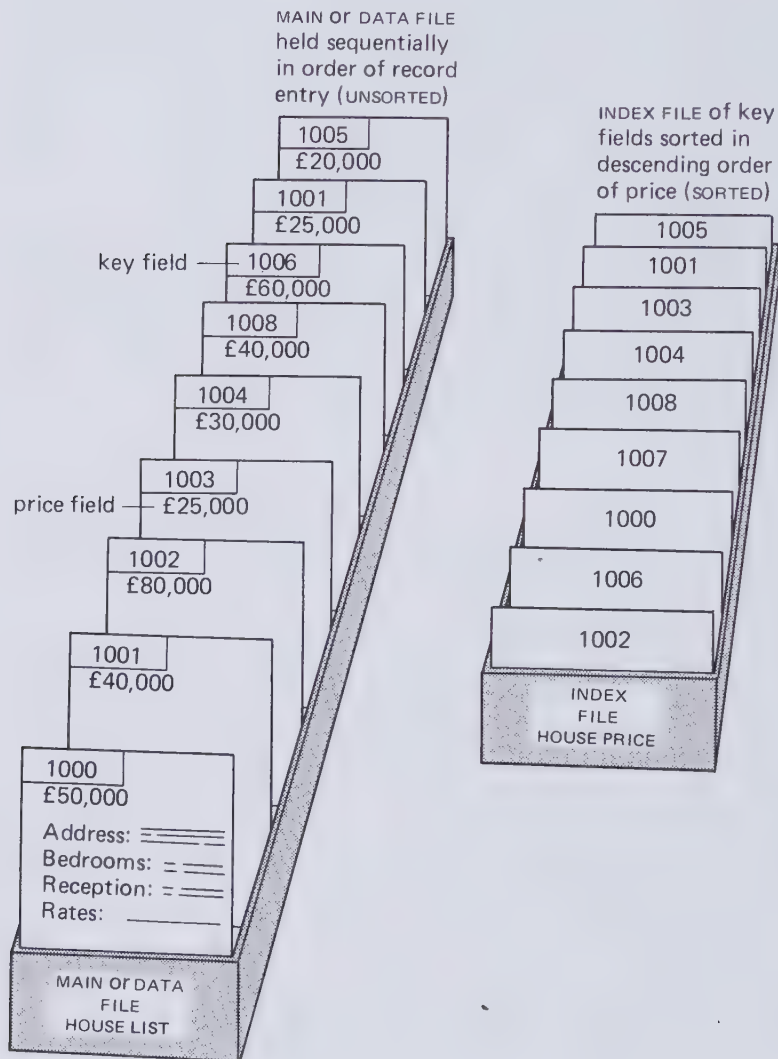


Figure 5.5 Diagrammatic representation of an unsorted data file and a sorted index file.

facilities) and in the case of PETAID the user is allowed to print just two fields, one of which would usually be the field on which the index file was sorted.

Figure 5.6 shows four such *index prints* for a data file Inventory. The record design was shown as Figure 5.4. These four index prints show the stock code sequence of:

- the original unsorted file Inventory (top left), unsorted meaning in this case that records are held in the order they were entered

- an index file Sellvalue sorted in ascending order on the field Sell Value (top right)

- an index file Description sorted in alphabetical order on the field Primary Description (bottom left)

- an index file Location sorted alphabetically on the field Store's Location, showing north, west, etc. (bottom right)

In those packages where it is possible to sort successively on different fields, it is important to sort on the *least important field first* and the most important last. Thus for this book's index, which was sorted using dBASE II, items were originally sorted by page number and subsequently alphabetically so that, for instance, the many occurrences in the manuscript of 'printer — dot matrix' were first ordered by page number and then collected together as one entry by the alphabetic sort.

Searching for particular records

After the creation of the data file, all database management and information retrieval packages allow the user to search through the data file to select records. This can be done either by 'nudging' or 'skipping' manually through sorted or unsorted files or by selecting records which meet either a single criterion or multiple criteria.

Search criteria can be set up using logical AND, NOT and OR functions together with criteria such as those shown in Table 5.1.

Search criteria, once created, can often be named and stored as a search criteria file. This saves the user setting them on each occasion which can be an advantage if the same ones are likely to be used again and again.

Records in a data file can be searched unsorted or sorted. If a sorted search is wanted, there must already be a named index file.

When searching for certain records in a data file, the user can typically:

INDEX PRINT

Data Filename : Inventory

Index Filename : Inventory

Date : 09/09/81

Unsorted

Stock Code	Primary Description

a43435	Flange
a73575	Castina
f34343	Flange
h64646	Nut
f45454	Manual
a65657	Bracket
a45454	Flange
a454541	Bracket
h45454	Nut
a45454	Castina
f46464	Flange
a76767	Bracket
b56565	Bracket
f676760	Castina
a97979	Bolt
h67676	Bracket
h78787	Nut
a20021	Bolt
a2002	Castina
a1000	Castina

INDEX PRINT

Data Filename : Inventory

Index Filename : Description

Date : 09/09/81

Primary Description	Stock Code

Bolt	a97979
Bolt	a20021
Bracket	b56565
Bracket	a76767
Bracket	a454541
Bracket	a65657
Bracket	h67676
Castina	a2003
Castina	a45454
Castina	f676760
Castina	a73575
Castina	a1000
Flange	a45454
Flange	f46464
Flange	a43435
Flange	f34343
Manual	f45454
Nut	h45454
Nut	h78787
Nut	h64646

INDEX PRINT

Data Filename : Inventory

Index Filename : Sellvalue

Date : 09/09/81

Sell Value	Stock Code

20.00	f45454
180.00	h64646
196.00	a97979
240.00	h78787
408.00	a45454
427.00	h45454
440.00	a45454
476.00	a454541
675.00	a43435
675.00	f34343
784.00	b56565
810.00	h67676
845.00	a65657
1064.00	f46464
1216.00	a2003
1380.00	a73575
1620.00	f676760
1640.00	a1000
2040.00	a76767
3600.00	a20021

INDEX PRINT

Data Filename : Inventory

Index Filename : Location

Date : 09/09/81

Store's Location	Stock Code

no	h64646
no	a97979
no	a43435
no	a1000
no	f34343
no	f45454
no	a45454
no	b56565
no	h45454
no	a2003
no	a45454
no	h78787
no	f46464
no	a76767
no	h676760
no	a454541
no	a73575
no	a65657
no	a20021
no	h67676

Figure 5.6 Examples of index file listings, sorted and unsorted.

Table 5.1 Search criteria

	Alphanumeric/key	Numeric/value	Date
Equal to, e.g.	= Lapworth	= 100	= 12/11/81
Greater than, e.g.	> Lapworth	> 100	> 12/11/81
Less than, e.g.	< Lapworth	< 100	< 12/11/81
Greater than (after for alphanumeric) or equal to, e.g.	≥ Lapworth	≥ 100	≥ 12/11/81
Less than (before for alphanumeric) or equal to, e.g.	≤ Lapworth	≤ 100	≤ 12/11/81

The occurrence of a particular character in a particular position in a field can also be used. For example, + + + 11 can be used to identify records with a November date within a DD/MM/YY date field (since the 11 field, coincides with the MM field, uniquely identifies the month of November).

print all records meeting the search criterion

view all records meeting the search criterion

view all records meeting the search criterion and print only those selected by the user

Figures 5.7a and 5.7b show the results of two searches conducted on the Houselist file. Figure 5.7a uses the simple criterion of searching for any houses on file before the date 09/07/81 – the type of criterion an estate agent might well use to identify houses which had been on his books for a long time. In this case a sorted index file was not used, the unsorted data file was searched, although the records will, of course, be shown in ascending order of date accepted simply because the records were originally entered and, therefore, stored in that order.

Figure 5.7b is the result of a search through the same Houselist file but in this case sorted on the field Asking Price. In this case the two records that have been found meet the criterion that the Asking Price should be greater than £50,000 and that the District is (equal to) Lapworth. Such a search criterion could be used to match houses to a relatively affluent prospective purchaser! Since the sorted index file was used the houses appear in ascending order of asking price.

```
11/10/81 Houses on file since before 09/07/81

Address           :567 Warwick Road
District          :Solihull Wood
Asking Price      : 45000   Date accepted :09/06/81
Reception : 2           Bedrooms : 3
Bathrooms : 1           Garage spaces: 0
Detached or semi :Semi
Garden(small/medium/large):Small
Annual rates :412
Reference No. :S1008   Comments :Older terraced property
```

```
Address           :65 Bermuda Avenue
District          :Sheldon
Asking Price      : 45000   Date accepted :08/07/81
Reception : 2           Bedrooms : 3
Bathrooms : 1           Garage spaces: 0
Detached or semi :Semi
Garden(small/medium/large):Small
Annual rates :389
Reference No. :S1012   Comments :Suitable first time buyer
```

Figure 5.7a Example of a record search within an unsorted Houselist file for houses meeting a single criterion of date.

Report writing

So far in this chapter we have discussed the design of a record, the creation of a data file of many records and the subsequent management of those records. In addition to these *record handling* facilities,

11/10/81 Houses above 50000 in Larpworth in Price order

Address :Greenways - Old Warwick Road
 District :Larpworth
 Asking Price : 75000 Date accepted :09/08/81
 Reception : 3 Bedrooms : 4
 Bathrooms : 2 Garage spaces: 3
 Detached or semi :Det
 Garden(small/medium/large):Large
 Annual rates :865
 Reference No. :S1005 Comments :Rural outlook

Address :Blenheim - Coeswood Road
 District :Larpworth
 Asking Price : 98000 Date accepted :09/08/81
 Reception : 3 Bedrooms : 4
 Bathrooms : 2 Garage spaces: 3
 Detached or semi :Det
 Garden(small/medium/large):Large
 Annual rates :989
 Reference No. :S1010 Comments :Gentleman's Residence

Figure 5.7b Example of a record search within the Houselist file sorted by value for houses meeting two specified criteria of price and location.

many database management and information retrieval packages also offer a *report writing* facility.

A report is designed to extract information from particular fields on either all or selected records within a data file and to present that information as a printed report. Where numerical data are extracted from

records, it is also possible to perform simple 'within report' calculations on those data in much the same way as for 'within record' calculations (see page 94). The design of the printed report has to be built up by the user and will generally be stored as a *report print control file* for subsequent use. For most reports it will be necessary to extract data from sorted records, hence a report print control file will generally be associated with a particular index file.

Designing the report

When building up the design of a printed report, most database management and information retrieval packages break the report into four elements which are:

Page controls. These specify headings, date, etc. which will appear on every page of the report and also indicate whether pages will be sequentially numbered or not.

Record controls. These specify which record data fields are to be extracted from records within the data file and give instructions as to where, on the page of the report, such fields are to be printed.

If any calculations are to be performed on numeric or value fields, the print control file must include a specification of those calculations, together with instructions as to where the results of those calculations are to be printed.

Subtotal controls. Where subtotals are to be accumulated, the report print control file must specify which numeric or value fields are to be accumulated. Subtotals are usually printed and then set equal to zero when the specified index field changes. Subtotals, therefore, can only be used in reports associated with a sorted index file. Any printing requirements such as the heading SUBTOTAL must also be specified. Because the subtotal control is triggered by a change occurring in a sorted data field, this facility can be used most effectively to *separate sections* of a report, either by printing a separation line of, say, hyphens or even more simply by producing a line space.

Total controls. Where totals are to be accumulated for all records appearing in the printed report, the numeric or value data field to be accumulated must be specified together with any printing requirements, such as TOTAL.

Examples of reports

To illustrate these various facilities as they could appear in printed reports, several examples are reproduced in Figures 5.8 to 5.10 together with comments on which facilities have been used and how.

The telephone extension example in Figure 5.8a illustrates one of the simplest types of report that might be produced. The page controls simply provide an overall heading and column headings. The record controls just extract the name, department and extension fields from each record and print all three on a single line per record. Records are sorted on the surname field, alphabetically. There are no calculations, subtotal or total controls.

Figure 5.8b shows a three-page report extracted from the same telephone extension file used to create Figure 5.8a. In this example the pages have been shortened to form a booklet and can accommodate only a maximum of 23 names per page. The title, column headings and date of issue are repeated on every page and pages are numbered sequentially. While there are no subtotal calculations, because the records are now sorted on the field DEPARTMENT, the subtotal control facility has been used to print a separation line of hyphens each time the DEPARTMENT field changes. The example in Figure 5.9a shows a printed report from the data file Inventory sorted on the field Store's Location (north, west). In this case five fields per record have been extracted which (referring to Figure 5.4) are: Stock Code, Primary Description, Stock, Store's Location and Cost Value. The values of the entities in these fields appear respectively in columns headed CODE, DESCRIPTION, QUANTITY, LOCATION and COST VALUE. The values in this latter column are accumulated as a subtotal which is printed whenever the Store's Location field changes. Apart from these subtotals, there are no further calculations.

Figure 5.9b shows a printed report from the same Inventory file as that used to produce Figure 5.9a but in this case records are sorted on the field Cost Value as might well be used in an ABC or Pareto analysis (see page 164). In this case the cumulative value is calculated as a subtotal printed with each record.

The sales commission example shown in Figure 5.10a illustrates nearly all the facilities available in a report print from a database management and information retrieval package. In this example three fields are extracted from each record (namely Sales Rep, Total and NUMBER) whose format is shown in Figure 5.10b. The fourth figure to be printed per record (i.e. Commission) is calculated automatically as 10 per cent of the Total field. Thus the subtotals represent the com-

TELEPHONE EXTENSIONS --- ALPHABETIC NAME ORDER

NAME	DEPARTMENT	EXTENSION
ANDREWS Mark E	Inspection	654
ANTONY Barry	Production	333
BENNETT David	Production	367
BROWN John G	Sales	165
BUCKLE Sandra (Mrs)	Sales	109
BURCHER Peter	Production	397
BURTON Helen (Miss)	Marketing	421
CALE Ronald	Marketing	444
DAVIES Sharon (Miss)	Sales	123
DIXON Edward J	Administration	707
EDWARDS David S	Administration	721
FREER Gill (Miss)	Purchasing	289
GABOR Peter	Administration	721
GIBBS Neal F	Administration	732
GORDON James G	Administration	721
GRAY Anthony F	Sales	121
GREGORY David	Inspection	654
GRENVILLE Alice (Ms)	Sales	109
GRIMLEY Edward J	Inspection	606
HALL Norman	Inspection	632
HALLAM Geoffrey H	Administration	732
HARRIS David S	Production	305
HARTLEY Jennifer (Ms)	Marketing	490
HIPKISS Jenny (Mrs)	Purchasing	231
ISLIP John D	Production	307
JOHNSON Anne (Miss)	Production	375
JOHNSON Edward K	Production	365
JONES Ann (Mrs)	Inspection	607
LANGLEY Edward	Production Planning	521
LAWRENCE Jane (Mrs)	Administration	747
LEWIS Colin D	Marketing	421
LING Maurice	Production	304
LIVINGSTONE John D	Purchasing	276
MACGREGOR John	Production Planning	521
MACMILLAN Brian L	Production Planning	532
MORRIS Julian D	Production	308
NANSEN Graham F	Sales	174
NICHOLSON Garth H	Production	364
OAKLEY Mark	Sales	109
PHIPPS Gordon L	Production	305
POWELL Graham J	Purchasing	234
PRENTICE Peter G	Administration	777
SANDERSON Andrew G	Production	387
SKINNER Jane (Ms)	Purchasing	254
SMITH James J	Purchasing	264
TAYLOR Brian S	Production Planning	555
WARING Philip A	Purchasing	207
WEBB Kenneth E	Marketing	454
WILLIAMS Graham J	Production	305
WILSON Brian H	Production Planning	532

Figure 5.8a Example of a printed report from a telephone extension file, sorted alphabetically by surname.

Page 1 TELEPHONE EXTENSIONS --- DEPARTMENT ORDER
10/11/81

NAME	DEPARTMENT	EXTENSION
GORDON James B	Administration	721
PRENTICE Peter G	Administration	737
DIXON Edward J	Administration	707
LAWRENCE Jane (Mrs)	Administration	747
EDWARDS David S	Administration	721
HALLAM Geoffrey H	Administration	732
GABOR Peter	Administration	721
GIBBS Neal F	Administration	732

GRIMLEY Edward J	Inspection	635
HALL Norman	Inspection	632
JONES Ann (Mrs)	Inspection	607
GREGORY David	Inspection	654
ANDREWS Mark E	Inspection	654

HARTLEY Jennifer (Ms)	Marketing	490
WEBB Kenneth E	Marketing	454
BURTON Helen (Miss)	Marketing	421
DALE Ronald	Marketing	444
LEWIS Colin D	Marketing	421

SANDERSON Andrew G	Production	387
JOHNSON Edward K	Production	365

Page 2 TELEPHONE EXTENSIONS --- DEPARTMENT ORDER
10/11/81

NAME	DEPARTMENT	EXTENSION
ISLIP John D	Production	387
HARRIS David S	Production	385
PHIPPS Gordon L	Production	385
LING Maurice	Production	384
ANTONY Barry	Production	383
MORRIS Julian D	Production	388
BEHNETT David	Production	367
JOHNSON Anne (Miss)	Production	375
BURCHER Peter	Production	397
NICHOLSON Garth H	Production	364
WILLIAMS Graham J	Production	385

LANGLEY Edward	Production Planning	521
MACMILLAN Brian L	Production Planning	532
TRAYLOR Brian S	Production Planning	555
MACGREGOR John	Production Planning	521
WILSON Brian H	Production Planning	532

LIVINGSTONE John D	Purchasing	276
FREER Gill (Miss)	Purchasing	289
WARING Philip A	Purchasing	297
SMITH James J	Purchasing	264
POWELL Graham J	Purchasing	234

Page 3 TELEPHONE EXTENSIONS --- DEPARTMENT ORDER
10/11/81

NAME	DEPARTMENT	EXTENSION
SKINNER Jane (Ms)	Purchasing	254
HIPKISS Jennie (Mrs)	Purchasing	231

HANSEN Graham F	Sales	174
BROWN John G	Sales	165
DAVIES Sharon (Miss)	Sales	123
GRENVILLE Alice (Ms)	Sales	189
ORACLE Mark	Sales	189
GRAY Anthony F	Sales	121
BUCKLE Sandra (Mrs)	Sales	189

Figure 5.8b Example of a printed report from a telephone extension file, sorted on the field DEPARTMENT and incorporating page headings and separation lines between Departments.

05/11/81

Stocktake by store's location.

CODE	DESCRIPTION	QUANTITY	LOCATION	COST VALUE
h64646	Nut	300	70	150.00
g97979	Bolt	56	70	168.00
g43435	Flange	45	70	585.00
a1000	Casting	40	70	1360.00
f34343	Flange	45	70	585.00
f45454	Manual	4	70	16.00
				2864.00
g45454	Flange	34	WE	340.00
b56565	Bracket	56	WE	672.00
h45454	Nut	700	WE	350.00
a2003	Casting	32	WE	1088.00
a45454	Casting	4	WE	404.00
h78787	Nut	300	WE	210.00
f46464	Flange	56	WE	1008.00
g76767	Bracket	34	WE	1370.00
f67676	Casting	45	WE	1530.00
g45454	Bracket	34	WE	408.00
g73535	Casting	23	WE	1242.00
g65657	Bracket	65	WE	780.00
g20021	Bolt	600	WE	3000.00
h67676	Bracket	54	WE	702.00
				13304.00

Figure 5.9a Example of a printed report from a file Inventory, sorted on Store's Location with subtotals triggered by changes in the Store's Location field.

mission earned by each sales representative and the total the overall commission to be paid. The report presupposes records are sorted alphabetically by sales representatives.

Although not apparent in the printed report itself, another facility that has been used is a search criterion specifying that only quotations with an acceptance date later than 05/09/81 be included. This obviously will ensure that no quotations accepted before that date, for

03/11/81

Listing of all stocked items ordered by cost value.

CODE	DESCRIPTION	COST VALUE	CUMULATIVE VALUE
------	-------------	------------	------------------

f45454	Manual	16.00	16.00
h64646	Nut	150.00	166.00
q97979	Bolt	168.00	334.00
h78787	Nut	210.00	544.00
q45454	Flange	340.00	884.00
h45454	Nut	350.00	1234.00
a45454	Casting	404.00	1638.00
q454541	Bracket	408.00	2046.00
q43435	Flange	585.00	2631.00
f34343	Flange	585.00	3216.00
b56565	Bracket	672.00	3888.00
h67676	Bracket	702.00	4590.00
q65657	Bracket	780.00	5370.00
f46464	Flange	1008.00	6378.00
a2003	Casting	1088.00	7466.00
q73535	Casting	1242.00	8708.00
a1000	Casting	1360.00	10068.00
f676760	Casting	1530.00	11598.00
q76767	Bracket	1870.00	13468.00
q20021	Bolt	3000.00	16468.00

Figure 5.9b Example of a printed report from a stock file, sorted by cost value and with a cumulative running total.

which commission has already been paid, or quotations which have yet to be accepted are included in the report. The quotation record shown in Figure 5.10b (to indicate the type of record on which the report was based) appears as the first commission due to sales representative FIN since the acceptance date for this quote was 20/10/81.

Other facilities

Global or selective record transactions

Another facility available on many database management and information retrieval packages is the ability to alter numeric or value fields on all, or selected, records. Thus, for example, all *price* fields on all records could be increased (or, less likely, decreased) by 10 per cent.

05/11/81

SALES REP'S COMMISSION FOR LAST 2 MONTHS

SALES REP	TOTAL	INV.NO.	COMMISSION

DGT	895.00	2	89.50
DGT	2205.00	9	220.50
DGT	2205.00	9	220.50
Sub Total			530.50
FIN	2611.10	5	261.11
FIN	105.00	10	10.50
Sub Total			271.61
FNL	34.90	6	3.49
FNL	175.85	8	17.59
FNL	8.11	11	.81
FNL	2144.65	3	214.47
Sub Total			236.36
GHS	2058.30	7	205.83
GHS	142.80	4	14.28
Sub Total			220.11
TOTAL			2171.48

Figure 5.10a Example of a printed report, sorted with commission calculated for each record, subtotalled for each representative and totalled for overall commission to be paid.

QUOTATION

NUMBER :0005

DATE :17/09/81

From,	For,
Bloggs & Co. Ltd.	CMS Ltd
Southern Avenue	20 Universe Rd
Birmingham B4 1ST	Bromley, Kent

QTY	DESCRIPTION	PRICE	
1	8032 Computer	895.00	895.00
1	8050 Dual Disc Driv	895.00	895.00
1	Aculab 1 Interface	90.00	90.00
1	Anadex Printer DP95	999.00	999.00

	Sub Total	2879.00
10 %Discount		287.90
Carriage		20.00

Sales Rep
FIN

Total 2611.10

Date Accepted VAT 391.66

20/10/81 INVOICE TOTAL 3002.76

Figure 5.10b Example of a record from a quotations file (record length 508 bytes).

An example of this is shown in Figure 5.11 using the package dBASE II and the keyed in instruction:

REPLACE ALL PRICE WITH PRICE*1.1

where ALL means all records and PRICE is the field to be changed.

A further sophistication offered by this package, also illustrated, is *selective transactions*. The instruction:

REPLACE FOR SIZE = "EIGHT INCH" PRICE WITH PRICE + .10

increases the price of only the eight inch disks by a further 10p.

PRICE LIST FOR FIVE AND EIGHT INCH FLOPPY DISKS

SIZE	DENSITY	SIDED	CODE:NO	PRICE
FIVE INCH	SINGLE	SINGLE	M11A411X	1.50
FIVE INCH	DOUBLE	SINGLE	M13A411X	1.66
FIVE INCH	DOUBLE	DOUBLE	M14A411X	1.82
FIVE INCH	DOUBLE	SINGLE	M15A411X	1.50
FIVE INCH	DOUBLE	DOUBLE	M16A411X	1.63
EIGHT INCH	SINGLE	SINGLE	F11A211X	1.50
EIGHT INCH	DOUBLE	SINGLE	F13A211X	1.84
EIGHT INCH	SINGLE	DOUBLE	F12A211X	1.91
EIGHT INCH	DOUBLE	DOUBLE	F14A211X	2.00

. REPLACE ALL PRICE WITH PRICE*1.1

00009 REPLACEMENT(S)

. REPORT FORM DISKPRICE

PRICE LIST FOR FIVE AND EIGHT INCH FLOPPY DISKS

SIZE	DENSITY	SIDED	CODE:NO	PRICE
FIVE INCH	SINGLE	SINGLE	M11A411X	1.65
FIVE INCH	DOUBLE	SINGLE	M13A411X	1.82
FIVE INCH	DOUBLE	DOUBLE	M14A411X	2.00
FIVE INCH	DOUBLE	SINGLE	M15A411X	1.65
FIVE INCH	DOUBLE	DOUBLE	M16A411X	1.79
EIGHT INCH	SINGLE	SINGLE	F11A211X	1.65
EIGHT INCH	DOUBLE	SINGLE	F13A211X	2.02
EIGHT INCH	SINGLE	DOUBLE	F12A211X	2.10
EIGHT INCH	DOUBLE	DOUBLE	F14A211X	2.20

. REPLACE FOR SIZE="EIGHT INCH" PRICE WITH PRICE+.10

00004 REPLACEMENT(S)

. REPORT FORM DISKPRICE

PRICE LIST FOR FIVE AND EIGHT INCH FLOPPY DISKS

SIZE	DENSITY	SIDED	CODE:NO	PRICE
FIVE INCH	SINGLE	SINGLE	M11A411X	1.65
FIVE INCH	DOUBLE	SINGLE	M13A411X	1.82
FIVE INCH	DOUBLE	DOUBLE	M14A411X	2.00
FIVE INCH	DOUBLE	SINGLE	M15A411X	1.65
FIVE INCH	DOUBLE	DOUBLE	M16A411X	1.79
EIGHT INCH	SINGLE	SINGLE	F11A211X	1.75
EIGHT INCH	DOUBLE	SINGLE	F13A211X	2.12
EIGHT INCH	SINGLE	DOUBLE	F12A211X	2.20
EIGHT INCH	DOUBLE	DOUBLE	F14A211X	2.30

Figure 5.11 Example of non-selective and selective transactions on record fields.

Macro programming

A few database management and information retrieval packages offer a very powerful facility known as macro programming, which allows the user to write programs made up of many instructions, each of which would normally have to be an individually keyed in instruction. Hence the instruction:

```
REPLACE ALL PRICE WITH PRICE*1.1
```

which was keyed into the computer to produce part of Figure 5.11 although *one* instruction at the macro level would, however, be automatically translated into *many* instructions at the normal higher language level (such as BASIC) or at assembly language level (for language levels, see page 29).

This macro programming facility is a powerful tool which can be used to design bespoke database applications much more rapidly than by using a normal higher level language such as BASIC. The advantage is illustrated in the following example using the dBASE II macro programming facility.

Consider the following four-instruction program:

```
USE DFILE INDEX DFIND
```

```
ERASE
```

```
REPLACE ALL PRICE WITH PRICE*1.1
```

```
DISPLAY ALL FOR PRICE >10.00 .AND. PRICE < 100
```

This simple little program instructs the computer to use a database file (DFILE) whose records are sorted in alphabetic order on a field specified by an index file (DFIND) and then proceeds to clear the VDU screen, increase all the price fields in all records by 10 per cent and then display on the screen all those records whose resultant price field is greater than 10 and less than 100. To write a program in BASIC to achieve the same result would require perhaps 30 instructions as opposed to the four used here.

Figure 5.12 illustrates the type of database system that can be designed using a macro system. In this particular example, which is arranged to maintain a company's telephone extension list, the user is always referred back to a simple four-option menu which allows the user to:

- 0 list the directory
- 1 add new records to the directory
- 2 delete records from the directory
- 3 alter existing records in the directory

Throughout the example the operator's responses are underlined. The initial response, 0, produces a listing of the current records. The next response, 1, allows the user to add a record for a D. F. James who has joined the PERSONNEL department and has been allocated extension number 274.

To delete all the records associated with extension 555, the operator keys in '2' to access the delete records facility and a subsequent '2' to indicate it is records linked to an EXTENSION (rather than a NAMED person) that are to be deleted. The macro program then requests the EXTENSION NUMBER and, given the response 555, identifies all the records associated with that extension and deletes them when a confirmatory Y is keyed in by the operator.

To alter an existing record, the operator responds to the menu with 3 and inadvertently keys in BROWN rather than the surname required which is BROWNLY. Since that search criterion finds two records, the operator can identify the particular record required by keying in its number, 12. To re-assure operator, the selected record is displayed and the field to be changed requested. In this case the EXTENSION number is changed from 432 to 423 and the altered record displayed. A final response of 0 re-lists the directory and confirms that all the alterations/deletions/additions have been made correctly and that records have been kept in departmental alphabetic order.

The macro program to achieve this directory maintenance system consists of only some sixty instructions.

Conclusion

The facilities of database management and information retrieval packages illustrated in this chapter are typical of many such packages. Some do have fewer facilities; and only a few, such as dBASE II, allow the user to write macro programs where instructions like CREATE (create a file), SORT, APPEND, etc. can be used within a program in much the same way as the much simpler statements are used in a BASIC program. This macro programming facility offers exciting possibilities for management applications. However, they are normally

the province of the professional systems analyst or programmer and only occasionally of the enthusiastic manager.

Database management and information retrieval packages form the basis of many applications of microcomputers. The flexible type of proprietary package discussed here could be used far more widely were it not for the average user's preconceived fear that the design procedure involved is too complex. It is hoped that this chapter has, at least partially, dispelled that fear.

Before deciding to buy a flexible form of database management and information retrieval package, as opposed to a package tailored to a specific application consider the following:

is the application so specific as to require a bespoke system designed around a flexible package? For most stock control, sales/purchase ledger and payroll applications a specially designed, proprietary package is usually more appropriate

are there further applications to which such a flexible package could be put to make it more cost effective?

More specifically:

can the data stored on records within a file remain confidential, i.e. is there a password control?

is the key field unique or non-unique? The former is preferable for efficiency, the latter if personnel records, etc. based on surnames are to be used

can the number of records within a file be specified and is the maximum number of records per file acceptable for the particular application?

if a lot of information has to be stored per record, how many bytes (characters) per record can be stored, and how much information can sensibly be stored on the first screen before one has to resort to a multiple screen record?

is a report printing facility available and what range of facilities does it offer? To reduce the purchase price for users not requiring report printing, some packages are offered without a report generator facility

DO MENU
 DIRECTORY MAINTENANCE
 *** MAIN MENU ***

- 0 - LIST DIRECTORY
- 1 - ADD NEW RECORDS
- 2 - DELETE CURRENT RECORDS
- 3 - ALTER EXISTING RECORDS

WAITING INSTRUCTION

WAITING 0

00013	DAVISON G H	ACCOUNTS	721
00017	WILLIAMS G S	ACCOUNTS	649
00019	SMITH Y (MISS)	ACCOUNTS	407
00006	LEWIS C D	INSPECTION	723
00018	SMITH D H	INSPECTION	640
00010	JAMESON F T	PERSONNEL	653
00021	CHAMBERS J J	PERSONNEL	657
00001	BROWN R G	PRODUCTION	345
00014	ASHID T F	PRODUCTION	555
00015	PIPER T F	PRODUCTION	921
00016	SMITH F S	PRODUCTION	555
00024	SINDEN D F	PRODUCTION	290
00025	EVERSFIELD D S	PRODUCTION	555
00009	RANKIN G H	PURCHASING	386
00012	BROWNLY A	PURCHASING	432
00022	BOLTON A	REGISTRY	412

WAITING 1

Enter 0 to exit

Enter SURNAME I I: JAMES D FEnter DEPARTMENT: PERSONNELEnter EXTENSION NO.: 274Are all fields correct?: Y

Figure 5.12 Printout from a database macro program menu (operator's responses underlined)

WAITING 2
Enter 0 to exit

Enter 1 to delete a NAMED record
Enter 2 to delete all records
sharing a single EXTENSION number

WAITING 2
EXTENSION NUMBER to be deleted:555

00014	ASHID T F	PRODUCTION	555
00016	SMITH F S	PRODUCTION	555
00025	EVERSFIELD D S	PRODUCTION	555

DELETE?Y

WAITING 3
Enter 0 to exit

Enter SURNAME of persons
record to be changed:BROWN

These are all the records with that SURNAME

00001	BROWN R G	PRODUCTION	345
00012	BROWNLY G A	PURCHASING	432

Enter NUMBER of record
to be altered if MORE than one, OR
if ONLY one record listed, key in
that records number
:12

00012	BROWNLY G A	PURCHASING	432
-------	-------------	------------	-----

Which FIELD do you want to alter
DEPARTMENT - D or EXTENSION - E?

WAITING E
New EXTENSION number:423

The new record is now as shown below

00012	BROWNLY G A	PURCHASING	423
-------	-------------	------------	-----

WAITING 0

00013	DAVISON G H	ACCOUNTS	721
00017	WILLIAMS G S	ACCOUNTS	649
00019	SMITH Y (MISS)	ACCOUNTS	407
00006	LEWIS C D	INSPECTION	723
00018	SMITH D H	INSPECTION	640
00010	JAMESON F T	PERSONNEL	653
00021	CHAMBERS J J	PERSONNEL	657
00026	JAMES D F	PERSONNEL	274
00001	BROWN R G	PRODUCTION	345
00015	PIPER T F	PRODUCTION	921
00024	SINDEN D F	PRODUCTION	290
00009	RANKIN G H	PURCHASING	386
00012	BROWNLY G A	PURCHASING	423
00022	BOLTON A	REGISTRY	412

Having acquired a flexible database management and information retrieval package, the average user should allow at least a week to become proficient in operating the record design and creating files and, perhaps, a couple of days for the report generator. Proficiency at macro programming, takes considerably longer.

CHAPTER 6

Sales, Purchase and Nominal Ledger

Ledger systems

The 1981/82 survey of microcomputer applications packages available in the UK (Figure 1.16) shows that 31 per cent of all packages deal with the areas of sales ledger (9 per cent), purchase ledger (9 per cent), general ledger (7 per cent) or integrated accounts (6 per cent). This preponderance of accounting packages is hardly surprising, since the efficient control of the money flowing into and out of a company is common to all business enterprises, even to companies that hold no stock whatsoever.

An integrated ledger package (that is, linked sales, purchase and nominal ledgers) can either stand alone or can itself be integrated with a stock control system. Where a package is designed to combine an integrated ledger system with stock control, the ledger system usually becomes a sub-system to the stock control system, simply because stock transactions normally occur every day, while the clearance of sales and purchase invoices is less frequent. Since the application of microcomputers to stock control is discussed fully in Chapter 7, this chapter deals only with ledger systems.

In practice ledger packages can be operated as:

- stand-alone sales ledger

- stand-alone purchase ledger

- sales and nominal ledger

- purchase and nominal ledger, or

- integrated ledger (sales, purchase and nominal ledger)

- stand-alone nominal ledger (occasionally used by such organisations as charities)

The above list is approximately ordered in descending order of usage, showing the stand-alone sales ledger as the most popular.

Function of the nominal ledger

Essentially the nominal ledger holds a series of nominal accounts – specifically nominated by the user – for recording the financial transactions of the company, the information thereafter being used as a basis for the preparation of financial statements. Typical categories of nominal accounts, which would apply to the majority of companies, are:

- fixed assets
- current assets
- current liabilities
- long-term liabilities
- expenditure
- revenue
- trading account

More specific nominal accounts, which could apply to a company involved in selling microcomputers, might be:

- sales of hardware
- sales of software
- sales of supplies
- sales of books
- stock purchases etc.

A principal function of accounts in the nominal ledger is to maintain a financial record of the company's functions, for example, raising invoices to indicate indebtedness of customers via the sales ledger or to record liabilities for the receipt of goods and services from suppliers via the purchase ledger.

Thus a simple *sales invoice* comprising:

- a sales price of goods and services
- VAT on the sales price
- carriage for the goods

would generate three separate credit entries to the following nominal revenue accounts held in the nominal ledger, namely:

sales of goods (which could be broken down further into sales of specific goods)

VAT on sales

carriage on sales

To achieve this allocation of funds to the nominal ledger, each item on the sales invoice needs to be identified with its respective nominal account.

At the same time as these individual nominal revenue accounts are credited, to maintain a balance, the nominal debtor account must be debited by the total value of the sales invoice.

A similar procedure applies to the processing of *purchase invoices* received from suppliers of goods and services. Debited entries are made to particular nominal expenditure accounts, such as:

purchase of goods and services

VAT on purchases

carriage on purchases

while simultaneously the nominal creditor account is credited with the total value of the purchase invoice to maintain the balance of the nominal ledger.

In addition to receiving money from the sales ledger and sending money to the purchase ledger, certain transactions occur *directly with the nominal ledger*, such as those concerning:

rent and rates

light and heat

capital

auditing, etc.

These are often referred to as 'journal postings'.

The nominal ledger, therefore, integrates the sales and purchase ledgers and also maintains a record of all other financial transactions. Because a nominal ledger always operates a conventional 'double entry' method of accounting, it always maintains a balance between debits and credits.

Many companies operating a manual ledger system (particularly smaller companies) do not integrate their sales and purchase ledger with a nominal ledger simply because of the manual effort involved.

Since the transference of information to a nominal ledger is so much simpler within a computerised system, many such companies are now tending to opt for integration with a nominal ledger when transferring from a manual system.

Function of the sales ledger

The sales ledger is essentially a file of all customers' accounts and as such maintains records of:

- invoices sent to customers
- credit allowed to customers
- payments received from customers
- credit notes sent to customers (e.g., for goods damaged in transit, etc.)
- discounts (to cope with optional discounts, etc.)
- direct entries (to cover bad debts, etc.)

Some sales ledger packages assume that invoices are raised manually and that the sales ledger simply records the transaction specified by those already raised invoices. Increasingly, however, sales ledger packages are incorporating invoicing routines which allow the user to create invoices on the computer screen, to print a batch of them (with several copies if required) and to post information from those invoices to the respective accounts in the sales and nominal ledger.

As well as maintaining customer accounts, from which statements can be derived for printing and posting, the sales ledger can produce summaries of credit allowed to customers (*aged debtor reports*) and also an analysis of sales. It also has a controlling function since it provides the nominal ledger with debtor's figures.

Function of the purchase ledger

The purchase ledger is essentially a file of all suppliers' accounts and as such it maintains records of:

- invoices received from suppliers
- credit allowed by suppliers

payments to suppliers

credit notes sent to customers (e.g., for goods damaged in transit, etc.)

As well as maintaining supplier accounts, from which statements can be derived to check customer statements sent by suppliers, the purchase ledger can produce summaries of credit allowed by suppliers (*aged creditor reports*) and also an analysis of purchases made.

Integrated ledger applications packages

A fully integrated ledger package combines the functions of sales, purchase and nominal ledgers. A diagrammatic representation of the files of records held by a microcomputer for such an integrated system, together with the transactions between the company and its customers and suppliers is shown in Figure 6.1.

The particular integrated ledger package used in this chapter is known as GBS and was developed by Bytesoft Systems Limited of Leicester, a member of the Byteshop Group. GBS can either stand alone as an integrated ledger system or can be used as a ledger sub-system within an integrated stock and ledger package known as ISL. Both packages can be tailored to run on any microcomputer using a CP/M operating system.

On a 64 kbyte microcomputer the capacity of GBS is:

400 sales or customer accounts

2000 open sales orders

400 purchase or supplier accounts

2000 open purchase orders

200 nominal ledger accounts

The package is menu driven. The simplest way to explain its operation, therefore, is to move logically through the various options offered by the package via the four principal menus.

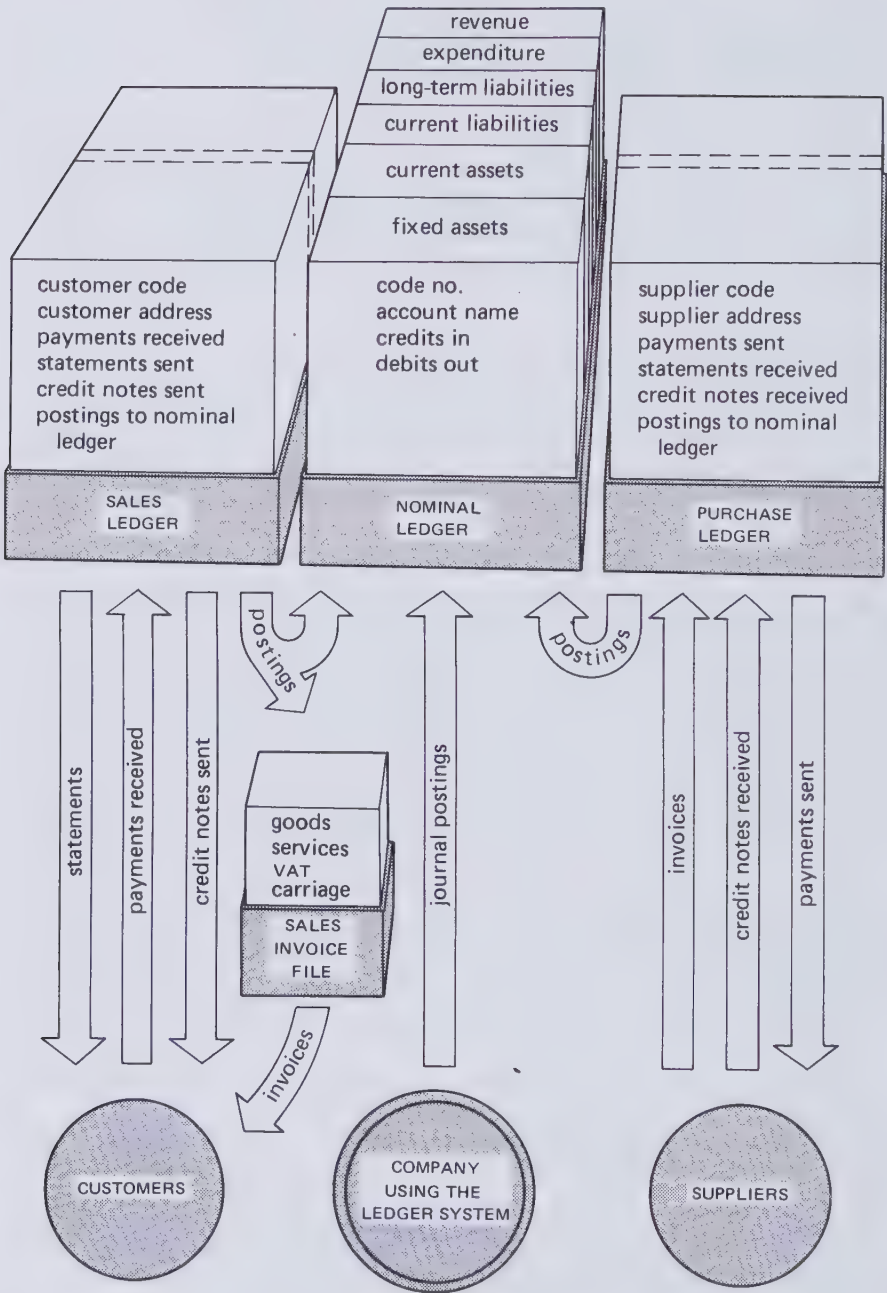


Figure 6.1 Diagrammatic representation of a microcomputer integrated ledger system.

Main menu of the GBS integrated package

The main menu of the GBS integrated ledger applications package offers five options, namely:

- 1 nominal ledger (which in turn offers nominal ledger menu)
- 2 sales ledger (which in turn offers sales ledger menu)
- 3 purchase ledger (which in turn offers purchase ledger menu)
- 4 backup system files
- 5 check system integrity

On start-up the system requires the current date and then expects the user to check the system's integrity by selecting option 5. (Note: later versions perform this check automatically.)

Check system integrity (main menu, option 5)

This is one of the most important facilities of the system. It should be used at each start-up and the resulting *system checkout print*, an example of which is shown as Figure 6.2, should be filed for information. In the case of a crash of the system, details from this checkout will be needed before the system can be resurrected. A software support contract for this package would stipulate that the user retain these checkouts, which are numbered serially to facilitate filing.

The system checkout takes about one minute to run and essentially checks the validity of all records and carries out certain book-keeping checks for example, the 'total owing' balance of the sales ledger should equal the 'debtors' balance of the nominal ledger and 'total owed' balance of the purchase ledger should equal the 'creditors' balance of the nominal ledger.

As Figure 6.2 shows, the system checkout print indicates the percentage of each file already occupied by data and also the numbers of the last sales invoice, purchase invoice etc. This ensures that the user is aware at exactly what stage the last series of transactions occurred.

Backup system files (main menu, option 4)

This facility allows the user to produce backup disks regularly. When the backup disk has been produced, the user is advised to operate with

=====			
BYTESOFT GENERAL BUSINESS SYSTEM			
SYSTEM CHECKOUT No. 37			
=====			
Bykeshop Commuterland			
2b Railway Arches			
Birmingham B5 4TD			18/10/81
=====			
All files are generation 7			
Last Audit (Sales)	10	Last Invoice Audit (Sales)	10
Last journal transaction:	79		
Nominal Ledger	49 recs.	60,783.08	49% full
Nominal statement file	64 recs.		34% full
Last sales inv:	1213	Last sales cash receipt	5
Last sales credit note	0		
Sales Ledger total	16 recs.	29,644.63	15% full
Sales Invoice File	15 recs.	29,644.63	3% full
=====			
SALES/NOMINAL SYSTEM IN BALANCE			
=====			
Last Audit (Purchase)	12	Last Invoice Audit (Purchase)	12
Last purchase inv:	155	Last purchase cash receipt	5
Last purchase credit note	0		
Purchase Ledger total	33 recs.	5,231.77	66% full
Purchase Invoice File	12 recs.	5,231.77	4% full
=====			
PURCHASE/NOMINAL SYSTEM IN BALANCE			

Figure 6.2 Initial system checkout print.

the latest disk, the one just created. This helps cycle the disks rather than using one set continually until a fault occurs. It also ensures that if there have been any copying errors in the backing up procedure, they are detected at once (using the system checkout) rather than days later.

To help the user identify which disk is a backup disk and which an original, the backing up procedure — while otherwise producing an identical copy of data files — updates a *generation number* which uniquely identifies the newly backed-up disk and its sequence relative to other disks.

Following a backing up procedure, the older generation disk, which now becomes the main backup disk, should be safely stored some distance from the microcomputer installation.

The remaining options offered within the main menu, namely nominal ledger (option 1), sales ledger (option 2) and purchase ledger

(option 3) represent the major part of the package and each needs to be discussed in detail. Before proceeding to the discussion of the facilities offered by these three ledger systems, however, we must look at the important concept of the audit trail.

The audit trail

After each session of entering transactions into the integrated ledger package, an audit trail listing all invoices/credit notes/cash payments entered/journal postings made during the session should be produced. With the GBS package this audit trail is automatically printed whenever any transactions are made which affect the balance of the system. The audit trails are numbered and, like system checkouts, should be filed safely. On the next start-up of the system, the last invoice/credit note numbers will be displayed and these should be checked against the most recent audit trail to prevent duplication of postings. The audit trail also displays the brought forward debtors' total, for comparison with the brought forward total of the previous audit trail.

If a user safely retains:

- all backup disks
- all system checkout reports
- all audit trails

the very worst that can happen, in the event of a system crash, is that the information posted during the session in which the crash occurred is lost.

Lest some readers think that the various steps being recommended to avoid disaster are excessive, it should be remembered that company auditors will require hard copy of all the company's transactions when they produce their annual audit.

Nominal ledger (main menu, option 1)

The nominal ledger option offers a menu with eleven further options which are:

- 1 enter journal transactions, print and post
- 2 sort nominal ledger file
- 3 list nominal ledger accounts

- 4 maintain nominal ledger*
- 5 list trial balance*
- 6 list profit and loss account*
- 7 list balance sheet*
- 8 list VAT report
- 9 change password*
- 10 print nominal statements*
- 11 end-of-month processing*

print = print audit trail

post = post to nominal accounts

For security reasons many of the options (those marked with an asterisk) may only be accessed by use of a password. For additional security the password does not appear on the computer's screen when entered, and can be changed from time to time using option 9 which may itself only be accessed by the current password.

The various facilities offered by the nominal ledger are dealt with in the sequence in which they would normally be used.

Maintain the nominal ledger (option 4)

This option allows the user to add new nominal accounts, with their associated codes, to the existing file (up to a maximum of 200) or to delete accounts which are no longer required. However, such accounts can only be deleted when their balance is zero.

The GBS package has six nominal accounts built permanently into the system which are:

100100	debtors
100200	cash at bank
100500	VAT on purchases
200100	creditors
200500	VAT on sales
300100	capital

Each nominal account is uniquely identified by its 6 digit code and these codes are organised in such a way that the first digit indicates the type of account, namely:

000000 – 099999	fixed assets
100000 – 199999	current assets
200000 – 299999	current liabilities
300000 – 399999	long-term liabilities
400000 – 499999	expenditure
500000 – 599999	revenue (i.e. income)

In addition, the last 3 digits in each 6 digit code indicate whether that account is VAT rated:

000 – 899	VAT rated (including zero rated)
900 – 999	exempt from VAT

Thus, for example, a nominal account code 100350 would represent a current asset which, if bought or sold, would be subject to VAT whereas code 400904 would represent an expense which is VAT exempt. It is necessary to distinguish between 'exempt' and 'zero rated'.

The purpose of this nominal account coding system is to enable the package to classify the nominal ledger accounts and determine whether they should appear in the balance sheet (option 7) or the profit and loss account (option 6) and also to determine whether a transaction should be entered into the VAT account, thus enabling the production of a VAT report on demand.

A listing of all nominal accounts and their respective codes can be produced using option 3, see Figure 6.3. Reference to such a listing is always necessary when operating the sales or purchase ledger.

Enter journal transactions (option 1)

This option is used to record the company's financial transactions which are not processed by either the sales or the purchase ledger. Once a suitable set of nominal accounts has been created, this option can be invoked to pay rent, electricity bills, clearing bills, or to record end-of-period adjustments such as depreciation of assets, accrual of rates and so on. This facility must NOT be used for paying suppliers' bills, which must be handled through the purchase ledger; similarly cash received from customers must be put through the sales ledger.

When this option is invoked, the system will list the last journal transactions entered, which should match the last journal transactions noted on the last audit trail.

When making journal transactions direct to the nominal ledger, convention insists that *credits* are made to accounts that *give* and *debits* to

BYTESOFT NOMINAL LEDGER			
NOMINAL ACCOUNTS			
Bykeshop Commuterland			
2b Railway Arches			
Birmingham B5 4TD			
18/10/81			Page 1
1	000010	LEASE	Fixed Assets
2	000020	LEASE IMPROVEMENTS	Fixed Assets
3	000030	FIXTURES & FITTINGS	Fixed Assets
4	000040	OFFICE FURNITURE	Fixed Assets
5	100010	STOCK OF WIDGETS	Current Assets
6	100020	STOCK OF BOOKS	Current Assets
7	100030	STOCK OF PAPER	Current Assets
8	100100	DEBTORS	Current Assets
9	100200	CASH AT BANK	Current Assets
10	100500	VAT ON PURCHASES	Current Assets
11	100600	RENT PAID IN ADVANCE	Current Assets
12	100610	RATES, IN ADVANCE	Current Assets
13	200100	CREDITORS	Current Liabilities
14	200110	DEPOSITS TAKEN	Current Liabilities
15	200500	VAT ON SALES	Current Liabilities
16	200600	PROVISION, TELEPHONE	Current Liabilities
17	200610	PROVISION, PROFESS.	Current Liabilities
18	200620	PROVISION, ELECTRIC.	Current Liabilities
19	200650	PROVISION INCOME TAX	Current Liabilities
20	200700	STOCK SUSPENSE	Current Liabilities
21	300010	CAPITAL	Longterm Liabilities
22	300020	LOANS	Longterm Liabilities
23	400010	WAGES & SALARIES	Expenditure
24	400020	EMPLOYERS' NHI	Expenditure
25	400030	REPAIRS TO WIDGETS	Expenditure
26	400040	COST OF SALES	Expenditure
27	400050	INCOME TAX	Expenditure
28	400070	PETTY CASH	Expenditure
29	400100	ELECTRICITY	Expenditure
30	400110	TELEPHONE	Expenditure
31	400120	ADVERTISING	Expenditure
32	400150	RENT	Expenditure
33	400160	RATES	Expenditure
34	400170	PROFESSIONAL	Expenditure
35	400180	ENTERTAINING	Expenditure
36	400200	DEPRECIATION	Expenditure
37	500010	SALES, BROWN WIDGETS	Revenue
38	500020	SALES, BLUE WIDGETS	Revenue
39	500030	SALES, GREEN WIDGETS	Revenue
40	500040	SALES, BOOKS	Revenue
41	500050	SALES, PAPER ETC.	Revenue
42	500100	HIRE OF WIDGETS	Revenue
43	500110	REPAIRS OF WIDGETS	Revenue
44	500500	DELIVERY	Revenue
45	600010	P&L, BROUGHT FORWARD	Trading Account
46	100620	PETTY CASH FLOAT	Current Assets
47	200700	WORK IN PROGRESS	Current Liabilities
48	500200	MR B CONTRACT	Revenue
49	500210	MR J CONTRACT	Revenue

Figure 6.3 Listing of the nominal accounts.

accounts that *receive*. Hence, for a £250 payment of rent, the cash at bank account is credited with £250 which it then gives to the rent account which receives the £250 as a debit. For the payment of a number of cheques, a series of debits can first be allocated to the receiving accounts (rent, electricity, petty cash, etc.) and covered by a single credit to the donating account (cash at bank).

Debit and credit transactions to the nominal ledger must always balance out and, in fact, this GBS journal transaction option does not permit a batch of journal transactions to be entered unless they do balance. At the end of a batch of journal transactions, an audit trail is automatically printed and the individual transactions are posted to their respective nominal accounts. As added security, if a printer is not connected, or connected but not on-line to the computer, the system is designed not to proceed. It cannot, therefore, accept journal transactions that would have gone unrecorded on hard copy.

Sort nominal ledger file (option 2)

This option sorts nominal accounts into ascending order of the identifying 6 digit code. It is usually only exercised at the beginning, when setting up the accounts in the nominal ledger, but clearly the inclusion of a new account, or the deletion of an existing one, may mean the file needs to be re-sorted.

Readers may note that the nominal accounts listing (Figure 6.3) indicates that four new accounts have recently been added to the end of the nominal ledger which have yet to be re-sorted. Nevertheless, the package will still operate correctly, whether the nominal accounts are sorted into categories or not.

List trial balance (option 5)

This option allows the user to obtain a listing, either on the screen or printer, of the balances of all the nominal accounts other than those with a zero balance. The nominal ledger will ALWAYS be in balance unless affected by some disaster such as a power failure or a corrupted disk.

Figure 6.4, which presents a trial balance from the nominal ledger, shows clearly the balance between the company's debts and credits.

List profit and loss account (option 6)

Assuming that the user of the GBS package has specified the nominal accounts intelligently and has observed the simple rules for classifying

=====			
BYTESOFT NOMINAL LEDGER			
TRIAL BALANCE			
Bykeshop Commuterland			
2b Railway Arches			
Birmingham B5 4TD			
18/10/81			Page 1
=====			
Line	Description	Debits	Credits
=====			
1	LEASE	6,500.00.	.Fixed Assets
3	FIXTURES & FITTINGS	2,775.00.	.Fixed Assets
5	STOCK OF WIDGETS	1,733.80.	.Current Assets
6	STOCK OF BOOKS	7,289.96.	.Current Assets
7	STOCK OF PAPER	4,510.29.	.Current Assets
8	DEBTORS	29,644.63.	.Current Assets
9	CASH AT BANK		20,833.19. Current Assets
10	VAT ON PURCHASES	2,323.50.	.Current Assets
11	RENT PAID IN ADVANCE.	500.00.	.Current Assets
12	RATES, IN ADVANCE	220.00.	.Current Assets
13	CREDITORS		5,231.77. Current Liabilities
14	DEPOSITS TAKEN	200.00.	.Current Liabilities
15	VAT ON SALES		2,207.61. Current Liabilities
16	PROVISION, TELEPHONE.		25.00. Current Liabilities
17	PROVISION, PROFESS.		5.00. Current Liabilities
18	PROVISION, ELECTRIC..		15.00. Current Liabilities
19	PROVISION INCOME TAX.		129.60. Current Liabilities
21	CAPITAL		100.00. Longterm Liabilities
22	LOANS		9,900.00. Longterm Liabilities
23	WAGES & SALARIES	604.70.	.Expenditure
24	EMPLOYERS' NHI	45.20.	.Expenditure
25	REPAIRS TO WIDGETS	102.10.	.Expenditure
26	COST OF SALES	3,402.00.	.Expenditure
28	PETTY CASH	35.70.	.Expenditure
31	ADVERTISING	91.00.	.Expenditure
32	RENT	120.00.	.Expenditure
34	PROFESSIONAL	34.00.	.Expenditure
35	ENTERTAINING	12.78.	.Expenditure
37	SALES, BROWN WIDGETS.		127.10. Revenue
38	SALES, BLUE WIDGETS		123.88. Revenue
39	SALES, GREEN WIDGETS.		1,097.02. Revenue
40	SALES, BOOKS		69.60. Revenue
41	SALES, PAPER ETC.		137.60. Revenue
42	HIRE OF WIDGETS		2,434.00. Revenue
43	REPAIRS OF WIDGETS		112.00. Revenue
44	DELIVERY		62.80. Revenue
45	P&L, BROUGHT FORWARD.		17,391.91. Trading Account
46	PETTY CASH FLOAT	78.42.	.Current Assets
47	WORK IN PROGRESS	580.00.	.Current Liabilities
48	MR B CONTRACT		780.00. Revenue
=====			
Totals:		60,783.08	60,783.08
=====			
=====			

Figure 6.4 Trial balance listing from the nominal ledger.

the nominal codes into revenue, expenditure, fixed assets, current assets, etc., this listing will provide a most useful first attempt at a profit and loss account. Of course, it is most unlikely that such a listing could represent the company's true trading figures, since the company's accountant would almost certainly wish to make adjustments for accruals, depreciation and so on but such a listing does provide an excellent starting point.

The profit and loss account shown in Figure 6.5 is drawn up from the revenue and expenditure accounts of the nominal ledger (see Figure 6.3) and includes figures on a month-to-date (MTD) basis to in-

=====				
BYTESOFT NOMINAL LEDGER				
Profit & Loss Account				
=====				
Bykeshop Commuterland				
2b Railway Arches				
Birmingham B5 4TD				
18/10/81				Page 1
=====				
	-----MTD-----		-----YTD-----	
Revenue		%		%
SALES, BROWN WIDGETS	127.10	2.57	2123.10	5.78
SALES, BLUE WIDGETS	123.88	2.51	625.88	1.70
SALES, GREEN WIDGETS	1097.02	22.19	3523.02	9.60
SALES, BOOKS	69.60	1.41	3157.60	8.60
SALES, PAPER ETC.	137.60	2.78	15512.60	42.26
HIRE OF WIDGETS	2434.00	49.23	8846.00	24.10
REPAIRS OF WIDGETS	112.00	2.27	1600.20	4.36
DELIVERY	62.80	1.27	540.80	1.47
MR B CONTRACT	780.00	15.78	780.00	2.12
	-----		-----	
	4944.00	** 100.00	36709.20	100.00
Expenditure				
WAGES & SALARIES	604.70	12.23	2245.70	6.12
EMPLOYERS' NHI	45.20	.91	88.80	.24
REPAIRS TO WIDGETS	102.10	2.07	247.10	.67
COST OF SALES	3402.00	68.81	14610.30	39.80
INCOME TAX	.00	.00	129.60	.35
PETTY CASH	35.70	.72	164.49	.45
ELECTRICITY	.00	.00	120.00	.33
TELEPHONE	.00	.00	150.00	.41
ADVERTISING	91.00	1.84	261.00	.71
RENT	120.00	2.43	492.00	1.34
RATES	.00	.00	20.00	.05
PROFESSIONAL	34.00	.69	204.00	.56
ENTERTAINING	12.78	.26	12.78	.03
DEPRECIATION	.00	.00	75.00	.20
	-----		-----	
	4447.48	** 89.96	18820.77	51.27
Profit/Loss	496.52	10.04	17888.43	48.73
	4944.00	100.00	36709.20	100.00
=====				

Figure 6.5 Profit and loss account taken from revenue and expenditure accounts in the nominal ledger.

indicate the current trading position, and a year-to-date (YTD) basis to indicate the overall yearly trading position. A useful feature of the print-out is that percentages are evaluated.

List balance sheet (option 7)

Whereas the profit and loss account represents a company's trading position for a specific period and is based on revenue and expenditure accounts, the balance sheet is based on the assets (fixed and current) and liabilities (current and long term) accounts of the nominal ledger.

The balance sheet, therefore, is an indication of a company's long-term financial standing and structure at a particular point in time. Figure 6.6 shows a balance sheet print out from the GBS package, which would again, form a very good basis for a company's accountant to produce a final amended balance sheet.

List VAT (option 8)

This option extracts five quarterly summaries of the company's VAT position as recorded through the VAT rated expenditure and revenue accounts. These will originally have been classified as VAT rated by the selection of the nominal ledger account codes (that is, codes ending 000–899). Figure 6.7 shows the VAT report produced by the GBS package. It could be used as the basis of a company's official VAT return.

Print nominal statements (option 10)

This option allows the user to examine the condition of any of the nominal ledger accounts at any time. The statement simply lists for each account:

- the balance brought forward

- the current month's postings to the account

- the current balance resulting from these two

End-of-month processing (option 11)

For the nominal ledger, the end-of-month processing simply updates the balance brought forward in line with the current month's postings, and then clears the latter. This processing also ages the balance-

=====			
BYTESOFT NOMINAL LEDGER			
BALANCE SHEET			
ByKeshop Commuterland			
2b Railway Arches			
18/10/81 Birmingham B5 4TD			
=====			
Page 1			
=====			
Fixed Assets			
LEASE		6500.00	
FIXTURES & FITTINGS		2775.00	

		9275.00	
Current Assets			
STOCK OF WIDGETS		1733.80	
STOCK OF BOOKS		7269.96	
STOCK OF PAPER		4510.29	
DEBTORS		29644.63	
CASH AT BANK		(20833.19)	
VAT ON PURCHASES		2323.50	
RENT PAID IN ADVANCE		500.00	
RATES, IN ADVANCE		220.00	
PETTY CASH FLOAT		78.42	

		25447.41	
Total Assets		34722.41	***
Current Liabilities			
CREDITORS		5231.77	
DEPOSITS TAKEN		(200.00)	
VAT ON SALES		2207.61	
PROVISION, TELEPHONE		25.00	
PROVISION, PROFESS.		5.00	
PROVISION, ELECTRIC.		15.00	
PROVISION INCOME TAX		129.60	
WORK IN PROGRESS		(580.00)	

		6833.98	
Longterm Liabilities			
CAPITAL	100.00		
P&L, BROUGHT FORWARD	17391.91		
MTD profit	496.52		

		17988.43	
LOANS		9900.00	

		27888.43	
Total Liabilities		34722.41	***
=====			

Figure 6.6 Balance sheet taken from assets, liabilities and trading accounts in the nominal ledger.

brought-forward date by one month (or period). Any reports required from the nominal ledger should obviously be produced before end-of-month processing.

=====					
BYTESOFT NOMINAL LEDGER					
VAT REPORT					
Bykeshop Commuterland					
2b Railway Arches					
Birmingham B5 4TD					
18/10/81					
=====					
Period ending	06/81	09/81	12/81	03/82	06/82
VAT-rated goods bought	.00	4,173.37	301.90	.00	.00
VAT paid out	.00	35.70	22.80	.00	.00
VAT-rated goods sold	.00	16,297.20	4,164.00	.00	.00
VAT collected	.00	.00	573.60	.00	.00
=====					

Figure 6.7 VAT report extracted from VAT rated revenue and expenditure accounts in the nominal ledger.

Sales ledger (main menu, option 2)

The sales ledger option offers a menu with eleven further options which are:

- 1 enter sales invoice transactions, print and post
- 2 enter cash received, print and post
- 3 enter credit notes sent, print and post
- 4 list customers' names and addresses
- 5 maintain customer file
- 6 list aged debtor report
- 7 list customer statements
- 8 end-of-month processing
- 9 sort customer file
- 10 sales analysis
- 11 customer invoice listing

print = print audit trail

post = post to customer account and nominal accounts

The various facilities offered by the sales ledger are dealt with in the sequence in which they would normally be used.

Maintain customer file (option 5)

This option allows the user to:

- create a new customer record
- update existing records with changes (of address, telephone, etc.)
- delete existing customer records (only if the account balance is zero)

As with nominal accounts, each customer record is identified with a six digit code and, whilst it is not necessary to allocate codes to customers in a logical fashion, since the customer records can be sorted in ascending order of the record code using option 9, it is sensible to allocate codes on the basis of some categorisation. It is also possible to create up to ten separate categories of customers by allocating codes in the range 000000–999999 to the first category, 100000–199999 to the second category and so on. Sensible allocation of codes to customer records at the initial stage results in a much meaningful sales analysis report (option 10) because category subtotals can be produced (see page 142).

It should be noted that this option only allows 'static' information such as address, telephone number, contact, etc. to be entered into the customer record. Financial ('live') information can only be entered into the account section of the record via the appropriate invoice transaction or the cash received or credit notes received options – all of which will ensure the printing of an audit trail and also postings of balanced credits and debits to the nominal ledger.

An existing customer record may only be deleted if the account stands at zero. In practice a deleted record will be removed from the sales ledger (and further space made available) when the file is next sorted.

Having created and sorted customer records, option 4 allows the user to print a list of all customers (see Figure 6.8). Such a list is used to identify customers for processing invoices, etc.

Some packages identify customers/suppliers by *alpha-matching* rather than, as here, by unique number codes. Alpha-matching, usually uses the first three characters of a name to identify the required customer/supplier. Although this may make a package appear slightly easier to operate initially, this non-unique coding system does introduce a certain inefficiency into the functioning of the package.

=====

BYTESOFT SALES LEDGER
CUSTOMER LISTING

Bykeshop Commuterland
2b Railway Arches
Birmingham B5 4TD

18/10/81

Page 1

=====

1 100010 HIT & RUN (1980) LTD 5 GAS STREET CHELTENHAM GLOUCS. CE3 4TT 0433-23232	2 200010 JONES THE WIDGET LTD 5 GREEN VALLEY CARDIFF CA4 2SD 054-332-3456
3 200030 SLOWPAY BROS LTD. GOVERNMENT HOUSE PLUSH STREET WIPLEY, CAMBS. 056-789-1111	4 100020 QUALITY CARPETS LTD 119 MAYORS WALK ALLINGTON, NORHTANTS 0332-77668
5 100052 J.T.ASPIN & SON JUBILEE HOUSE ST IVES, CAMBS 0774-99775	6 100060 BAXTON FUELS LTD. SHERWOOD LODGE BENNINGTON, CAMBS 0442-77889
7 100070 LINES COLD STORES TEMPLE MEAD FARLEY, NOTTS 98-66442	8 200030 PETER JONES NURSERIES LTD "ABBEY ROAD KESTEVEN, LINES 0442-54432
9 200050 WHITMORE BUILDERS LTD. 22 WESTBOURNE ROAD STAUGHTON, LEICS 0311-4279	10 200090 MORGAN BROS UNIT 7a LITTLE END, MORETON 3342221
11 300020 BYTESHOP (GRIMSBY) LTD MOUNTAIN WALK GRIMSBY	12 300060 B. HENRY & SON LTD. 14 FOSTER AVENUE, GRANTHAM. LINES.
13 400010 TAYLOR BROS (BUILDERS) THE BUTTERLEYS KIRTON, LINES 0332-12111	14 600030 APRIL COLD STORES LTD 15 MERVIEW ESTATE DODDINGTON, LINES 0665-21334
15 700030 DAMPROOF LTD CHAPEL STREET BUCKDEN, HUNTS 0885-25252	16 700040 JONES & SON FLAGUE HOUSE MORBID ROW 999

=====

Figure 6.8 Customer listing.

Enter sales invoice transactions (option 1)

This option is routinely used to record all manually raised sales invoices sent to customers or, where an automatic facility for raising invoices on the customer is available, retaining details of those invoices.

Before using this option the operator needs:

- a listing of customers' addresses created by option 4 (see Figure 6.8)
- a listing of all nominal accounts created by main menu, option 3 (see Figure 6.3)

As each item of information from a sales invoice is entered it will be necessary to identify which nominal revenue account is to be credited such as:

- sales
- hires
- repairs
- delivery
- VAT on sales etc.

To balance the nominal ledger, the total value of each sales invoice will be debited to the debtors account.

Having identified the customer, the system informs the user of the number of the last sales invoice processed, which should tally with that produced by the last sales invoice audit trail. This check should ensure that sales invoices are never processed twice.

Identification of the customer to whom an invoice is to be sent via his listed identification number produces the following information on the screen:

- customer's name and address (for final identification)
- date and amount of last payment received
- sales turnover, year-to-date

While sales invoices need not be entered in numbered sequence, in practice it is sensible to adopt such a discipline as an additional safeguard against duplicate entries and omissions. As the amount of each item on the sales invoice is entered, together with its associated

nominal revenue account code, the current invoice total will be shown. Should this check total not eventually match that on the manually raised sales invoice, the user can make the requisite alterations or, if the original invoice was incorrect, a corrected invoice can be sent to the customer.

When a batch of sales invoices has been entered, a printed Audit Trail is produced, the customers' accounts debited and appropriate balanced postings made to the nominal ledger (see Table 6.1).

Enter cash received (option 2)

This option allocates cash received from customers against previously posted sales invoices. Once a customer is identified, through his or her number, all the outstanding sales invoices posted to that customer are shown. The computer's cursor can be moved freely over the amounts displayed and with this facility the user can decide which previously invoiced amounts are to be covered by the cash payment received by hitting the 'P' (*post complete*) key when the cursor is opposite an amount to be cleared, or by keying in a specific amount in the case of part-payments.

After this, yet another audit trail will be printed, customers' accounts credited and postings made to the nominal ledger.

Enter credit notes sent (option 3)

This option allows the user to issue credit notes to customers against items identified on previously raised invoices in much the same way as for cash received (option 2).

Table 6.1 summarises how the various accounts in the sales and nominal ledgers should be credited and debited, as a result of the transactions made using options 1, 2 and 3, in what is – in effect – a triple entry accounting system.

List aged debtor report (option 6)

This option produces an extremely useful report which breaks down debtors by age of debt over the last four months. Within the GBS package one can either opt for a complete list of all debtors or a selective list of debtors of more than a certain age (for example, owing over 90 days) or owing more than a certain amount (for example, owing more than £1000). The report also identifies when each debtor's last payment was made. The full aged debtor report, an example of which

is shown in Figure 6.9, also gives the percentage breakdown of the debt over the last four months (the fourth month including debts of four months or older).

Table 6.1 Account transactions for sales and nominal ledgers

		Sales invoice	Payment received	Credit note send
Sales ledger	Customer accounts	debit	credit	credit
Nominal ledger	Sales (revenue)	credit		
Accounts	Bank (current assets)		debit	
	Returns inwards (revenue)			debit
	Debtors (current assets)	debit	credit	credit

=====					
BYTESOFT SALES LEDGER					
AGED DEBTOR REPORT					
Bykeshop Commuterland					
2b Railway Arches					
Birmingham B5 4TD					
18/10/81	File generation 7				PAGE 1
=====					
Name	October	September	August	July+	Total due
=====					
1					
HIT & RUN (1980) LTD	3017.60	.00	.00	572.15	3589.75
(5000.00 paid on 15/10/81)					
2					
JONES THE WIDGET LTD	1720.00	.00	2457.00	2006.83	6183.83
(126.78 paid on 14/05/81)					
3					
SLOWPAY BROS LTD.	.00	.00	1288.20	4509.85	5798.05
6					
BAXTON FUELS LTD.	.00	12552.00	.00	.00	12552.00
16					
JONES & SON	.00	.00	.00	1521.00	1521.00
=====					
Totals:	4,737.60	12,552.00	3,745.20	8,609.83	29,644.63
Percentage breakdown	15.98	42.34	12.63	29.04	100.00
=====					

Figure 6.9 Aged debtor report from the sales ledger.

List customer statements (option 7)

This option allows the user to produce a statement of the current standing of any customer's account. This can be displayed on the computer screen (in response to a customer's telephoned query, for example) or can be printed and sent to the customer (at the end of a month). Statements can be produced either for individually identified customers or for all customers and indicate amounts owed for more than 90 days, 60 – 90 days and currently.

When customer statements are printed, the printing can be tailored to fit either pre-printed continuous stationery or to produce its own letterhead on blank continuous stationery as in the example shown in Figure 6.10.

From discussions with those who have successfully implemented a sales ledger system on a microcomputer, it appears that the greatest boon is the ability to produce all customers' statements in a matter of minutes rather than over several days.

End-of-month processing (option 8)

This option removes all fully cleared sales invoices, payments received and credit notes from the customer accounts in the sales ledger and also ages all debts with respect to the system date. Like most good ledger packages, the GBS system operates around an *open-order* discipline which only allows invoices that have been completely covered by a payment, and which from the system's point of view are therefore now only of 'historic' interest, to be cleared from the account. Readers should be wary of ledger packages which *claim* to be open-order or open-item but are essentially based on a brought forward balance.

Any reports required from the sales ledger should be produced before this option is invoked, as should the monthly backup disk. The GBS end-of-month processing does not produce any printout, but takes several minutes to run as clearances are made and files reorganised.

Sales analysis (option 10)

If a sensible allocation of customer code numbers has been made when establishing customer records (see page 137) the sales contribution of different categories of customers can be readily identified from the customer analysis report produced by this option, an example of which

is shown in Figure 6.11. In this particular example, only four of the possible ten customer categories that can be identified through the code numbering system of the GBS package have been utilised.

Bykeshop Commuterland 2b Railway Arches Birmingham B5 4TD					
STATEMENT					
SLOWPAY EROS LTD. GOVERNMENT HOUSE PLUSH STREET WIPLEY, CAMBS.					19/10/81
=====					
90 Days +	:	4,509.85			
60-90 Days	:	1,288.20			
Current	:	564.80			
				Total due :	6,362.85
Date	Invoice	Amount	Paid	Credited	Balance
06/03/81	3	1,421.40	.00	.00	1,421.40
14/05/81	8	1,843.45	.00	.00	1,843.45
23/03/81	128	1,245.00	.00	.00	1,245.00
31/08/81	2215	1,288.20	.00	.00	1,288.20
18/10/81	734345	564.80	.00	.00	564.80
Please pay this amount.....:					6,362.85

Figure 6.10 Customer statement with printed letterhead.

```
=====
                        BYTESOFT SALES LEDGER
                        CUSTOMER ANALYSIS REPORT

                        Bykeshop Commuterland
                        2b Railway Arches
                        Birmingham B5 4TD

18/10/81                                                    PAGE 1
=====
Customer group                                           Sales for period
=====
100000 to 199999                                           21,165.35
200000 to 299999                                           14,014.66
300000 to 399999                                           1,435.80
700000 to 799999                                           1,521.00
=====
Report total:                                           38,136.81
=====
```

Figure 6.11 Summary of sales made to categories of customer.

Customer invoice listing (option 11)

This option prints a summary listing of all outstanding sales invoices (see Figure 6.12). This would generally be produced only for internal use.

Purchase ledger (main menu, option 3)

The operation of the purchase ledger is similar to the sales ledger (already described) except that it deals with 'purchases' not 'sales', 'suppliers' not 'customers' and 'creditors' rather than 'debtors'. Because the operation of the two ledgers is so similar, I shall merely list the menu of the purchase ledger.

The purchase ledger option offers a menu with eleven further options which are:

- 1 enter purchase invoice transactions, print and post
- 2 enter cash paid, print and post
- 3 enter credit notes received, print and post
- 4 list suppliers' names and addresses
- 5 maintain supplier file
- 6 list aged creditor report
- 7 list supplier statements
- 8 end-of-month processing
- 9 sort supplier file
- 10 purchase analysis
- 11 supplier invoice listing

print = print audit trail

post = post to supplier and nominal accounts

The setting up, and weekly and monthly operations follow the same lines as those of the sales ledger.

Conclusion

This chapter has dealt with the accounting and other facilities offered by a fully integrated ledger package with sales, purchase and nominal ledgers. Where a stand-alone sales or purchase ledger is used, the facilities provided are obviously much the same as the sales and purchase elements of an integrated system. But, as stand-alone ledger

===== BYTESOFT SALES LEDGER CUSTOMER INVOICE LISTING =====			
18/10/81	ByKeshop Commuterland 2b Railway Arches Birmingham B5 4TD		Page 1
	No.	Date	Invoice Amount
HIT & RUN (1980) LTD	1	14/05/81	144 572.15
		15/10/81	1213 3,017.60
			3,589.75 **
JONES THE WIDGET LTD	2	06/03/81	2 17.43
		10/03/81	5 691.27
		22/03/81	7 611.80
		14/05/81	9 418.03
		14/05/81	127 268.30
		24/08/81	1255 2,457.00
		15/10/81	1212 1,720.00
			6,183.83 **
SLOWPAY BROS LTD.	3	06/03/81	3 1,421.40
		14/05/81	8 1,843.45
		23/03/81	128 1,245.00
		31/08/81	2215 1,288.20
			5,798.05 **
BAXTON FUELS LTD.	6	23/09/81	1211 12,552.00
			12,552.00 **
JONES & SON	16	23/03/81	129 1,521.00
			1,521.00 **
			=====
			29,644.63 ***
			=====

Figure 6.12 Listing of outstanding sales invoices.

packages are not required to send postings to a nominal ledger, they are somewhat easier to operate. Invoices are treated as single transactions and do not usually have to be broken down into individual elements.

However, the additional effort required to incorporate a ledger of nominal accounts together with either or both a sales and purchase ledger in a well designed integrated microcomputer package, is well rewarded by the wealth of information as to the operating company's financial structure and standing that it provides.

The practical operation of an integrated ledger system tends to

revolve around daily, weekly and monthly transactions which are typically as follows.

Daily

Maintain sales and purchase ledger, if necessary, by adding any new accounts or changes of address. (It is not necessary to re-sort accounts and, in practice, since the operator(s) of the system generally become accustomed to associating customers and purchasers with particular identifying account numbers it is not sensible to be continually re-sorting and, hence, destroy this relationship.)

Enter sales invoices

Enter credit notes sent

Record cash payments received

Take backup record if frequency of transaction warrants

Weekly

Enter suppliers' (purchase) invoices

Enter credit notes received

Record cash payments made

Enter outstanding journal transactions for petty cash, etc.

Print aged debtor report

Monthly

Print and send all customer statements

Print aged debtor report

Print sales invoice listing

Print sales analysis

Print aged creditor report

Print profit and loss and balance sheet to check for adjustments

Enter journal entries to nominal accounts to adjust

Print final profit and loss report and final balance sheet

Perform end-of-month procedures on all three ledgers. (The end-of-month procedure appears as an option on each GBS ledger menu only because the sales and purchase ledgers can be used as stand-alone packages.)

CHAPTER 7

Stock Control

Stock-control packages

Stock control versus stock recording

As can be seen from the survey of microcomputer applications packages (Figure 1.16) stock control appears to be the most popular single area of application of microcomputers at the moment. While most packages currently on offer are referred to as stock control, a very large majority are strictly speaking *stock recording* packages. My interpretation of the difference between the two is that, in the former, parameters which control the level of stocks, such as re-order levels, replenishment quantities, etc., are automatically updated in line with changes in demand, that is, an element of *forecasting* is a prerequisite. In stock recording, such parameters have to be set manually by the user and would, therefore, fail to control stocks effectively if demand were to change dramatically.

If forecasting is incorporated in a package, allowing true stock control, more information needs to be stored per stock record, which reduces the number of individual stock items that can be accommodated.

Having made my point about the distinction between stock control and stock recording, I shall, nevertheless, bow to market pressures and conventional usage and throughout this chapter call both 'stock control'!

Stand-alone versus integrated packages

Stock control packages for microcomputers can be either stand-alone or, to varying degrees, integrated. A stand-alone package simply controls the movements of stock and has no means of communicating with sales or purchase ledgers or aiding other management functions.

An integrated package is designed to communicate with either one or several of these functions and, where integration is partial, the most common link is to a purchase or sales ledger package. A link with the purchase ledger could provide for the automatic raising of replenishment purchase orders (if, say, an allocation of stock causes a re-order level to be broken) and with a link to a sales ledger, an allocation of stock could automatically trigger a sales invoice.

Most of the stock control packages on the market can be obtained in a stand-alone form or integrated. As I warned in an earlier chapter, any later integration of a stand-alone system with other packages is a major undertaking and it is, therefore, sensible to think well ahead in making the initial choice (see Chapter 2). Any degree of integration increases the number of disks required, which is an operating disadvantage. However, because all stock control packages require a file of supplier records which is also required for a purchase ledger, the integration of these two functions causes only a marginal reduction in the number of stock items that can be covered. This accounts for the relative popularity of this form of integration.

Stock control packages on the market which can stand alone (most of which can alternatively be integrated to varying degrees) have been written by TABS, CPS, ANAGRAM, OMICRON, Beam, MICROBITS, Bristol Software Factory, Triumph-Adler, Compact, Mediatech, Bytesoft Systems, Tridata Micros and many others. The examples shown in this chapter are produced by the stock control package written by Anagram Systems of Horsham.

Initial suitability of stock control packages

All stock control packages operate around a fixed record design format. It is, therefore, essential to ensure that the information for each stock item to be stored can be accommodated within that format. While software houses may be prepared, for instance, to increase the stock code from ten characters to twelve, such a change might well require further changes in the design of the package, all of which will have to be paid for.

As well as accommodating the information required for a single stock item, it is obviously also essential that a stock control package must be able to accommodate the likely maximum number of stock items to be controlled by the system, together with their associated stock movements. In practice, the number of items to be held will control the number of floppy disks needed. A rough estimate can be made

by assuming that 350–500 individual items can be accommodated per 100 kbytes of disk storage, Table 7.1 gives a rough idea of that relationship in terms of operational disks.

If more than two 5¼ inch disks are to be used, additional hardware (disk drives) will be necessary if direct access to all items is required. With daily backup disks (see page 11 for details of backup security), the actual number of disks to operate the system could be five times the number selected from Table 7.1, and on top of that there would have to be twelve monthly backup disks. Thus to control 6000 stocked items with four disks operating simultaneously, some 30 floppy disks could be required, which shows why, at this level, it is sometimes preferable to opt for an admittedly much more expensive hard disk system.

Table 7.1 Disk requirements as a function of items to be stocked (assuming an average of one purchase order and two allocations, or issues, per item per month)

<i>Disk configuration</i>	<i>Number of items</i>	<i>Number of suppliers</i>
1 x 5¼" disk	1500	200
2 x 5¼" disks	2700	250
3 x 5¼" disks	4400	300
4 x 5¼" disks	6000	400
2 x 8" disks	8000–10000	500
1 x Winchester hard disk	30000	1000

Setting up a stock control system

Figure 7.1 shows diagrammatically the file structure of a typical microcomputer stock control package. Before it can be put to use, all the information for the records within these files will have to be transferred from the existing manual system – and for 3000 items, the entry of this information could well occupy someone full-time for a week to a fortnight.

Having decided how many disks are needed, and having prepared or formatted the requisite number of new disks (see page 10 for formatting procedures), the sequence of entering information would usually be as follows:

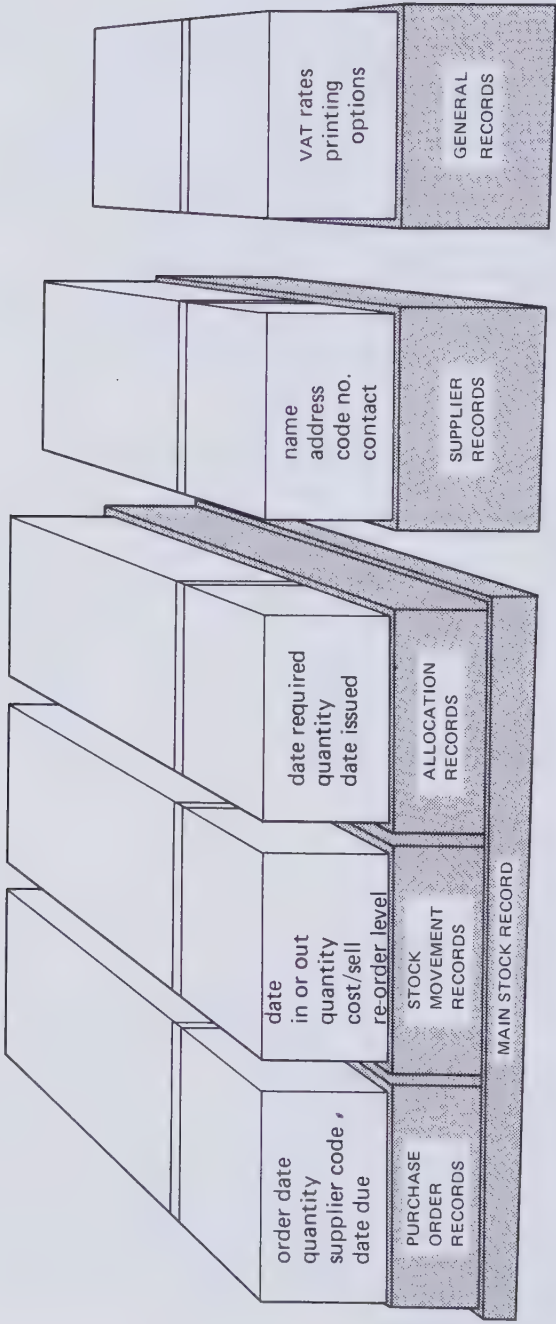


Figure 7.1 Diagrammatic representation of the record files of a stock control package.

General

Enter company information, that is, the name, address, etc. of the company operating the stock control system.

Enter print facilities. Because a variety of printers might be used, the package must be told what type of printer is connected and in particular if a line-feed is required from the package. Details of how many lines can be printed per page will also have to be specified. At a normal printing of 6 lines to the inch, for 11 inch paper this cannot be greater than 66 and the norm is 60.

Supplier records

Each supplier will have his own individual record including information such as address, telephone number and possibly person to contact. To cut down on storage and to improve the package's efficiency, each supplier record is allocated a supplier code (either a number or alphanumeric abbreviation of the supplier's name) and references to suppliers from the stock records will be via this code.

Figure 7.2 shows a list of suppliers together with their allocated supplier codes, which in this case are numbers.

Stock records

The bulk of the information required by a stock control package will be for the individual stock records. While most of this information will be available from the existing manual system, it is sensible to perform a stocktake at the time of changing over from the manual to microcomputer-based system to ensure, in particular, that the figures entered for the quantities in stock, etc. are an accurate representation of the real life situation.

Figure 7.3 shows a typical record where

free stock – represents the stock free to be issued and is equal to *in stock* plus *on order* minus *allocated* (i.e. $27 + 4 - 30 = 1$)

in stock – represents the actual physical stock held in stores and which, because it has been paid for by the stockist, represents capital tied up in stock

on order – the amount of stock already ordered from suppliers which has yet to be delivered

Printed: 16 May 1981

SUPPLIER NAMES AND ADDRESSES

Page 1

Supplier: 001 Name : Commodore Business Machines
 Address : 818 Leigh Road
 : Slough
 : Berks
 Post code: BG2 3TR
 Telephone: 0765-98321
 Contact : Julie North

Supplier: 002 Name : Anadex Printer Co Ltd
 Address : Exhall Trading Estate
 : Slough
 : Bucks
 Post code: BU3 1CF
 Telephone: 0981-4567
 Contact : Raymond Higgins

Supplier: 003 Name : Software Services Limited
 Address : 12 The Green
 : Ballsover
 : Kent
 Post code: KE3 1SD
 Telephone: 0987-7654
 Contact : Jane Frisbey

Supplier: 004 Name : XYZ Electronics Ltd
 Address : 45 North End Road
 : Newbury
 : Hants
 Post code: HF2 1CF
 Telephone: 0995-54545
 Contact : Penelope Arbuthnot

Supplier: 005 Name : Brown's Multi-cables Ltd
 Address : Unit 4
 : Marley Trading Estate
 : Teiford
 Post code: TF2 1CF
 Telephone: 032-96868
 Contact : John Brown

+++ END OF PRINT +++

Figure 7.2 List of suppliers with allocated supplier codes.

Printed: 16 May 1981

STOCK CARD PRINT

Page 1

Stock item: cbm8032 32K 12 in. computer

Free stock: 1 In stock: 27 On order: 4 Allocated: 30

Last activity : 10 May 1981 Minimum level : 10 Lead time days:
 Bin / Location: Maximum level : 30 Cost price : 700.00
 Supersedes : Re-order level: 15 Selling price : 895.00
 Superseded by : Re-order qty : 15 V.A.T. rate : 15
 Quantity desc :

----- SUPPLIER(s) -----

Main Supplier : 001 Name : Commodore Business Machines
 Address : 818 Leigh Road
 : Slough
 : Berks
 Post code: BG2 3TR Lead time days:
 Telephone: 0765-98321 Cost price : 700.00
 Contact : Julie North

----- ORDER HISTORY -----

Order date	Reference	Ordered	Sup. Date due	Received	Total value	Qty./O/S
10 May 1981	abc123	10 001		6	7000.00	4

----- MOVEMENT SUMMARY -----

Date	Reference	Type	Cost/Sell	In	Out	Balance
1 May 1981	BALANCE	Balance C/F	700.00	27		27
10 May 1981	abc123	Order received	700.00	6		33
10 May 1981	123456789	Allocation sent	895.00		6	27
10 May 1981	out1	Stock out	895.00		2	25
10 May 1981	STOCK-TAKE	Stocktake (in)	700.00	2		27

----- ALLOCATION SUMMARY -----

Required	Reference	Quantity	Centre	Issued	Total value	Qty.o/s
	123456789	5		6	4475.00	
20 May 1981	asd	30		0	26850.00	30

+++ END OF PRINT +++

Figure 7.3 Typical stock record.

allocated – allocations which have been made against enquiries, etc. and for which confirmatory orders are awaited

minimum and maximum stock levels – these are used to specify the acceptable levels of *in stock*. Stock items with *in stock* levels above the maximum or below the minimum will be highlighted in a stock level *highlights report* and, for this package, within the stock record itself

re-order level – used to trigger the placing of purchase orders with suppliers when the *free stock* falls to, or below, this level. In a stand-alone stock control package, purchase orders are not raised automatically but the indication that a purchase order should be raised is signalled through a stock level highlights report and, for this package, within the stock record itself

re-order quantity – the quantity normally purchased to replenish stocks

cost price – the price at which stock is purchased. Many stock control packages allow for several cost prices and evaluate stock capital at an average price

selling price – the price at which goods are valued when issued from stock

In the example stock record shown, the *free stock* figure of 1 would be highlighted on the VDU screen since this is lower than the re-order level of 15. However, the *in stock* figure of 27 would not be highlighted since it is neither higher than the maximum level of 30 nor below the minimum level of 10.

Day-to-day transactions

The day-to-day transactions of a microcomputer-based stock control system are essentially concerned with stock movements, on very much the same basis as in a manual system. The big advantage of the microcomputer-based system – apart from its overall speed and its ability to store the data compactly on disks – is that, if any potentially *illegal* transactions are entered, the system immediately reacts and indicates why that proposed transaction just is not possible. Where *correct* information is entered into the stock control system which subsequently requires cancelling (for example, an allocation made to a

customer who subsequently cancels) or where *incorrect* – but not illegal – information is entered (for example, an allocation is made against the wrong stock item), the design of the system must allow corrections to be made easily. Indeed, if the operator does not know, for example, to which stock item a piece of information relates, the system should be able to allocate this to a ‘floating’ location simply to allow the as yet unidentified information to be made available to the system. At a later stage, hopefully, the correct location will be identified and the information transferred to that location from the ‘float’.

As Figure 7.3 shows, day-to-day transactions may be concerned with:

purchase orders – essentially recording that they have been placed and later that the goods are received. These records, therefore, represent the *input* to the stock control system

allocations – essentially recording the allocation of stock to potential customers and the subsequent despatch of those orders. These records, therefore, represent the *output* of the stock control system

movement – essentially recording the results of the stock balances replenished by purchase orders and depleted by customer allocations. To these must be added miscellaneous movements, such as corrections due to stocktaking. These records, therefore, represent the current state of the stock control system

End-of-month processing (alternatively referred to as start-of-month processing)

Because of the relatively limited amount of disk storage space available on microcomputer systems, it is essential for such systems to remove non-essential information on a regular basis. This *purging* of the system usually takes place at the end of a month (or planning or accounting period) and essentially involves running an end-of-month program which removes any information which is now *historic* rather than *current* and which is, therefore, not essential for further day-to-day transactions.

Thus an allocation made to a particular customer which was then followed by a withdrawal of stock against that customer's subsequent purchase order is (provided the quantities match exactly), as far as the system is concerned, of no further interest. Thus, both the original allocation and the subsequent withdrawal can be erased from the

allocation record to make space for future allocation transactions. If the allocation and withdrawal figures do not match (as would occur with a partial fulfilment of a customer's order), the information obviously remains current and would not be removed by an end-of-month processing.

Similarly, information on purchase orders for which goods are subsequently received can be removed from the system if the quantities involved match exactly. If the quantities do not match (as in the case of a partial delivery against a purchase order) the information continues to be current and must, therefore, be retained on the relevant purchase order record.

Information deleted from both the purchase order and allocation record can also be removed from the stock movement record.

Before performing an end-of-month processing, it is absolutely essential to produce a backup copy of the stock control system on the last day of the month. In practice, this can best be achieved by withdrawing the relevant *daily* backup disks from the system and replacing those disks with new backup disks. Thus, if the end-of-month occurred on a Friday, the Friday backup would become the end-of-month backup disks and the following Friday a set of new disks would become the Friday backup set. Such a procedure ensures that all daily backup disks are eventually withdrawn to become monthly backup disks, and thereby limits the number of times an individual disk will be used (which in practice should not exceed fifty or sixty).

The end-of-month backup disk represents the state of the stock control system at that point in time. If the stock control system subsequently crashes (due to a disk failure, etc), the latest end-of-month disk will be the backstop from which the current state of the stock control system can be re-established. If any reports are required from the stock control system, these must be produced either before end-of-month processing is undertaken, or later from the end-of-month backup disk.

Reports available

With a microcomputer-based stock control system containing information on up to 6000 items, one of management's main concerns is to be able to take rapid and effective decisions for those stock items requiring action. The microcomputer-based stock control system's ability to produce *exception reports* of various kinds can, therefore, become a very powerful tool in effecting such 'management by

exception'. Some of the reports produced by the ANAGRAM stock control package are described here.

Stock level highlights report

This report lists all the stock items held on file for which:

the *free stock* figure is less than the re-order level and, hence, a purchase order to replenish stocks should be raised

the *in stock* figure is either greater than the maximum or less than the minimum figures previously set

In the stock level highlights report shown in Figure 7.4, item ad1981 has been included because the *in stock* figure of 4 is less than the minimum of 7. Item cbm76767 is included since the *in stock* figure of 15 is above the maximum of 10. Since no items appear on this report indicating a *free stock* figure below that of the re-order level, one can assume that no items are in need of replenishment and, hence, that no purchase orders need to be raised.

Stocktaking report

This report, shown in Figure 7.5, indicates the amount of stock for each item which the stock control system has recorded as being *in stock*. It includes a blank column for actual *in stock* values to be recorded manually, a task made easier if bin location information is available. Once any discrepancies between the recorded and actual figures are established, the recorded figures must be brought into line with the actual by effecting a miscellaneous stock movement which would not appear either as a purchase or an allocation.

Outstanding orders report

This report lists all the stock items for which purchase orders have been placed with a specified supplier and from whom goods have yet to be received in full. The outstanding orders report, therefore, can be used by a purchasing department as an action list for chasing suppliers. In the report shown in Figure 7.6, because the value of outstanding orders is also given, this indicates the company's future financial commitment to stock.

Printed: 16 May 1981		STOCK LEVEL HIGHLIGHTS				Page 1	
Stock item	Bin no	Qty desc	Re-order	Minimum	Maximum	In stock	Free stock
ad1981		each	15	7	27	4	18
cbm76767		each	5	2	10	15	15
+++ END OF PRINT +++							

Figure 7.4 *Stock level highlights report.*

Printed: 21 May 1981		STOCKTAKING LIST		Page 1	
Stock item	Description	Qty desc	Bin/Loc	Recorded In stock	Actual In stock
A123456789	Clever Word Package	each		4	
ad1981	IEEE Cable	each		18	
bcf100009	Payroll Package	each		1	
bgh23343	Network cable system	each		0	
bvf544444	IEEE/Centronics Interface	unit		2	
C10	Cassette in Packs of 10	packs		18	
C2N	Cassette Unit	unit		6	
C30	Cassettes in Packs of 10	packs		19	
cbm4016	40 col PET, 4 k in ROM	unit		4	
cbm76767	8032 Brochure	each		10	
cbm8032	32K 12 in. computer			16	
cbm8050	dual floppy disk unit	unit		12	
M42	Midelectron Paper Tape St	unit		0	
swq65446	40 column printer	unit		1	
WX4671	X-Y Plotter	unit		0	
yte76767	22 inch monitor unit	unit		1	
+++ END OF PRINT +++					

Figure 7.5 *Stocktaking list.*

Printed: 16 May 1981		OUTSTANDING ORDERS				Page 1	

Supplier: 001 Commodore Business Machines							
Stock item	Order ref.	Date of Order	Date due	Qty. desc.	Order qty.	Qty. o/s	Outstanding order value

cbm8032	abc123	10May81			10	4	2800.00
cbm8032	ucs6566	16May81	01Jun81		15	15	10500.00

Total outstanding order value							13300.00

+++ END OF PRINT +++							

Figure 7.6 Outstanding orders report.

Printed: 21 May 1981		OUTSTANDING ALLOCATIONS				Page 1	

Stock item	Allocation reference	Date required	Cost centre	Qty. desc.	Quantity required	Quantity issued	Outstanding alloc value

A123456789	Salif Tech	4Jun81		each	5		2000.00
ad1981	Gas Bd	3Jun81		each	15		315.00
bcf100009	Brit Gas	7Jun81		each	1		345.00
bvf544444	BLMG	7Jun81		unit	1		76.00
cbm76767	Brit Ley	7Jun81		each	6		36.00

Total outstanding allocation value							2772.00

+++ END OF PRINT +++							

Figure 7.7 Outstanding allocations report.

Outstanding allocations report

This report lists all the stock items for which customer allocations have been made but for which a confirmatory customer order has yet to be received, or the quantity issued is less than the quantity required. As such this report can represent an action list for the sales department. As shown in Figure 7.7, the value of the outstanding customer allocations is an indication to the accounting department, in particular, of the prospective sales that have yet to be converted into firm orders and, hence, cash payments to the company.

Stock valuation analysis report

This report, shown in Figure 7.8, lists each stock item, together with in stock figures, the item's cost value (in stock \times cost price) and the item's selling value (in stock \times selling price). The total cost value and total selling value represent respectively, money tied up in stock and potential sales (or issues).

Stock movement valuation analysis report

This report, shown in Figure 7.9, gives the value of stock items moved in and out of stock since the start of the month (period). Issued at the end of a month (period), it shows the difference between the selling value of stock issued and cost value of stock acquired, that is, the operating profit of the stock system.

Inactive stock report

Sometimes referred to as a slow movers report, this lists items for which there has been no stock movements — in or out — since a date specified by the user. Such a report identifies those stock items that have either become or are rapidly becoming obsolete and thus provides valuable information to prevent the retention of redundant stock. If it is decided to delete these items from the stock control system, a fictitious withdrawal of stock will have to be made before the system will allow the item to be actually deleted.

Cost centre reports

Where a system of cost centres is in existence, many of the reports already described can be restricted to the stock items associated with a particular cost centre. A similar facility is provided in some packages for stock items associated with product groups.

Printed: 21 May 1981

STOCK VALUATION ANALYSIS

Stock item	Qty, desc.	In stock	Cost value	Selling value
A123456789	each	4	1380.00	1600.00
ad1981	each	18	270.00	378.00
bcf100009	each	1	300.00	345.00
bgh23343	each	0	0.00	0.00
bvf544444	unit	2	100.00	152.00
C10	packs	18	90.00	99.00
C2N	unit	6	270.00	330.00
C30	packs	19	104.50	118.75
cbm4016	unit	4	2000.00	2200.00
cbm76767	each	10	50.00	60.00
cbm8032		16	11200.00	14320.00
cbm8050	unit	12	8400.00	10740.00
M42	unit	0	0.00	0.00
smq65446	unit	1	400.00	460.00
WX4671	unit	0	0.00	0.00
yte76767	unit	1	200.00	273.00
Total stock value			24764.50	31075.75
+++ END OF PRINT +++				

Figure 7.8 Stock valuation analysis report.

Future trends and developments

Pareto analysis

One of the advantages of a computerised stock control system compared with a manually operated one is the ability of the computer to sort stock items into ascending or descending order on the basis of, say, cost value. Such a facility could be used to perform a Pareto

Printed: 21 May 1981		STOCK MOVEMENT VALUATION ANALYSIS			Page 1	
Stock item	Qty, desc.	'IN' movements	Cost value	'OUT' movements	Selling value	Difference
A123456789	each	3	1062.00	0	0.00	1062.00-
ad1981	each	20	300.00	7	147.00	153.00-
cbm76767	each	0	0.00	5	30.00	30.00
cbm8032		27	18900.00	38	34010.00	15110.00
Totals			20262.00		34187.00	13925.00
+++ END OF PRINT +++						

Figure 7.9 *Stock movement valuation analysis report.*

analysis for all stock items to establish which are:

A type items – few in number but often representing up to 80 per cent of the capital invested in stock

B type items – more in number than A items but representing less in investment terms

C type items – the majority of items, often 70–80 per cent but representing sometimes as little as 5 per cent of capital invested

Such a Pareto (or ABC) analysis is widely used in stock control to identify which stock items are more important than others. Few of the microcomputer stock control packages on the market offer this facility as yet, but since it is such a useful tool in stock management and is relatively simple to incorporate in a package, it will assuredly become more common in the next generation of microcomputer stock control packages currently under development.

Figure 7.10a shows a printout of just twenty stock items ordered by cost value, and Figure 7.10b the resulting Pareto (or ABC) analysis which is derived from this. Even on this limited sample of twenty items

Listing of all stocked items ordered by cost value.

CODE	DESCRIPTION	COST VALUE	CUMULATIVE VALUE
f45454	Manual	16.00	16.00
h64646	Nut	125.00	141.00
g97979	Bolt	168.00	309.00
h78787	Nut	210.00	519.00
g45454	Flange	340.00	859.00
h45454	Nut	350.00	1209.00
a45454	Casting	404.00	1613.00
g454541	Bracket	408.00	2021.00
g43435	Flange	585.00	2606.00
f34343	Flange	585.00	3191.00
b56565	Bracket	672.00	3863.00
h67676	Bracket	702.00	4565.00
g65657	Bracket	360.00	4925.00
f46464	Flange	1008.00	5933.00
a2003	Casting	1088.00	7021.00
g73535	Casting	1242.00	8263.00
f676760	Casting	1530.00	9793.00
a1000	Casting	1360.00	11153.00
g76767	Bracket	1870.00	13023.00
g20021	Bolt	3000.00	16023.00

Figure 7.10a Printout of stock items listed in order of cost value to produce a Pareto analysis.

it can be seen that 20 per cent of the items (that is, four: namely, g20021, g76767, a1000, and f676760) represent 50 per cent of the cost value and that 40 per cent of the items (eight: namely, f45454, h64646, g97979, h78787, g45454, h45454, a45454 and g454541) represent only 10 per cent of the cost value.

Forecasting

As I stressed at the beginning of the chapter, because most micro-computer based stock control packages do not incorporate an element of demand forecasting, they are strictly speaking stock recording rather than true stock control packages. A few packages on the market do incorporate a forecasting function, based on exponential smoothing techniques (see Figure 4.4), and these forecasts are then used to

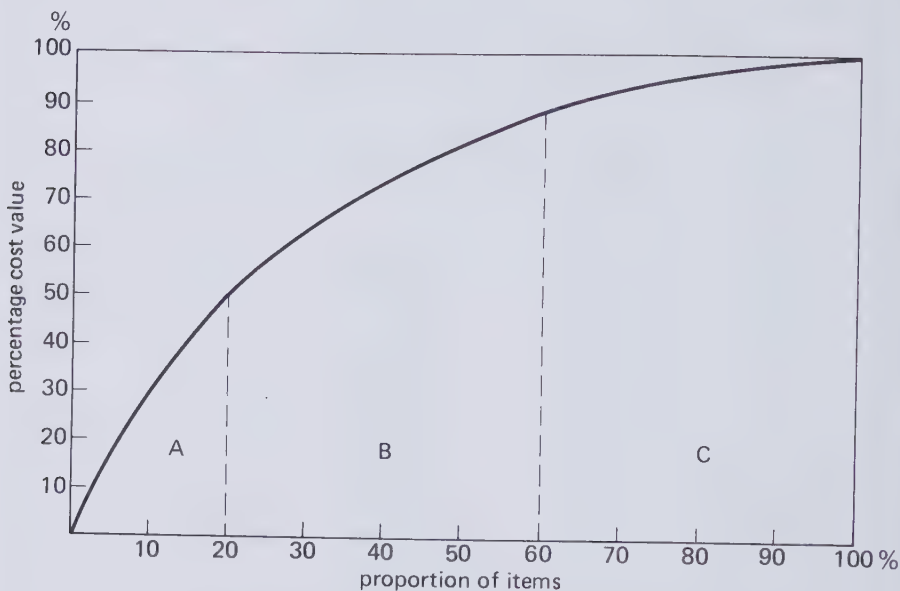


Figure 7.10b Pareto analysis of stock items as derived from Figure 7.10a.

establish the stock control parameters such as re-order levels, replenishment quantities, etc. As storage facilities on microcomputers becomes both larger and cheaper, I would expect to see an increasing move in the direction of true stock control for microcomputer-based packages.

Decentralised stock control via microcomputer networks

Many large organisations hold stock on several sites and in the past have exercised control over those dispersed stocks using regional interactive terminals accessing a central mini- or mainframe computer. The main disadvantages of such a system are the running expenses of connecting terminals to the central computer for up to eight hours every day via dedicated lines and the total dependence of all regional sites on the central computer.

In such decentralised stock control situations, independent microcomputers are increasingly being used to control regional stocks, with only occasional reporting to a central minicomputer to update the overall situation. Such a system considerably reduces running ex-

penses and also allows regional control to continue if the central computer crashes.

Material requirements planning

In many manufacturing situations, where several components or subassemblies are used in the production of a main assembly it is apparent that the demand for these components does not operate independently, as is assumed in conventional stock control. In such situations it is more efficient to control stocks of components and subassemblies using a procedure called material requirements planning (MRP). While MRP is more efficient at controlling stocks in such dependent demand situations, to achieve that improved control the system requires far more information about what components and subassemblies are needed to produce final assemblies and at what level in the manufacturing process. This has so far meant that microcomputers, with their limited storage facilities, have not proved suitable for this type of application. However, I can visualise the inclusion of MRP packages in the next generation of microcomputers. Already the latest versions of the ANAGRAM package discussed earlier in this chapter incorporates a single-level *parts explosion* which allows the user to identify shortages of components one level down from the main assembly when a proposal to build a certain quantity of that main assembly is investigated. It can only be a matter of time before, with increased storage facilities, microcomputer-based MRP packages are available with multiple-level parts explosions, such as are currently available on mini- and mainframe machines.

Conclusion

Stock control is currently the largest area of application of microcomputer packages. Some sixty packages are available on the market in the UK which means that, for the more popular types of microcomputer, potential users have a choice of four or five packages.

While no microcomputer package will exactly mimic an existing manual stock control system, because the costs of having a bespoke package written can prove prohibitive, many existing users have found that the relatively small restrictions placed on them by a particular stock control package are more than offset by the advantages offered by such a microcomputer-based system.

CHAPTER 8

Payroll

Payroll packages

Although stock control packages represent the largest area of application in terms of variety of packages, when one turns to consider actual installations, payroll packages predominate. The implication is that, although there are slightly fewer payroll packages on the market, those which are successful are used at a larger number of sites. Since every company must pay its employees, although it may not necessarily hold stock, this is hardly surprising.

One factor that distinguishes payroll from all other packages is that failure of the system must be avoided at all costs. A failure of a stock control system might cause chaos for a period of time, and perhaps even precipitate an additional stocktake, but a failure to pay employees would be a major disaster. Thus, the successful payroll packages tend to be those written by the larger software houses such as Tridata Micros, TABS, Graffcom, Peachtree, Microtrend, Holland Auto, Compact, OMICRON etc, who, because of their size, can offer a reasonable guarantee of continued support. This, in practice, mainly means that staff are available to answer queries (over the phone) in an emergency. Such support is absolutely essential for a payroll package, not only for the occasional difficulty but also to ensure that the system is updated in line with any legislative changes, some of which usually occur every year. Recent examples of changes which will result or have already resulted in alterations to payment procedures are:

April 1983
Jan. 1984

petrol expenses for company owned cars/sick pay
major clearing banks stopped accepting
printed bank giro's, so they either have to be
'machine readable', transmitted electronically
over telephone lines or recorded on disk to a
format acceptable to the banks.

A software *support contract* or '*update agreement*' ensures that any such changes will be incorporated in the payroll package, usually in the form of a new program disk delivered a few weeks before the changes have to be implemented.

Software support contracts are rare outside the payroll field; within it they are almost universal and relatively cheap at about £100 *per annum*.

The more successful payroll packages now available on the UK market have certainly all been around for three or four years. Hence, through an evolutionary process of development stimulated by customer feedback, such packages should now be able to cope with the majority of idiosyncrasies of most payments systems. However, if a feature of a company's payment system is so unusual that no micro-computer payroll package can deal with it, the sensible course is to change that feature rather than get involved in the necessarily great expense of a bespoke payroll package. At a cost of approximately £250, the advantages of a standard, proprietary payroll package are such that several companies, even with as few as five employees, are more than satisfied with their purchase.

In brief, a typical payroll package should be able to:

deal with hourly, weekly, two, three and four weekly and monthly paid staff

produce pay advice slips for all employees and also bank giros if required. (Automatic printing of cheques is not usually a feature of microcomputer payroll packages, mainly because the pre-printed cheque stationery has to be obtained from security-approved printers, who often insist on a minimum quantity of 2000. Accounting for each individual cheque form is also a problem and, since the average number of employees on a microcomputer payroll system is small (see below), it is generally much more practical to print a cheque list and then raise cheques manually.)

cope with all PAYE tax deductions, national insurance contributions, pension and other specified deductions and also non-taxable allowances

produce departmental analysis of payments made in both the current period and year-to-date

produce information for, and be able to print that information in a format suitable for, year-end tax forms such as P60s, P11s and P35(CS)s

if an integrated ledger system is operated, produce balance postings to the PAYE, national insurance, cash at bank and wages accounts of the nominal ledger

The payroll package used to illustrate this chapter is the Gilt Edge payroll package written by Fast Software Products, Birmingham. Over a thousand copies of this package are now (1984) operating on a wide range of microcomputer installations throughout the UK. With a range of from 5 to 1400 employees per installation, but with an average of 50, this one package is therefore processing payment information for more than 50,000 people.

The Gilt Edge payroll package requires a 32 kbyte microcomputer system (64 kbyte with CP/M), two disk drives and a printer with a minimum of 120 characters per line. One disk drive is used for the controlling program (that is, the systems disk) and details of up to 250 employees per 5¼ inch disk or 700 per 8 inch disk are stored and maintained using the second disk drive. The package is menu driven and the principal options (called programs here) are accessed through the main menu which is shown in Figure 8.1. These programs will now

VERSION AD.08	PAYROLL	29/04/81

1) CREATE/AMEND EMPLOYEE DATA	9) PRINT ANALYSIS TOTALS	
2) CLEAR B.T.G. DETAILS	10) END OF YEAR PROCEDURES	
3) BUILD UP TO GROSS	11) BLANKET CHANGES	
4) GROSS TO NET CALCULATION	12) AMEND SYSTEM PARAMETERS	
5) PRINT PAYSLEIPS	13) AMEND TOTALS	
6) PRINT COIN ANALYSIS	14) LIST EMPLOYEE NUMBERS	
7) PRINT CHEQUE'S LIST	15) RESET SYSTEM DATE	
8) PRINT BANK GIROS	16) END PAYROLL RUN	
Select Program No.(1-16):..		
Copyright TRIDATA MICROS LTD/1980/81		Telephone 021 622 6085

Figure 8.1 Payroll package's main menu.

be examined in detail in the chronological order in which they would normally be used, rather than in their numbered sequence (which is based more on frequency of use in week-to-week and month-to-month operations).

Setting up a payroll system

Set up employer information (amend system parameters — program 12)

When installing a payroll system initially the user provides basic information as to the company's address, tax district, tax reference number, bank, etc. This information and any changes to either PAYE or national insurance (NI) tables can be made using program 12 of the main menu. The system will itself provide the PAYE and NI information details currently in force and these will require altering only if and when legislative changes are enacted.

In this package employer's data, PAYE data and NI data are displayed on three separate screens as shown in Figure 8.2.

Note particularly on screen 1:

field 9 — *highest note (\$)* refers to the highest note denomination in pounds sterling that can be used in cash net payments. Values can be £20, £10, £5 or £1. (Because many printers are manufactured abroad, the \$ sign, or sometimes the # (hash) sign, is often used to represent the £ sign.)

field 10 — *net pay adjustment amount* indicates the smallest multiple amount that can be used in cash net payments, e.g. if 50p is entered (as here) then net pay will be made up to the next 50p and the difference carried forward as a debit to the following period. The maximum adjustment amount is £1.00

fields 11 to 14 — *overtime rates 1 to 4* refer to the four overtime rates which can be used in the build-up-to-gross procedure (BTG, see below) if overtime hours are booked for employees, e.g. 1.5000 is time-and-a-half

This option of setting up employer information is normally only used when setting up the payroll system and whenever legislative changes alter PAYE or NI parameters.

PAYROLL PARAMETER FILE MAINTENANCE

AMEND

1/04/81

EMPLOYER'S DATA

Screen 1 of 3

1) Employer's Name : J.B. SMITH & SONS LTD.
 2) Address Line 1 : 156-160 COVENTRY ROAD
 3) Address Line 2 : ERDINGTON
 4) Address Line 3 : BIRMINGHAM B5 6BS
 5) Tax District : BIRMINGHAM 10
 6) Tax Ref No : 72/T680
 7) Std Works Hours : 40.00
 8) Std Staff Hours : 35.00
 9) Highest Note(\$) : 10
 10) Net Pay Adj Amt : 0.50
 11) Overtime Rate 1 : 1.0000
 12) Overtime Rate 2 : 1.2500
 13) Overtime Rate 3 : 1.3330
 14) Overtime Rate 4 : 1.5000
 15) Bank Name : NATIONAL WESTMINSTER
 16) Address Line 1 : LAW COURTS BRANCH
 17) Address Line 2 : DALE END

P.A.Y.E. DATA

Screen 2 of 3

BAND	RATE	LIMIT	BAND	RATE	LIMIT
1 20)	30.00%	32) 11250	7 26)	60.00%	38) 90000
2 21)	40.00%	33) 2000	8 27)	60.00%	39) 90000
3 22)	45.00%	34) 3500	9 28)	60.00%	40) 90000
4 23)	50.00%	35) 5500	10 29)	60.00%	41) 90000
5 24)	55.00%	36) 5500	11 30)	60.00%	42) 90000
6 25)	60.00%	37) 90000	12 31)	60.00%	43) 90000

44) Basic Rate Band No. : 1

N.I. DATA

Screen 3 of 3

EMPLOYEE'S RATES				EMPLOYER'S RATES			
RATE	NORMAL	REDUCED		RATE	NORMAL	REDUCED	
A 50)	7.75%	55) 7.75%		A 60)	13.70%	65) 13.70%	
B 51)	2.75%	56) 2.75%		B 61)	13.70%	66) 13.70%	
C 52)	0.00%	57) 0.00%		C 62)	13.70%	67) 13.70%	
D 53)	7.75%	58) 5.25%		D 63)	13.70%	68) 9.20%	
E 54)	2.75%	59) 2.75%		E 64)	13.70%	69) 9.20%	
70) N.I. Lower Limit: 1404.00				71) N.I. Upper Limit: 10400.00			

Figure 8.2 Employer, PAYE and NI data.

Create/amend employee data (program 1)

This program is used initially to create employee records and subsequently to create additional records for new employees. The program can also be used to amend employee records, although financial information can only be altered if the program 'clear BTG details' has been run. The create/amend program can also be used to access an employee record purely for information.

Each employee must be allocated an *employee number* which becomes the unique key code through which employee records are identified. The format of the employee number is DD.NNN where:

DD = department number in the range 0–35 (99 on some machines)

NNN = a three digit number in the range 001–250 (700 on Tandy model II) (e.g. 0.083 is employee 83 in department 0)

Figure 8.3 shows an employee record for F. T. Morris code number 1.003, a monthly paid employee, whose bank details are included as payments to be made by bank/giro (B/G). The employee record is divided into three screens: *basic information*, *to-date-totals* and *other information*. Detailed points of interest to note from Figure 8.3 are as follows:

On screen 1 — basic information

field 7 — *pension option*, which specifies the type of company pension deduction. The eight pension options available in this particular package are:

- 0 = no company pension
- 1 = contracted in where the deduction is an amount (N/A – not allowable for tax)
- 2 = contracted in where the deduction is a percentage (N/A)
- 3 = contracted out where the deduction is an amount (allowable)
- 4 = contracted out where the deduction is a percentage (allowable)
- 5 = contracted in where the deduction is an amount and allowable against tax
- 6 = contracted in where the deduction is a percentage and allowable against tax
- 7 = contracted out where the deduction is a percentage allowable against tax and only to be taken within NI limits

8 = contracted in where the deduction is a percentage allowable against tax and only to be taken within NI limits

Pension amounts and percentages are specified as Fields 60 and 61 respectively for employees and 62 and 63 for employers

field 8 – *employee type*, which can be:

- 0 = hourly
- 1 = weekly
- 2 = 2 weekly
- 3 = 3 weekly
- 4 = 4 weekly
- 5 = monthly

field 9 – *standard weekly hours*, which for hourly employees (type 0) has a maximum value of 60 and is used for setting standard weekly hours when these differ from the employer's normal working week, e.g. for part-timers

field 10 – *payment method*, which offers three alternatives:

- 0 = cash
- 1 = cheque (drawn up manually)
- 2* = bank/ giro (printed on B/G forms)

An * in this field indicates that the employee's record has already been through a payroll run

field 11 – *hourly rate or basic salary*, which specifies either the hourly rate (limited to £30) for hourly employees or annual salary (limited to £99,999) for salaried employees

field 13 – *paid to period*, which indicates the week or month up to which the employee has been paid. Since this example is created at the start of the tax year this period is zero, as are all the to-date-totals on the second screen. All these latter data fields would also be set to zero when running program 10 – *end-of-year procedures*

On screen 2 – to-date-totals

fields 30 and 31 – *gross pay and PAYE*, which for new employees is entered from previous employment P45 forms

PAYROLL EMPLOYEE DATA FILE MAINTENANCE

AMEND

1/04/81

EMPLOYEE NO. : 3

BASIC INFORMATION

Screen 1 of 3

1) Initials : F T
 2) Surname : MORRIS
 3) N.I. Number : AS998763A
 4) N.I. Code : D
 5) Tax Code : 400H
 6) Wkl/Mthl Basis : N
 7) Pension Option : 4
 8) Employee Type : MNTHLY
 9) Std. Weeks Hrs : 35.00
 10) Payment By : B/G
 11) Basic Salary : 9990.00
 12) Department No. : 1
 13) Paid To Period : 0
 14) Start Date : 9/08/77
 15) Leaving Date :
 16) Birth Date : 12/12/43

BANK/GIRO DETAILS

17) Bank Code : 80-98-65
 18) Account No : 43542312
 19) Ac Name: F T MORRIS
 20) Bank : LLOYDS
 21) Branch : SOLIHULL

EMPLOYEE NO. : 3

TO DATE TOTALS

Screen 2 of 3

PREVIOUS EMPLOYMENT

NATIONAL INSURANCE CONTRIBUTIONS

30) Gross Pay : 0.00
 31) P.A.Y.E. : 0.00

EMPLOYEE'S C/D RATE
 36) 0.00 37) 0.00 38) 0.00

THIS EMPLOYMENT

32) Gross Pay : 0.00
 33) P.A.Y.E. : 0.00

B 39) 0.00 40) 0.00 41) 0.00

PENSION CONTRIBUTIONS

34) Employee : 0.00
 35) Employer : 0.00

D 45) 0.00 46) 0.00 47) 0.00

E 48) 0.00 49) 0.00 50) 0.00

EMPLOYEE NO. : 3

OTHER INFORMATION

Screen 3 of 3

EMPLOYEE'S DEDUCTIONS

EMPLOYER'S DEDUCTIONS

60) Pension Amt : 0.00
 61) Pension Xge : 5.00

62) Pension Amt : 0.00
 63) Pension Xge : 10.00

64) Deduction 1 : 0.00
 65) Deduction 2 : 0.00
 66) Other Dedns : 0.00

MISCELLANEOUS

ALLOWANCES

67) Non-taxable : 0.00

68) Wk 53 Gross : 0.00
 69) Wk 53 Tax : 0.00
 70) Last Net Pay : 0.00
 71) Carried Fwd : 0.00

Figure 8.3 Monthly paid employee record at start of tax year.

fields 32 and 33 – *gross pay and PAYE*, which are respectively gross pay and tax to date for the current tax year in this employment

fields 34 and 35 – *employee's and employer's pension contributions* to date this tax year

fields 36 to 50 – *NI contributions*, which record contributions made by the employee (contracted in or out) and also employer contributions

On screen 3 – other information

fields 60 and 62 – *pension amount*, which is a fixed amount contributed by the employee (60) or employer (62)

fields 61 and 63 – *pension percentage*, which is the percentage (of gross salary including bonus, etc.) contributed by the employee (61) and employer (63), 5 per cent and 10 per cent respectively here

fields 64 to 66 – *deductions*, which are fixed amounts

field 67 – *non-taxable*, which is a regular fixed payment that is non-taxable, e.g. car allowance

fields 68 and 69 – *week 53 gross and tax*, which are automatically stored for use on P60 if period number is 53, 54 or 56

field 71 – *carried forward*, which is an amount credited to any employee paid in cash to bring his or her current pay up to a rounded amount. It is recoverable in the next pay period or upon leaving

While it is obviously much easier to start a payroll system at the beginning of the tax year, since all cash figures are then zero, the system can be started up at any time by transferring the figures from the previous manual system.

When allocating employee numbers and creating records with this Gilt Edge payroll package, it is also possible to allocate numbers to blank records which can subsequently be used for new employees who join the company after the original payroll system has been established. Once the employee details have been created using program 1, a complete list of employees can be produced using program 14, which can also print a list of numbers only allocated to blank records. An example

of a list for just five employees, in two departments is shown in Figure 8.4.

The facilities offered by the Gilt Edge payroll package will be illustrated via the payment records of these five employees whose basic details are shown in Table 8.1.

J.R. SMITH & SONS LTD.				1/04/81			
EMPLOYEE NO'S							
NO.	NAME			NO.	NAME		
0.001	G H	BROWN		0.002	T B	SMITH	
1.003	F T	MORRIS		0.004	R G	EVANS	
0.005	R S	HAMMER					

Figure 8.4 Employee listing.

Table 8.1 Payment records of the five employees

Name	Hourly, weekly or monthly	Method of payment	Annual salary or basic hourly rate
G. H. Brown	hourly	cash	£3.50
T. B. Smith	weekly	cheque	£5600.00
F. T. Morris	monthly	bank/giro	£9990.00
R. G. Evans	monthly	bank/giro	£7800.00
R. S. Hammer	hourly	cheque	£3.70

Week-to-week and month-to-month payroll operations

Having created the necessary employer information (program 12) and all employee records (program 1), the payroll system is ready to become operational. The normal sequence of tasks before each pay day is given below.

Clear BTG details (program 2)

This program must be run before any processing for the new pay period can take place. Since this procedure will clear out any pre-

viously inserted build-up-to-gross information, such as overtime hours booked in the previous pay period, the period backup disk must be generated before running this program.

This procedure 're-initialises' all employee records by reinstating the basic salary (per period), for salaried staff, and, for hourly paid staff, *standard weekly hours* are reset to the standard for each employee. All other build-up fields are set to zero (or 'zeroised' to use American computer jargon).

This program can be run for individual departments or for all employees on the disk being processed. However, only employee records which have been processed through a previous payroll run will be cleared.

Build up to gross (program 3)

This procedure is used to introduce any relevant data which changes from one day period to the next. It is, therefore, principally used for booking overtime hours, recording leavers, paying bonuses, and holiday pay in advance.

When this program is used, the particular employee must be specified using the employee number, and then the *build-up-to-gross* details appear as is shown in Figure 8.5 for G. H. Brown, an hourly paid employee. Note particularly:

field 1 – *basic hours*, which records the basic number of hours for hourly paid employees and salary for all other employees

fields 2 to 5 – *overtime hours*, which records the number of hours of overtime at rates previously specified under employer's data and which are repeated on the second line of the screen

field 6 – *unpaid hours*, which records number of hours laid off without pay

field 7 – *leaving date*, which records the date an employee leaves and ensures that the next payslip is the last. The only time a leaver's record is processed again after that is at the end of the tax year

field 8 – *holiday weeks*, which records the number of weeks for which holiday pay is being paid in advance. The system advances the tax period and apportions NI contributions over the number of weeks advanced. *Total holiday pay* (field 16) must be specified as

PAYROLL BUILD UP TO GROSS				5/05/91			
O/T 1-	1.0000	O/T 2-	1.2500	O/T 3-	1.3330	O/T 4-	1.5000
NO. 1 G H BROWN							
1) + BASIC HOURS:	40.00	9) + BONUS :	0.00				
2) - O/T 1 HOURS:	0.00	10) + COMMISSION :	0.00				
3) + O/T 2 HOURS:	0.00	11) + OTHER PAY 1:	0.00				
4) + O/T 3 HOURS:	0.00	12) + OTHER PAY 2:	0.00				
5) + O/T 4 HOURS:	10.00	13) - N.I.BENEFIT:	0.00				
6) - UNPD HOURS:	0.00	14) + NON/TAX 2 :	0.00				
7) LEAVING DT :	0	15) - TEMP DEDN :	0.00				
8) HOL WEEKS :	0	16) + HOLIDAY PAY:	0.00				

Figure 8.5 Build up to gross details.

the system does not calculate this amount. (This holiday procedure does not apply to monthly paid employees.)

fields 9 to 12 – *bonus, commission, other pay 1 and other pay 2*, which record additional payments made for this period

field 13 – *NI benefit*, which records the amount received from the DHSS if the employee is absent through illness. This figure is, of course, deducted from the gross pay

field 14 – *non-taxable 2*, which records an amount paid for this period which is not subject to tax, e.g. clothing allowance, etc.

field 15 – *temporary deduction*, which records an amount deducted for this pay period only, e.g. cost of breakages

field 16 – *holiday pay*, which records the amount paid in advance for holidays

In practice, if hourly workers are not working overtime, the BTG procedure is normally only used for holidays and leavers. For companies

employing only monthly staff the procedure is, therefore, rarely used.

On the BTG details screen, any field can be changed by specifying the field number. In the example shown in Figure 8.5, the only field that has been changed is field 5 which records that G. H. Brown has worked ten hours overtime at time-and-a-half (+ O/T 4).

Gross-to-net calculation (program 4)

This program, by taking gross pay figures and performing national insurance and tax calculations, produces net pay figures. As such it represents the greatest saving of a microcomputer-based payroll system compared to a manually operated system. In the Gilt Edge payroll packages, employees are processed together depending on their type (all hourly, all weekly, all monthly etc.).

When processing monthly employees immediately after weekly, the user should remember that period (month) in the former case will be different from period (week) in the latter.

This gross-to-net procedure is completely automatic. To indicate progress, as an employee record is about to be updated, the computer flashes up that employee's number on the screen. To give some estimate of the speed with which pay details can be processed, the gross-to-net calculation program typically takes approximately one hour to update all the information on one disk containing data for 250 employees.

Print payslips (program 5)

This program is used to print payslips either for individual employees or for all employees. Departments are processed sequentially and departmental total payslips and overall total payslips are also produced.

For this procedure special pre-printed pay advice stationery has to be loaded into the printer equipped with a facility for correctly aligning this stationery. This feature is illustrated in Figure 8.6 where the pay advice slip for hourly paid employee G. H. Brown is preceded by an alignment slip. Since this employee's basic hourly rate for a 40 hour week is £3.50, adding a further ten hours at time-and-a-half, his gross earnings are the equivalent of 55 hours at £3.50, that is, £192.50.

Print coin analysis (program 6)

This procedure produces a coin analysis report showing the

TAX CODE		N1 No.		TABLE LETTER		PAY ADVISE					NAME		
DATE	STD. HOURS	O-T 1 HOURS	O-T 2 HOURS	O-T 3 HOURS	O-T 4 HOURS	UNPAID HRS	DEPT.	PERS No.	PERIOD No.				
BASIC PAY	OVERTIME PAY	BONUS	COMMISSION	OTHER PAY 1	OTHER PAY 2	N1 BENEFIT	HOLIDAY PAY		GROSS PAY				
PENSION	NET GROSS PAY	TAX	N1	N1 (C/O)	STD. DEON 1	STD. DEON 2	OTHER DEONS	TEMP DEON	TOTAL DEONS				
PENSION T/O	GROSS T/O	TAX T/O	N1 T/O	N1 (C/O) T/O	FREE PAY	TAXABLE GROSS		NON-TAXABLE 1	NON-TAXABLE 2				
EMPLOYERS N1	EMPLOYERS N1 T/O					NET PAY	B/PWD	C/PWD	PAYABLE NET				
TAX CODE		N1 No.		TABLE LETTER		PAY ADVISE					NAME		
200L		A0645321A		A							G H BROWN		
DATE	STD. HOURS	O-T 1 HOURS	O-T 2 HOURS	O-T 3 HOURS	O-T 4 HOURS	UNPAID HRS	DEPT.	PERS No.	PERIOD No.				
5/05/81	40.00	0.00	0.00	0.00	10.00	0.00	0	1	5				
BASIC PAY	OVERTIME PAY	BONUS	COMMISSION	OTHER PAY 1	OTHER PAY 2	N1 BENEFIT	HOLIDAY PAY		GROSS PAY				
140.00	52.50	0.00	0.00	0.00	0.00	0.00	0.00		192.50				
PENSION	NET GROSS PAY	TAX	N1	N1 (C/O)	STD. DEON 1	STD. DEON 2	OTHER DEONS	TEMP DEON	TOTAL DEONS				
0.00	192.50	46.20	14.92	0.00	1.00	0.50	0.00	0.00	62.62				
PENSION T/O	GROSS T/O	TAX T/O	N1 T/O	N1 (C/O) T/O	FREE PAY	TAXABLE GROSS		NON-TAXABLE 1	NON-TAXABLE 2				
0.00	752.50	167.70	58.32	0.00	193.25	559.00		2.00	0.00				
EMPLOYERS N1	EMPLOYERS N1 T/O					NET PAY	B/PWD	C/PWD	PAYABLE NET				
26.37	103.09				3.5000	131.86	0.40	0.02	131.50				

Figure 8.6 Alignment payslip together with payslip recording overtime payment.

breakdown of each employee's net pay for selected coin denominations which have previously been specified as system parameters. Any employee paid in cash and whose record has already been processed by a gross-to-net calculation procedure will be included in this report. The printing is automatic and the report can be printed either by department or for all departments. Totals indicate the amounts of each note or coin required from the bank.

Figure 8.7 shows a very short coin analysis report simply for the purposes of illustration. In this case it can be seen that the net payment of £131.50 has been broken down into 13 x £10, 1 x £1 and 1 x 50p. Since G. H. Brown is the only employee paid in cash in this small hypothetical company, the total figure does not vary, but in a department of some 30 employees paid by cash the time saved by this automatic coin analysis procedure compared with a manual breakdown would be considerable.

J.E. SMITH & SONS LTD.		COIN ANALYSIS							5/05/81	PAGE 1
NO	NAME	NET PAY	10'S	5'S	1'S	50P	10P	5P	2P	1P
0.001	G.H. BROWN	131.50	13		1	1				
TOTAL		131.50	13	0	1	1	0	0	0	0

Figure 8.7 Coin analysis for cash payments.

Print cheque's list (program 7)

This program produces a list of all employees who are paid by cheque, together with their net pay figure. A blank column is provided to record the identification numbers of the cheques which will have to be drawn up manually. Once started, the printing of this report is automatic, and it can be printed either by department or for all departments. Departmental and overall totals are also printed.

Figure 8.8 shows a cheque payment list for the two employees, T. B. Smith and R. S. Hammer, who have opted to be paid by cheque.

Updated employee record

Before we move on to the third method of payment, namely by bank giro (B/G) (program 8), which in practice usually applies to monthly paid employees, it will be useful to examine in detail the records of one employee, F. T. Morris. Figure 8.3 showed F. T. Morris's payroll details at the *start of the tax year* and Figure 8.9 shows the equivalent details at the *end of the first month* of that tax year and which have been produced by processing this employee's record through the gross-to-net calculation procedure.

Specific points to note on Figure 8.9 are:

field 10 – an asterisk here indicates that this employee's record has been through a payroll run

field 32 – gross pay for this month has been calculated as

J.R. SMITH & SONS LTD.		C H E Q U E	P A Y M E N T S
		29/04/81	PAGE 1
NO	NAME	AMOUNT	CHEQUE NO.
0.002	T B SMITH	96.99	
0.005	R S HANNER	103.83	
TOTAL		200.82	

Figure 8.8 Listing of payments to be made by cheque.

$\pounds 9990/12 = \pounds 832.50$ less 5 per cent pension contribution = $\pounds 790.87$

field 33 – PAYE has been assessed at $\pounds 136.50$ on the basis that with a 400H tax code this employee can earn $\pounds 334.90$ tax free this period, leaving a taxable gross of $(\pounds 790.87 - \pounds 334.90) = \pounds 455.00$ which at 30 per cent produces a $\pounds 136.50$ tax deduction

field 34 – pension contribution for the employee is 5 per cent of gross pay, i.e. 5 per cent of $\pounds 832.50 = \pounds 41.63$

field 35 – pension contribution by the employer for this employee is 10 per cent of gross pay, i.e. 10 per cent of $\pounds 832.50 = \pounds 83.25$

field 45 – employee's NI contribution, evaluated as 7.75 per cent of NI lower limit of $\pounds 1404$ annual (i.e. $\pounds 117$ monthly) plus contracted out rate evaluated as 5.25 per cent of balance of monthly gross pay of $\pounds 832.50$ after NI lower limit deduction of $\pounds 117$.

i.e. $7.75 \text{ per cent of } \pounds 117 + 5.25 \text{ per cent of } (\pounds 832.50 - \pounds 117) = \pounds 9.07 + \pounds 37.56 = \pounds 46.63$

see figure 8.2 for NI details under D

field 46 – employee's contracted out rate taken as $\pounds 37.56$, evaluated above

field 47 – employer's NI contribution evaluated as 13.7 per cent of NI, lower limit of $\pounds 1404$ annual (i.e. $\pounds 117$ monthly) plus contracted

PAYROLL EMPLOYEE DATA FILE MAINTENANCE

ENQUIRY

29/04/81

EMPLOYEE NO. : 3

BASIC INFORMATION

Screen 1 of 3

1) Initials : F T
 2) Surname : MORRIS
 3) N.I. Number : AS998763A
 4) N.I. Code : D
 5) Tax Code : 400H
 6) Wkl/Mthl Basis : N
 7) Pension Option : 4
 8) Employee Type : MNTHLY
 9) Std. Weeks Hrs : 35.00
 10) Payment By : B/G*
 11) Basic Salary : 9990.00
 12) Department No. : 1
 13) Paid To Period : 1
 14) Start Date : 9/08/77
 15) Leaving Date :
 16) Birth Date : 12/12/43

BANK/GIRO DETAILS

17) Bank Code : 80-98-65
 18) Account No : 43542312
 19) Ac Name : F T MORRIS
 20) Bank : LLOYDS
 21) Branch : SOLIHULL

EMPLOYEE NO. : 3

TO DATE TOTALS

Screen 2 of 3

PREVIOUS EMPLOYMENT

30) Gross Pay : 0.00
 31) P.A.Y.E. : 0.00

THIS EMPLOYMENT

32) Gross Pay : 790.87
 33) P.A.Y.E. : 136.50

PENSION CONTRIBUTIONS

34) Employee : 41.63
 35) Employer : 83.25

NATIONAL INSURANCE CONTRIBUTIONS

EMPLOYEE'S		EMPLOYEE'S C/O RATE		EMPLOYER'S	
A	36)	0.00	37)	0.00	38)
B	39)	0.00	40)	0.00	41)
C	42)	0.00	43)	0.00	44)
D	45)	66.63	46)	37.56	47)
E	48)	0.00	49)	0.00	50)

EMPLOYEE NO. : 3

OTHER INFORMATION

Screen 3 of 3

EMPLOYEE'S DEDUCTIONS

60) Pension Amt : 0.00
 61) Pension Xge : 5.00
 64) Deduction 1 : 0.00
 65) Deduction 2 : 0.00
 66) Other Dedns : 0.00

ALLOWANCES

67) Non-taxable : 0.00

EMPLOYER'S DEDUCTIONS

62) Pension Amt : 0.00
 63) Pension Xge : 10.00

MISCELLANEOUS

68) Wk 53 Gross : 0.00
 69) Wk 53 Tax : 0.00
 70) Last Net Pay : 507.74
 71) Carried Fwd : 0.00

Figure 8.9 Monthly paid employee record at the end of the first month (compare Figure 8.3).

TAX CODE		NI NO		TABLE LETTER		PAY ADVISE				NAME			
100H		11/18		11						J. MORRIS			
DATE	STD HOURS	O.T. 1 HOURS	O.T. 2 HOURS	O.T. 3 HOURS	O.T. 4 HOURS	UNPAID HRS	DEPT	PERS NO	PERIOD NO				
19/01/81	0.00	0.00	0.00	0.00	0.00								
BASIC PAY	OVERTIME PAY	BONUS	COMMISSION	OTHER PAY 1	OTHER PAY 2	NI BENEFIT	HOL DAY PAY			GROSS PAY			
71.90	0.00	0.00	0.00	0.00	0.00					71.90			
PENSION	NET GROSS PAY	TAX	NI	NI (C/D)	STD DEDN 1	STD DEDN 2	OTHER DEDNS	TEMP DEDN	TOTAL DEDNS				
11.08	71.90	1.56	46.63	37.49	0.00	0.00	0.00		0.00				
PENSION T.D.	GROSS T.D.	TAX T.D.	NI T.D.	NI (C/D) T.D.	FREE PAY	TAXABLE GROSS	NON TAXABLE 1	NON TAXABLE 2					
11.08	71.90	1.56	46.63	37.49	0.00	70.34		0.00					
EMPLOYER'S N.	EMPLOYER'S N. T.D.					NET PAY	B. FWD	C/FWD	PAYABLE NET				
11.08	11.08					60.77		0.00	60.77				

Figure 8.10 Pay advice slip for a monthly paid employee.

out rate evaluated as 9.2 per cent of balance of monthly gross pay of £832.50 after NI lower limit deduction.
 i.e. 13.7 per cent of £117 + 9.2 per cent of (£832.50 - £117) =
 £16.02 + £65.83 = £81.85

field 70 - last net pay is evaluated simply as gross pay (£790.87) less PAYE payment (£136.50) less NI deduction (£46.63), i.e.
 £790.87 - £136.50 - £46.63 = £607.74

The above discussion indicates how all the fields that have been updated using the gross-to-net calculation procedure have been evaluated. The pay advice slip resulting from Figure 8.9 is shown as Figure 8.10.

Print bank giros (program 8)

This program prints bank giro forms for employees paid by bank giro, and also produces a summary list of all such employees, their payment and the total payment made by bank giro. Both bank giro and summary list printing can be for employees in a specified department or for all employees.

Since special stationery is required for bank giro printing, if plain paper is already in the printer when this program is to be used, it is sensible to print the summary first. Figure 8.11 shows the bank giro summary list for the two employees, F. T. Morris and R. G. Evans, who receive payments by this method.

J.B. SMITH & SONS LTD.		BANK-GIRO SUMMARY	29/04/81
NO	NAME	AMOUNT	
1.003	F T MORRIS	607.74	
0.004	R G EVANS	516.95	
TOTAL		1124.69	

Figure 8.11 Bank giro summary list.

As from January 1984, the major clearing banks will only accept machine readable bank giros so that those shown in Figure 8.12 for Morris and Evans will no longer be acceptable. A more likely alternative method will be to transmit bank giro information electronically from microcomputer to bank via a modem over telephone lines or recorded on disk to an agreed format.

Print analysis totals (program 9)

This program allows the user to print various sets of analysis totals developed by the payroll system. It offers four options for analysis total printing which can be accessed via the analysis totals menu shown in Figure 8.13.

As an indication of the type of information that is produced using this program, the year-to-date totals listing (option 3) for the five employees in two departments considered in this chapter is shown in Figure 8.14.

The payroll cycle

The discussion so far has covered in detail the facilities offered by the Gilt Edge payroll package to provide a comprehensive week-to-week and month-to-month payroll system.

The sequence of activities required to complete a payroll cycle, which for 250 employees would represent approximately a morning's work for one person, are shown in Figure 8.15.

Should any incorrect entries be made during the payroll cycle, the resulting incorrect totals can be amended using program 13 – amend totals – which permits the user to amend either totals for the current period or year-to-date totals.

FROM

bank giro credit 

DATE

DESTINATION
BRANCH
CODE NUMBER

00-00-00

£ 000.00

BANK

BRANCH

ACCOUNT

BY ORDER OF

FROM

NATIONAL WESTMINSTER
LAW COURTS BRANCH
DALE END

bank giro credit 

DATE 29/04/81

DESTINATION
BRANCH
CODE NUMBER

80-90-65

£ 800.00

BANK

LLDIPS

BRANCH

SOLIHULL

ACCOUNT

F T MORRIS

NO. 73542317

BY ORDER OF

J.B. SMITH & SONS LTD.

REFERENCE : 000

FROM

NATIONAL WESTMINSTER
LAW COURTS BRANCH
DALE END

bank giro credit 

DATE 29/04/81

DESTINATION
BRANCH
CODE NUMBER

09-08-76

£ 516.00

BANK

NATIONAL WESTMINSTER

BRANCH

ERDINGTON

ACCOUNT

R D EVANS

NO. 63433760

BY ORDER OF

J.B. SMITH & SONS LTD.

REFERENCE : 000

Figure 8.12 Bank giros with initial alignment.

PAYROLL	ANALYSIS TOTALS	29/04/81
<hr/>		
1 PERIOD TO DATE TOTALS		
2 PERIOD END TOTALS		
3 YEAR TO DATE TOTALS		
4 YEAR END TOTALS		
5 RETURN TO MENU		
Select Option (1-5):.		

Figure 8.13 *Print analysis totals menu.*

End-of-year procedures

End-of-year procedures (program 10)

At the end of the tax year it is necessary to produce certain payroll documentation, make a backup disk, and then to reset the system in readiness for the next tax year. Thus the end-of-year procedures program provides facilities to:

- 1 print P60 forms for all employees on pre-printed stationery
- 2 print P35 (CS) documents on plain stationery
- 3 perform the end-of-year 'cleardown' which will clear each employee record of 'active' data in preparation for the next tax year, delete leavers from the payroll file and release their employee numbers for re-allocation

Blanket changes (program 11)

Although not strictly speaking an end-of-year procedure, blanket tax changes as issued by the Inland Revenue can be keyed in using this

P A Y R O L L A N D E M P L O Y E E S J O B C O D E S

J.B. SMITH & SONS LTD. 5/05/81

FINAL TOTALS	YEAR-TO-DATE TOTALS FOR PERIOD NO. - 2
STANDARD HOURS	540.00
OVERTIME HOURS @ RATE 1	0.00
OVERTIME HOURS @ RATE 2	0.00
OVERTIME HOURS @ RATE 3	0.00
OVERTIME HOURS @ RATE 4	10.00
UNPAID HOURS	0.00
BASIC PAY OR SALARY	4830.76
OVERTIME PAY	50.50
BONUS	0.00
COMMISSION	0.00
OTHER PAY 1	0.00
OTHER PAY 2	0.00
N.I. BENEFIT	0.00
HOLIDAY PAY	0.00
GROSS PAY	4880.26
COMPANY PENSION	128.26
P.A.Y.E.	110.00
EMPLOYEES N.I.	316.43
STANDARD DEDUCTION 1	20.00
STANDARD DEDUCTION 2	2.00
OTHER DEDUCTIONS	0.00
TEMPORARY DEDUCTION	0.00
TOTAL DEDUCTIONS	1072.35
NON-TAXABLE 1	47.00
NON-TAXABLE 2	0.00
NON-TAXABLE PAY	47.00
NET PAY	3362.87
BROUGHT FORWARD (START OF PERIOD)	0.00
CARRIED FORWARD	0.00
EMPLOYER'S N.I.	557.31
EMPLOYER'S PENSION	200.00

Figure 8.14 Year-to-date totals.

procedure. Such blanket changes are issued on P7X forms and will relate to suffix H,L,P and V tax codes. When the changes for these

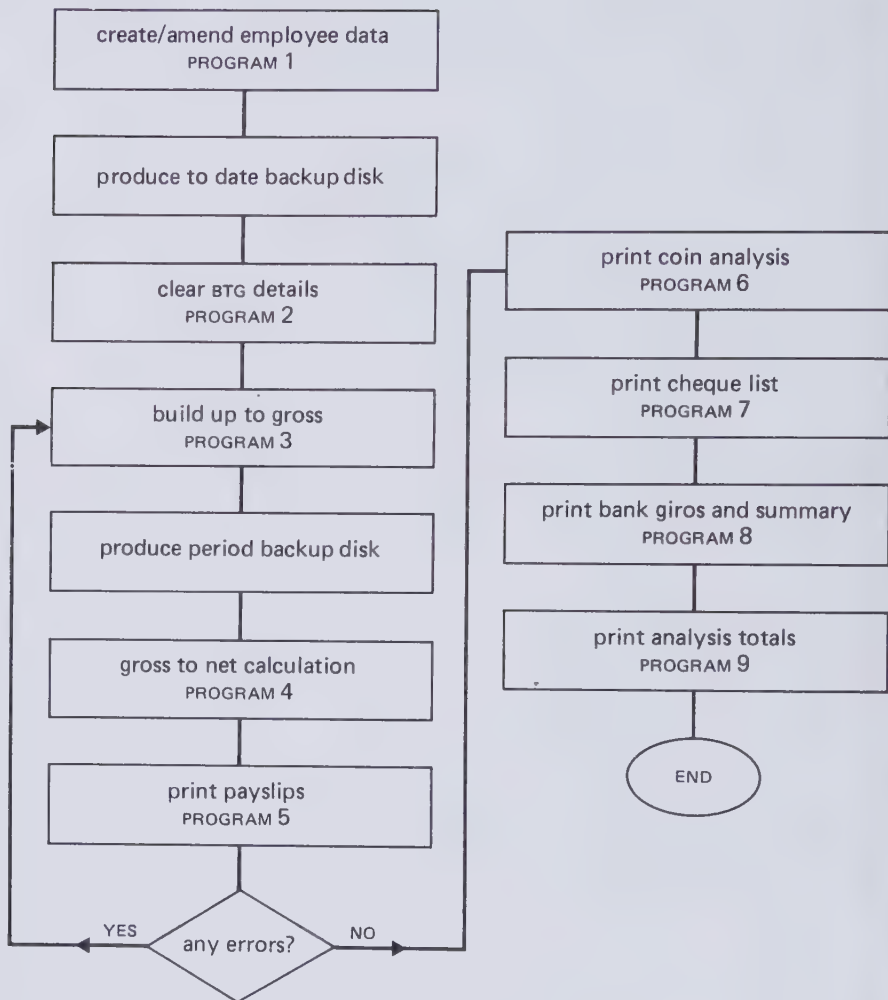


Figure 8.15 The payroll cycle.

four tax code suffixes are entered, each employee's record whose code is to be amended is automatically updated and a report of the change also printed.

Conclusion

Payroll is an ideal application for a microcomputer for companies with up to a thousand employees. Payroll calculations, although well specified, are reasonably intricate and extremely boring to perform manually. Equally, the amount of data that has to be stored for payroll is, in microcomputer terms, relatively small, so that records for up to 250 employees can be held on one 5¼ inch floppy disk.

Also, because most payroll functions are exactly specified, a microcomputer-based payroll system is very simple to implement and virtually mimics the equivalent manual system whilst operating much more quickly and efficiently.

These features, combined with the ability to produce printed reports and to print on pre-printed stationery, perhaps explain why there are more installations of payroll packages than any other single microcomputer applications package.

Glossary of Terms

Access time	Time taken to transfer data from disk to computer memory.
Address	Identifier of internal storage location.
Alphanumeric	A character set which includes only alphabetic and numeric characters and in some interpretations can also include punctuation marks and other symbols.
Applications package	A proprietary program or suite of programs, usually developed by a software house, for a specific application (canned software — American)
Assembler	Systems software which translates an assembly language into a machine-readable code.
Assembly language	<p>A programming language which is 'lower' than a high level language such as BASIC (which uses understandable English words) but which is 'higher' than a machine-readable code.</p> <p>Assembly languages are usually the province of professional programmers, are more difficult to use than higher level languages but are more efficient in terms of processing and size.</p>
Backup	Data retained, usually on disk, separate from the operational systems. Used to reinstate the system if a failure should occur.
BASIC	The most used high level language for programming microcomputers. Stands for Beginners All-purpose Symbolic Instruction Code

Baud	Measurement of the speed of transmitting data in bits per second.
'Boot up'	A euphemism for reading in systems software (operating system) from disk, particularly CP/M.
Bit	Abbreviation for binary digit – a character or byte being usually made up of 8 bits.
Bug	A euphemism for a fault, usually in a program. Hence to debug is to correct a fault.
Bus	Etched circuits (wires) providing electrical connections between chips.
Byte	Equivalent to a character and composed generally of 8 bits on current microcomputers.
Cassette	Physically exactly the same as a music cassette and used as a storage medium (instead of disks) on smaller microcomputers.
Central processing unit – CPU	The main control unit of a computer incorporating processor, main memory and input/output controller.
Character	Equivalent to a byte. Can be alphabetic, numeric or alphanumeric.
Chip	A small piece of etched silicon which contains circuits which perform processor and memory functions. Usually mounted in plastic with metal legs which can be plugged into sockets within the computer.
Compiler	Systems software which translates an entire program in a high level language into a machine readable code program.
Correspondence quality typefont	Acceptable typefont as produced by a dot-matrix printer.
CP/M (Control Program for Microprocessors)	An operating system, originally developed by Digital Research Inc., which is used in numerous microcomputers.
Cursor	Position on computer screen where character currently being entered will appear. Often represented by an underline character and in some configurations, flashes on and off.

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Daisy-wheel printer	A fairly slow but high quality printer.
Data	Information.
Database	A file of data structured to allow a number of applications to access the data and update it without dictating or constraining the overall design of the content.
Digital	Representation of data in form of digits taking discrete forms, i.e. binary form of 0 or 1.
Disk (or disc)	A disk(ette) with a magnetic surface used for storing data which can be accessed directly (rather than serially as with tapes). For microcomputers floppy disks are cheap, removable and can store up to 500 kbytes on a single side, whereas Winchester hard disks are expensive, non-removable but can store up to 30 Megabytes.
Disk operating system – DOS	A program in the systems software which controls the operation of the disk storage system.
Dot-matrix printer	A relatively fast printer.
EPROM	Erasable programmable read only memory – a ROM chip that can be erased and programmed.
Field	A group of alphanumeric or numeric characters.
File	A collection of many records.
Floppy disk	See disk.
Formatting	The process by which a new disk is prepared to accept programs and or data
Hard copy	Printed computer output.
Hard disk	See disk.
Hardware	The physical components making up a computer.
Hexadecimal	A number system to base 16 as opposed to digital to base 2.

High level language	A computer language that uses English and mathematical notation and which is translated into a machine code by a compiler or interpreter.
Hobbyist	A home-based computer user.
Ink-jet printer	A relatively expensive and fast printer using ink jets to produce the printed image. Very quiet operation.
Input	Data entered into the computer.
Interface	A device and the appropriate programs that allow different electronic devices (such as printers) to communicate with a computer's CPU.
Interpreter	Program which translates a high level language line by line to a machine readable code.
I/O	An abbreviation used to cover input and output processes.
k	A measure of memory capacity $1\text{ k} = 2^{10} = 1024$ (approximated to 1000).
Letter quality typefont	High quality typefont as produced by a daisy-wheel printer.
Machine code	The numeric codes in 0s and 1s which are the only code which the CPU can understand.
Macro programming	Very high level programming.
Mainframe computer	A large computer usually marketed by companies which have traditionally supplied comprehensive applications and systems software together with appropriate support.
Mega	A measure of memory capacity $1\text{ Mega} = 2^{20} = 1,048,576$ (approximated to 1,000,000 or 1,000k)
Memory	Elements of the computer system that store data and program instructions. Internal memory is directly accessible by the CPU.
Menu	A form of design used in an applications program indicating what alternative sub-program options are on offer.

Microcomputer	A computer based on a single microprocessor unit — MPU — or chip.
Microprocessor	An integrated circuit which contains several computational elements on a single chip.
Microprocessor unit — MPU	A microprocessor designed specifically to control the components of a microcomputer.
Mini-computer	A computer between a microcomputer and a main-frame computer in both price and performance.
Modem	MODulator/DEModulator — a device which translates digital signals into an analogue form for transmission down an analogue telecommunications line.
Nano second	One-billionth of a second (i.e. 10^{-9} seconds).
Non-volatile memory	Memory which does not lose its contents when the power is turned off.
Operating system	A suite of programs that controls the overall operation of the computer.
Output	Data produced by the computer.
Package	A set of programs offering computing facilities for a particular application.
Parallel	A method of signal transmission in which all bits are transferred simultaneously.
Password	A personal codeword used for security purposes and known only to a restricted set of users.
Period	American word for a fullstop (.) — hence 'type a period' in VISICALC etc.
Peripheral	Hardware devices other than the CPU.
Printer	An output device which prints results on paper.
Printout	Output from a printer (hard copy).
Program	A collection of computer instructions — usually spelt as here, not as programme.
Programmer	A person who writes a program.

PROM	Programmable read only memory — a memory chip permanently programmed by the user which cannot subsequently be altered.
RAM	Random access memory — a memory chip which can be written to and read from. Loses contents when computer is switched off.
Random access	The retrieving of information from memory or storage via an index — direct access as opposed to serial access.
Read to or into	Enter information into memory or storage.
Record	Part of a file with a predetermined format and containing several fields.
Register	A high speed storage device in the MPU for the temporary storage of small amounts of data.
Resident monitor	Small resident program which will load the systems software from disk.
ROM	Read only memory — a memory chip programmed by the manufacturer which can only be read from, not written to.
S100 bus	The most popular bus used to interconnect sections of a microcomputer.
Serial	A method of signal transmission in which bits are transferred one at a time.
Software	A generic term for programs.
Software house	A computer services company exclusively developing and marketing software.
Stand-alone	A computer system or package which operates independently.
Store	See memory.
Systems software	Programs which provide the computer's operating system.
Systems house	A computer services company which buys in hardware and produces a total computing system for sale under its own marketing label using its own software.

True descenders	The tails of characters such as p, q, z etc. which occur below the print line.
'Turn-key' system	A computer system delivered complete and ready for the user to 'turn the key'. Likely to be supplied by a systems house.
Upward compatible	A program or suite of programs that will operate on larger machines in the same range of microcomputers.
User	General term for a computer user.
User-friendly	Designed to appeal to the user, particularly used of programs.
VDU	Visual display unit — a television-like screen for the temporary display of data.
Volatile memory	Memory which loses its contents when the power is turned off.
Winchester disk	A hard disk system in which the disk cannot be removed (see disk).
Word	A group of bits treated as a single unit, can be the same as a byte.
Word processor	A computer system for manipulating text.
Zeroise	An (unsuccessful) attempt to abbreviate 'to set to zero' — American.

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