Computer Basics for Health Practitioners 1993

A.C. Lynn Zelmer
Editor

Contents

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Published by the Australian Health Informatics Association (Queensland) Inc, with the collaboration of the Central Queensland Computer Users Society and the Department of Mathematics and Computing, University of Central Queensland.

ISBN 0 646 14657 2

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Acknowledgments

Many of the *Primers* are part of a series prepared by A. C. Lynn Zelmer, Lecturer, Department of Mathematics and Computing, University of Central Queensland, publications editor for the Australian Health Informatics Association (Queensland) Inc, and Associate Editor, *Informatics in Healthcare—Australia*, the new magazine for national health informatics practitioners.

Most have previously been published in the newsletters of the Central Queensland Computer Users Society (CQCUS) and the Australian Health Informatics Association (QLD) Inc.

'Choosing the Solution', was prepared by Liza Reinberger, Australian Centre for Unisys Software, Melbourne, and is reproduced with the permission of the *AMR Journal*. Information about the journal is available from: The Editor, AMR Journal, GPO Box 4119, Sydney, NSW 2001.

'Patient Care System: Greenslopes Repatriation Hospital' was previously published in a substantially different form as a Resource Book by UCCQ for the subject, Information Systems II.

'The Challenge of Change: Computers in a Regional Hospital' was presented in a different form as a paper at the UCQ, Faculties of Health Science and Business, Information Systems in a Regional Context Conference, 1993.

The editor and publishers gratefully acknowledge the assistance of:

- the management and staff of the three hospitals described by the case studies, without whom there would not have been projects to report;
- Sally McPhee (Computer Systems) and Estelle Bartley of Greenslopes Hospital, Brisbane, who inspired the first case study; Estelle Bartley, Jill Watts, and Helen Baker for their case studies;
- Peter Adkins, RACGP SIG QLD, in the preparation of the section on word processing;
- Richard Owens from Apple; Bruce Young, Steve Kirby, and others from UCQ, Faculty of Health Science, particularly in the preparation of the Multimedia section;
- Mary Cranston, Allison Plant, Peter Stoneley, and others in Mathematics and Computing, for their proof reading, editorial assistance, and support for 'end-user' computing;
- Don Troughton, UCQ, Educational Media Services, for the preparation of some of the DTP illustrations;
- the author of the *Community Media Handbook* (Metuchen, NJ: Scarecrow Press, 1979) for the page layout illustrations and some of the DTP terminology, used with permission;
- various individuals and suppliers in the preparation of the barcode information,
- the readers of the CQCUS and AHIA(QLD) newsletters, the computer workshop participants in Queensland and New Delhi, India, and the (primarily nursing) students in my computing classes for their encouragement to continue preparing basic materials that helped them to understand the technology; and finally
- my partner, Professor Amy Zelmer, for her inspiration, support, and, most importantly, her proof reading skills.

Introduction

This publication has two primary purposes.

First, it is intended to assist novice computer users to understand the basics of computer use. To that end, we have included a number of *Primers* on a variety of current computer topics.

Second, we were concerned at the lack of basic information on Australian experience with the implementation of computer systems. The three case studies included here begin to provide that Aussie experience.

AHIA(QLD) and the editor are very grateful for the assistance of all of the contributors to this *Yearbook*. Without your assistance the *Yearbook* would not have been possible.

The Primer Series

The *Primers* selected for inclusion here are the result of many years of training programs for novice computer users in situations as different as primary school children in Alberta, GPs in Brisbane, nursing students in rural Australia, and primary health care workers in India.

While the novice users will not typically start developing multimedia applications immediately, they are often very interested in knowing more about such topics.

Buying your first computer, choosing a system, selecting software, and similar topics are, of course, directly aimed at the novice user or first-time system purchaser.

The Case Studies

The case studies have been developed by healthcare practitioners, with the assistance of academics, to document the process of change in their own place of work .

It is no accident that the three cases in this yearbook are nursing related and written by nurses. Nurses have been in the forefront of implementing many health information systems and learned early that the human aspects involved in implementing a new technology are as important, or even more important, than the technological aspects.

Communicating the Basics

Computer books and magazines are one of the largest areas of technical publishing, yet it is amazing how many fail to meet the needs of novice users for basic information presented in a non-threatening format. This series attempts to overcome those problems and received its inspiration from several sources.

First, the Royal Bank of Canada published a similar series of single topic monthly letters on writing and communication skills many years ago. Second, the book format was successful in the editor's *Community Media Handbook*, published over a decade ago.

Finally, in 1969 University Associates in the US demonstrated with their *Series in Human Relations Training* that it was possible to build a significant resource base from very small beginnings.

The Future

Some of the current *Primer* titles have been written to meet specific training needs, some have been the result of attending a technical session where the speaker did a particularly good job of explaining a difficult concept, and others have resulted from the editor's on-going research into the needs of 'end users', those computer users who end up having to use the programs and systems produced by our computing profession colleagues.

The case studies have resulted from the efforts of some of those end users, nursing colleagues who were trying to understand the computer-based systems they were implementing.

As new topics are constantly being prepared, this is the first of what is hoped will be an annual yearbook from the Australian Health Informatics Association (Queensland) Inc. This organisation holds regular educational meetings, provides basic computer training programs, and serves to promote health informatics in Queensland. AHIA(QLD) also provides a link with other state and national health informatics associations.

The next yearbook will probably contain revisions of one or two *Primers* from this issue—some of the basics will have changed between the time this yearbook went to press and the first copies were sold—plus new Primers and Case Studies.

If you have any comments about the materials in this publication—including corrections—or materials that might be suitable for inclusion in future yearbooks, please write to AHIA(QLD), or to the Editor at one of the addresses on the previous page.

A.C. Lynn Zelmer, Editor
Rockhampton, 30 June 1993.

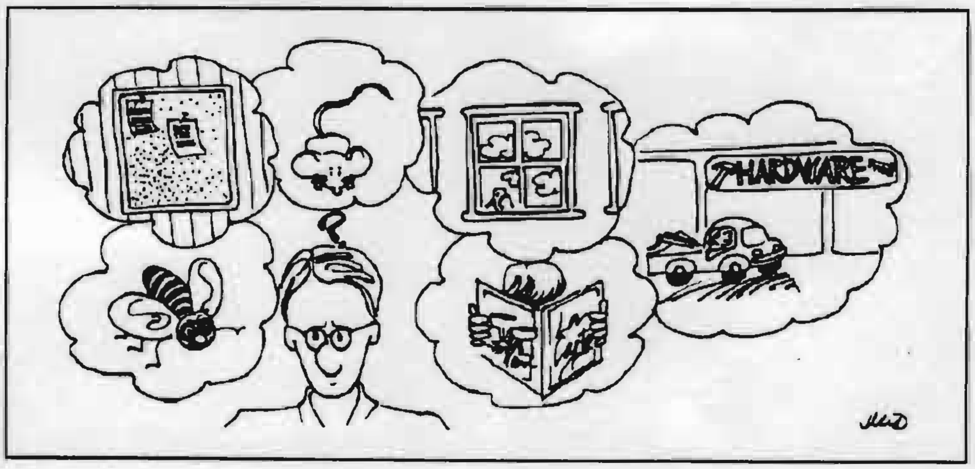
Successful Computer Use

'I have only anecdotal evidence but four years spent training people to operate word processors have left me with the distinct impression that those who have the most difficulty are the ones who want rigid lists of procedures to follow in every eventuality.

'... the successful users probably just remember roughly what sort of procedure is needed, then either look up the details or press buttons and see what happens.

'Eventually, of course, what works gets "hard-wired" into our brains for things we do a lot, but we certainly don't memorise long sequences of action right off.'

Rosemary Rodd, ***Playing by the Rules***
New Scientist, 30/6/90, 54.



Computer Primer Series

Buying Your First Computer

This Primer was originally written for the student or home computer purchaser. The concepts—quantifying needs, prioritising, looking at a range of products, and trying before you buy—are just as important to the GP, small clinic, small business, or institutional purchaser. The scale may be different, but the needs are similar.

The Primer also includes a list of terminology useful for the novice, defined in plain language.

So You Want to Buy a Computer?

When buying a new computer, or upgrading an old one, you should follow the same process that you would use for any other major purchase, and the purchase should receive the same care and research before you decide to act.

- *Set a realistic dollar limit for your computer purchase.*

Because they are such wonderful tools, *personal* computers can make it much easier to produce a good looking school assignment or to keep the financial records for a footy team, the school newspaper, or family business. They can be status symbols and provide endless hours of enjoyment for the games player, but *do you need one?*

Setting a budget limit early ensures that you don't get into something you cannot afford.

- *Make a list of problems to be solved with the computer*

I've owned a variety of personal computers but the first one was purchased for two main reasons. First, I had a mailing list of several hundred names and a library catalogue which were almost impossible to maintain by hand. Second, I was preparing a large number of written reports and couldn't afford secretarial support.

The mailing list and catalogue required a system that would store information, allow changes to be made easily, allow me to sort the information into a new order (by post code perhaps rather than by name) and/or select parts of the data, and to both display and print the information.

The written reports required a system that would allow me to prepare the reports, easily change and reuse parts of the reports, and to print them out in various formats. As my reports were often 50 or more pages in length I wanted a system that would automatically generate a table of contents and hoped to find a system that would handle footnotes conveniently.

- *Quantify the tasks involved in these problems.*

My first computer was purchased when memory and data storage were much more expensive than they are today. I calculated how much space each name on the mailing list would take for storage in order to determine how much disk storage would be necessary. Calculations can be much looser today but are still necessary to help you make a decision about the size of the hard drive you need.

Minimum Hardware Requirements

My university encourages students to purchase a computer that runs specified software, minimising teaching and marking difficulties. It recommends that students have an IBM/MS-DOS computer with a fast CPU, at least 1MB of memory, a floppy disk drive (5.25", 1.2M), a 20 MB hard drive, an EGA display, and a modem and printer.

This minimal hardware configuration is supposed to enable a computing student to run any of the software that will be used in their course. Other courses have different requirements. For example, a nursing student can complete the computing assignment using any computer with a word processor and a database manager.

This configuration would not be suitable for other needs, will not run some of the software being used for assignments in senior subjects, and is far behind the machines currently being sold. To be cost effective, and run current Windows applications, a new IBM/MS-DOS machine (Jun 93) would probably have a 486SX or 486DX CPU in the 33-50 MHz range, come with a minimum of 8-12M of RAM, 3.5" floppy drive, 200MB hard drive, SVGA display, and mouse. Depending upon quality, such a machine costs roughly $3-4,000.

Machine like this are available in either desktop or notebook configurations. Other users might require a comparable machine that uses the Macintosh operating system because of their particular needs—ease of use and graphics, for example.

The tasks need to be quantified over time as well. My mailing list has about a 10% change per year and I need to keep archive copies of the entries. In this case I can keep a paper archive, but your needs might dictate tape or other electronic archiving.

- *Prioritise your list of tasks.*

Some tasks would be nice to have done, others are essential. A list of tasks by priorities will help answer questions such as whether it would be merely nice or absolutely essential to have a high capacity hard drive.

- *Look to the future! Talk to people who have used computers for similar work in the past. How did their needs, and priorities, change over time?*

  What kind of training and support was required to operate their system?

Your best source of additional information is to read the computer magazines which target your area of interest (CAD, database, DTP, business, information systems, home, games, etc.).

What kind of software?

Assuming that your tasks can and should be done by computer, the type of computer purchased will depend upon your locating software that will allow you to effectively do these tasks on the computer.

- *The software may be specified for you.*

Parents buying a computer for their children will usually find that their school uses specific software tools that will dictate the type of computer required to achieve compatibility. Similarly, uni courses require specific types of computer to run the software used in assignments, and a GP might find that the insurer specifies the type of software, and forms, for submitting claims.

- *There are word processing, spreadsheet, database, and communications programs available for almost every computer ever made.*

If your needs are modest you may find that almost any computer, new or old, can be used to solve your problems.

When I bought my first computer, my work included the preparation of reports with indexes and tables of contents. I chose a word processor with these features. Today I would also want the ability to prepare multi-column text and graphics. These features may not be available with a basic word processor.

- *Software should never be purchased without a 'test drive'.*

Don't let the salesperson simply show you the software. Insist on trying it out yourself—on a sample of your own work—before you make a decision. The software choice will determine what type of computer you require, take your time to make a wise choice.

Look at the various software alternatives for ease of use, flexibility, dependability and cost. In general, choose the least expensive option that meets your needs AND fits your style of working.

- *Applications software is typically written for one specific type of computer and cannot be used on another type.*

The software may also have special memory or other needs that dictate minimum or preferred hardware requirements. While software may run under the minimum requirements, the preferred requirements are almost always necessary for the software to run properly.

Your list of priorities and budget will determine whether you should, or can, go beyond the minimum system that will meet your needs.

Software Upgrades

Software developers continue to make enhancements and upgrades to the software they produce. Sometimes the changes fix bugs that customers have identified, other times the changes add new features requested by users. While the developer may constantly make changes, the costs of distributing the changes will necessitate combining several changes into one release.

The version number will reflect the changes. Major changes will result in a new version number. Version 2.03 therefore reflects minor changes to version 2, while the release of version 3 should indicate major product changes.

In order to retain customers the distributors of the software will usually allow registered customers to purchase new versions at a reduced cost. Bug fixes should be distributed free.

There are additional training and installation costs involved in upgrading your software. A new version of a word processor, for example, might use a different file format, requiring all your old files to be converted to the new format.

Order the upgrade if:

- the upgrade fixes a bug that has caused you problems,
- the enhancements are not only desirable but something that you will use sufficiently to justify the costs, or
- the changes will significantly improve your work, or the special printer drivers will significantly improve your printed output.

What kind of computer?

As a new computer buyer you want to get the computer that will best meet your needs within the budget you have available.

But it's ONLY 3 Years Old!!!

Sensible business people purchase computers based on their needs for the next three years. Government departments and schools talk about five to seven years of use from their computers but often have to replace their equipment sooner.

A good quality computer keyboard will last for one to three years of heavy office use. The computer itself will last much longer. Hard drives, printers, and other mechanical devices and are guaranteed to malfunction when you need them most.

Almost all computer users find that they 'need' more computer speed and power than they currently have. As computers are constantly dropping in price and increasing in speed and capacity this can be a never ending game of 'chase your tail'.

An otherwise well functioning computer, perhaps three years old and a little too slow or lacking features required to run the newest software, can still be a good first computer for a clerical worker or a student. Since most of us type relatively slowly, almost any word processor is faster and more useful than a typewriter. A novice programmer can similarly afford to wait a few seconds longer for a program to compile since most of his/her time goes to program design and typing; the computer is still faster than having to wait for an overnight 'batch' run, as happened as recently as ten to fifteen years ago.

Some computer companies offer a 90 day warranty, others 1, 2, or even 5 years. The length of the warranty is some indication of what the manufacturer feels about customer service and/or his confidence in the hardware.

Unfortunately computer manufacturers are just like any other business and some will go baknrupt every year. In the final analysis, a warranty is only as good as the company behind it. Select your vendor wisely, looking for people that care about you as an individual and who look as though they will be in business for some time. Such a company will probably also offer one of the best warranties.

Price the total computer system—hardware, software, maintenance, and training—before you make a selection. Some computers, such as the Macintosh, seem to be more expensive than their competitors—until you price all of the extra boards and options to achieve the same functionality.

- *What type of computer and accessories are required to run the software of your choice?*

How often will you be needing the special features? If an expensive feature will not be used often, omitting it might save your budget.

- *Can you afford this choice, or do you need to make a compromise?*
- *Must your computer be portable or will a desktop model be satisfactory?*

The physical configuration of the computer does not, in general, affect its performance. My laptop computer, for example, is just as powerful and has the same limitations as any other machine in its class. I have a need for portability because of the way in which I work and paid a premium price for that portability. Most users only require standard equipment.

Mac vs IBM vs Other

The Macintosh, from Apple, and the IBM/MS-DOS 'clones', from a various manufacturers, are the two main desktop computer types. These computers are available in a variety of packages ranging from entry-level laptop or desktop computers to the powerful network servers.

The Macintosh has had a black and white graphical user interface for many years while the DOS computer, often with a colour screen, has been character and command oriented. Recently more powerful DOS computers have also become graphically oriented and most Macintosh models can now display colour. Both types have a wide range of available software although the Macintosh is generally considered to be easier to use because of the consistency between applications.

The Amiga computer, from Commodore, has had the best colour graphics system among personal computers for many years. Similarly Radio Shack (Tandy) has had a true notebook computer for about a decade and Atari, the games manufacturer, and others have pocket sized computers that are fully functional. In all cases, their major fault is likely a lack of promotion resulting in a lack of support from software suppliers.

Look closely at your needs and buy the computer that runs the software and has the other features that you need for your individual situation.

- *Are the manufacturer and local vendor reliable? What do other customers say about the vendor?*

I almost always buy from a vendor that I know. I don't necessarily get the best initial price, but if I want service from the vendor I have to expect to pay for the time taken by the vendor to get to know my needs.

- *What kind of service is available? Does the vendor provide assistance with software installation? Who provides maintenance both during and after the warranty?*

No computer system is cheap, even if the price looks to be a bargain.

In a business setting the cost of the computer itself, the hardware, accounts for roughly half of the initial cost. The software, the programs which provide the applications that make the computer useful account for the other half. In addition, it will cost roughly one quarter of the initial capital cost, per year, to maintain the computer. This includes paper and other supplies, maintenance, software upgrades, insurance, etc., but excludes communication and similar costs. Training to use the system will cost about the same as the initial capital expenditure but is spread over several years.

While a home user won't likely spend the same amount of money on software as a business would, I think that the cost ratios for a home or student system for reasonably full time use would likely be fairly similar. In other words, if you spend $1,500 on a computer you can expect to spend almost the same amount for software within the first year and $500-750 annually for supplies, maintenance, etc. Some costs will be lower if you only use the computer on a casual basis, but why would you want to buy a computer for casual use?

Printers

Impact dot matrix printers provide inexpensive output. The more printhead pins, the better the quality of print. Printer ribbon and paper costs are low, and compare favourably with a typewriter.

Laser printers, commonly 300 dpi and relatively expensive ($1,500-5,000) to purchase, provide the best quality output for normal use. Paper and toner costs are about the same as for a photocopier—typically at least 3-5 times the cost of an impact printer. Graphic output is generally very good.

Ink jet printers are relatively inexpensive (under $1,000) and provide very good text and graphical output, typically up to 360 dpi, but are much more expensive to operate than a laser printer.

Terminology

Bug: Software/Hardware: a bug is 'an undocumented feature' in some minds and a stupid error that should have been caught by the developer in others. Novices should understand that bugs, or errors, are inherent in almost any computer software or hardware product; it's just that some products are worse than others.

Bubble Jet Printer: Hardware: currently the best quality, low-cost, dot matrix printers available. They operate by heating a droplet of ink which expands and squirts onto the page. Resolutions of 360dpi are common.

Bulletin Board: Application: a computer bulletin board is the electronic version of the display board where notices, reminders, etc., can be posted for later retrieval. Bulletin Boards are accessed via a modem and the telephone line,and are typically operated by individuals or clubs as a community service or hobby. The best boards provide a reliable source of shareware and public domain software as well as computer advice and messaging services.

CAD/CAM: Application: computer aided drafting/computer aided manufacturing. (CADD adds Design)

CD-ROM: Hardware: a computer data storage system using technology similar to that in CD music systems.

CGA/EGA/MDA/VGA/SVGA: Hardware: these are all display adaptor designations for an IBM/MS-DOS type computer and indicate the type of text and graphics which can be displayed.

Communications: Application: interchange of information using computers, see electronic mail for one type.

CPU: Hardware: the Central Processing Unit is the chip in the hardware where the computer's work is accomplished. IBM/MS-DOS computers essentially use a CPU manufactured by Intel Corporation and referred to as a '286' (80286), '386' (80386), '486', Pentium, etc. The Macintosh computer uses a Motorola CPU such as the 68030.

Cursor: Hardware/software: the cursor is the point, usually indicated by a flashing bar or square, which indicates that the computer is ready to accept input. Normally text input will be displayed at the cursor location.

Database Manager: Application: a database manager allows the computer user to manipulate lists and similar data.

Desk Top Publishing: Application: DTP is a software and hardware combination that allows the computer user to layout and print pages of combined text and graphics.

Dot Matrix Printer: Hardware: A dot matrix printer is a low to medium quality computer printing unit that forms individual letters using a 'matrix' of small dots, often created by a tiny hammer striking the paper. An 'ink jet' provides higher quality output using a non-impact system.

dpi: Abbreviation: dots per inch

Electronic Mail: Application: Email is a computer messaging system that allows messages to be stored for later retrieval. Electronic mail systems can communicate worldwide through telephone or other links.

Floppy Disk: Hardware: a data storage system that uses magnetic coated flexible plastic diskettes as the storage medium. Older computers will use a 5.25 inch square diskette with either 360K or 1.2M capacity; newer computers will generally use 3.5 inch square hard-sided diskettes with either 720/800K or 1.4M capacity.

Games Port: Hardware: a motion oriented input mechanism, usually for games use.

Graphics: Application: graphics include any non-text data form (photographs, icons, drawings, etc.).

Hacker: Concept: originally the term to describe an individual (often a 'nerd') whose work or hobby required intimate knowledge and understanding of a computer, such a person was almost always a programmer and produced software utilities and applications for personal use; now applied to a person who uses a computer for illegal purposes.

Hard Disk: Hardware: a hard disk uses a non-removable magnetic platter for data storage.

IBM/MS-DOS: Software (usually): DOS commonly refers to the microcomputer Disk Operating System jointly marketed by IBM and Microsoft Corporation.

Icon: Concept: an icon is a representation of something else, usually graphical when used in computer terms, thus a graphic of a file folder is used to represent a data storage location.

Laptop: Marketing term: a laptop computer is small enough to be used in an airline seat and can usually be battery powered.

Laser Printer: Hardware: a paper printing technology that works much the same way as a photocopier except that the image is generated by a laser beam onto a sensitised drum. Medium to high quality output.

Modem: Hardware: a modem converts digital data to sounds that can be sent over the phone lines and vice versa.

Mouse: Hardware: the mouse is the most common of the alternate input devices that includes trackballs, light pens, touch sensitive screens, and digitisers.

Network: Hardware: Any interconnection system to allow computers to share resources such as printers or communicate using electronic mail or similar facilities.

Paperless Office: Myth: just as computers have been promoted as being the salvation of any business, they also supposedly cut down on the amount of paper used in any computerised activity.

Presentation System: Software: presentation systems are common business applications for the presentation of 'slides' combining text and visuals on the computer.

Printer Driver: Software: special files that enable your software to convert its print output into a format that is designed for the specific features of your printer.

Public Domain Software: Software: in the early years of personal computers many developers produced useful computer products simply for the pleasure of doing so. As they didn't want to be bothered with commercial distribution they put the products into the 'public domain', allowing the software to be distributed without cost. Today there is almost no software distributed in this manner and computer users should be prepared to pay for the software they use.

Shareware: Software: a category of semi-commercial software where you can evaluate the item before purchase. Shareware is inexpensively distributed through 'user groups' and individuals; if you use the software you are required to send a 'registration' payment to the software developer. While some shareware packages cost as much as their more commercial counterparts, the normal registration fee of a shareware package is $50-100.

Software License: Software: computer users typically purchase a license to use the application when purchasing the physical embodiment of the software (disks, manuals, etc.). Other rights, especially the right to distribute copies of the software, are retained by the developer. Unfortunately some users distribute 'bootleg' copies of software, a practice which is both illegal and damages the ability of software developers to survive.

Spreadsheet: Application: a spreadsheet is the electronic equivalent of an accountant's worksheet, complete with formulas and functions that permit automatic calculations, etc.

UPS: Hardware: an uninterruptible power supply keeps your computer operating at least long enough to shut down properly when the power fails.

Utility: Software: a category of software which includes all the useful programs, often small, which make your computer tasks easier. Utility programs assist in finding files, executing programs using a menu system, translating files from one format to another, etc.

VDT/VDU: Hardware: the computer screen or visual display terminal/unit, provides a paperless output device for your computer work.

Virtual Memory: Hardware/Software: something that is virtual doesn't really exist; a virtual memory system uses slower, but cheaper, space on the hard drive to expand the working memory available to the CPU.

Virtual Reality: Concept: VR simulates a situation that, in theory, cannot be differentiated from reality—uses computer generated images, sound and motion, etc., and is becoming common in training.

Voice Input: Hardware/Software: an input device that controls the computer through spoken commands by matching a voice pattern with a small list of commands that have been previously 'learned' by the computer. Note that some computers also have voice output, usually accomplished through a voice synthesiser 'reading' text rather than from 'digitised' sound.

WIMPS: Concept: WIMPS refers to the attributes of a 'gooey' (GUI or graphical user interface)-- windows, icons, menus and pointers.

Windows: Concept: as with windows in a house, computer software windows allow different views of the same data, similar views of different data, etc.

Software: an enhancement to the IBM/MS-DOS operating system to effectively use mice and provide a graphical user interface.

Word Processing: Application: allows the computer to be used as a sophisticated typewriter; while spelling checkers and other utilities are often used, any word processor will allow text to be created, revised, stored and printed.

Work Station: Hardware: a powerful computer unit for individual use, may be stand alone or part of a networked computer system. Work stations are common in CAD, mapping, graphics and engineering applications and normally provide a GUI.

M&C UCQ CQCUS

Computer Primer Series

Portable Computing—Luggables, Laptops, Notebooks & Palmtops

There is an old army joke, with more than a little truth to it, that portability is defined as 'anything that either has handles or can be moved with a 4x4' (heavy duty 4 wheel drive military ute).

In the 1950s and 60s computer manufacturers followed a similar tradition. Some minicomputer models, for example, were built into desks or cases that allowed them to be moved, but hardly made them portable. Microcomputers were smaller, but they also tended to be packaged in such a way—separate terminals and system units, for example—that made them moveable but not easily portable.

This changed in the late 70s with systems—monitor, system unit, floppy disk drive, keyboard and acoustical modem—which would fit into a padded bag for carrying. Weighing roughly 15 kg they were hardly ideal, but did show that portable computer was realistic.

In the early 1980s Osborne, Kaypro and others brought out luggable, single box computers, Radio Shack introduced the first notebook computer (lighter than today's notebook computers but with an 8 line screen and limited memory) and several manufacturers introduced the handheld computers that evolved into today's executive organisers and palmtop computers. The market responded enthusiastically to many of these entries—portable computing became a reality!

> Today we can buy a fully functional laptop computer for little more than the cost of a comparable desktop unit, and, at a slight additional cost, it is possible to have a completely portable notebook system (battery powered computer and printer, modem, hard drive, and manuals) that fits into a slim briefcase with enough room to spare for business papers and a change of clothes.

The most recent notebooks have super thin screens and at least one has a built-in inkjet printer. Colour is also becoming affordable. Alternatively, most monochrome machines will attach to an external colour display.

This Primer examines the current (1/93) state of portable computing to help you make an intelligent choice to meet your needs. Unless indicated otherwise, prices shown are Australian.

Form Factors—Luggable, Laptop, Notebook, Subnotebook, and Palmtop‡

Luggable (sometimes referred to as a 'lunchbox' computer)	12+ kg, 50 x 40 x 22 cm, screen varies.	Full featured, often fully expandable, normally mains powered, floppy and hard drive, normally monochrome.
Laptop	5-12 kg, 30 x 30 x 9 cm, 25 cm diag. screen.	Full featured, limited expansion, battery or mains, floppy and hard drive, VGA, colour now common.
Notebook	3-4 kg, 27.5 x 22 x 5 cm, 24 cm diagonal screen	Full featured, 386-486 chip, often limited or no expansion, battery life a limiting factor, floppy and hard drive, VGA, colour is expensive.
Subnotebook	1-2 kg, 27.5 x 22 x 2.5 or smaller, 24 cm diagonal screen.	New (1992), full-featured, 386 chip, hard drive, no expansion except through PCMCIA‡‡ cards, longer battery life, VGA.
Palmtop (or pocket size)	.5-1 kg, 20 x 10 x 2.5 cm, 12.5 cm diagonal screen.	Often special purpose or limited function, typically NEC V20/30 chip, battery (AA), limited screen and keyboard, software in ROM or PCMCIA‡‡ cards, CGA (some true 25 line x 80 character).

‡ This chart describes typical machines in each category. Dimensions ,weights, and features are approximate and provided for comparison purposes only.

‡‡ Credit card style memory packs.

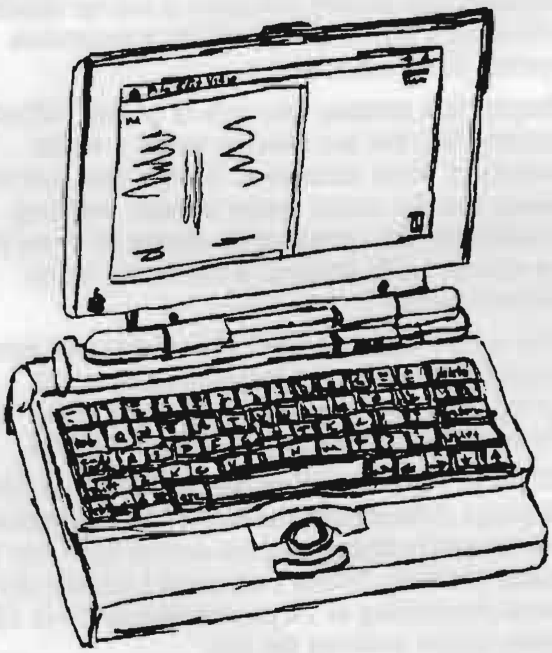
Searching for an Ideal System—A Personal Odyssey

Your ideal system obviously depends upon your unique needs.

For the past 14 years I have been using both desktop and portable computers, upgrading as circumstances, and technology, required. In 1990 I obtained a battery/mains powered 8086-based DOS *laptop* (Toshiba 1200) with 2 floppy disk drives, a monochrome LCD screen, a lightweight (220v) printer, and a cigarette package sized 2400 baud modem. It cost almost twice as much as the 80286 desktop machines the uni was then buying, but provided mobility and functionality (word processing, communications and database).

The laptop has served me well and continues to be used daily as my second office machine (data communications and quick memos, accessing online databases, etc.). Its keyboard has all the function keys plus eight dedicated cursor keys, a local vendor, and an international service network.

In 1992 I upgraded to a Macintosh PowerBook 170 *notebook* computer for my primary office work. [The laptop was still too heavy to drag from one end of the country to the other].



This light-weight battery powered machine has a wide-angle (monochrome) screen that can be viewed by several people at once and a far too small hard drive. However, it operates my graphic (draw, paint and photo), word processing, and analysis software without problems.

Because of the cost of the system, I don't have an internal modem, nor do I have a battery powered printer, however I do have a small ink-jet printer that can be packed in my suitcase when required.

I still don't have *my* ideal computer—and I do have access to powerful desktop machines for my research and courseware development—but the combination of the Macintosh and Toshiba give me access to the two computer platforms I use regularly, and I seldom feel the need for a fancy desktop or colour unit for my daily work.

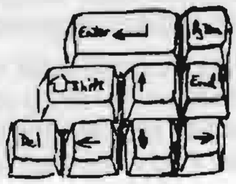
As well, I have learned some things to think about when selecting a portable computer.

- Purchase quality. A good local vendor and service support becomes more critical as your computer becomes smaller. Inexpensive hard drives are often also quite fragile.
- Test the keyboard and screen under *your* normal working conditions. If the keyboard is too small to allow you to type comfortably, and/or you cannot view the screen properly, you will never be happy with the machine. Likewise, look at how you connect a mouse and other peripherals.
- Buy light-weight IF you will be travelling a lot; every gram is important if you will be carrying the computer daily. Larger portable computers are quite useable as alternatives to desktop models; ignore their added weight if you will only occasionally move the computer.
- The computer isn't the only weight! How many 'extra' pieces are required for working on the road (computer, power pack, power cord, mouse, modem and cables, carry case, etc.)?
- Plan for expansion potential. Extra RAM, an internal modem, and a larger hard drive are all likely upgrades.
- Look at battery use and the cost of extra power packs. With my Macintosh, for example, I have two power packs, one for the office and another at home, rather than several extra batteries.
- Purchase security fittings as well as the machine. Portable computers are very theft prone, get a security cable and a lock for regular use—then use them!
- Always try the computer in actual working conditions, particularly typical lighting, before making a final decision.

The technology is still changing rapidly, but it isn't likely that many users would choose to use a palmtop computer as their only computer. It is possible to touch type on an 80-key keyboard less than 22 cm wide, but the small size, limited storage (maximum 20MB maximum for both flash RAM cards and 1.3 inch hard drives) and necessarily limited functionality will restrict these machines to frequent travellers and gadget collectors—for a few months at least.

Selection Tips

Keyboards: A 'normal' DOS keyboard has 101 keys including 12 function keys, 10 cursor control keys (Insert, Delete, PageUp, PageDown, Home, End, and 4 direction keys), and a separate numeric keypad. MS Windows and other graphical software also require the use of a mouse, sometimes part of the keyboard but usually an extra component.



An inverted 'T' layout for the DOS cursor keys.

The Keyboard/Screen is Almost Everything

Insist on four full-sized direction keys, preferably placed in an inverted 'T' pattern, and separate Home, End, PageUp and PageDown keys when buying a DOS-type computer. Twelve full-width function keys are also important.

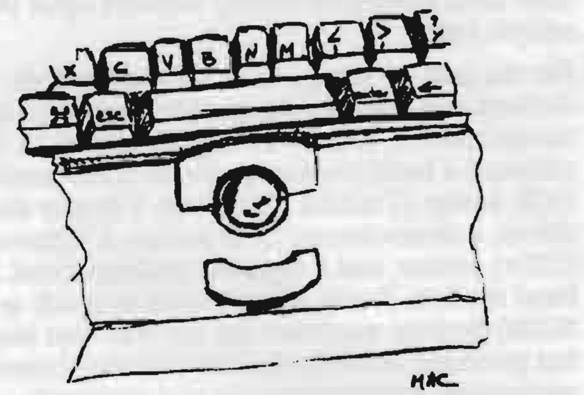
A built-in pointing device is more than convenient. With graphical software and MS Windows it is a must. Look for a keyboard layout that allows you to manipulate the trackball or other device and press its button with one hand. Your hand shouldn't have to travel far from the 'home' position to use the pointing device (see the Macintosh PowerBook computers for a large, readily-accessible trackball that sets the standard for DOS computers as well).

There are a wide variety of screen types—LCD, backlit, gas plasma, active and passive matrix, paper white, etc.—the best screen is always a compromise between brightness, sharpness, surface glare, and power consumption.

Test a prospective purchase for at least a couple of hours under normal working conditions before you make the final purchase decision.

Many portable computers have only 78 or 80 keys, with the numeric keypad and some of the function and cursor control keys overlaid on the regular keyboard. While a few portable computers do have built-in trackballs or other mouse substitutes, many require an add-on mouse that hangs off the side of the computer or dangles around your feet when working in an airline seat.

The Macintosh PowerBook has set somewhat of a standard here, with an innovative keyboard design that provides a wrist rest and an easily used trackball.



Macintosh Powerbook Keyboard with Trackball.

Screens: Increasingly laptop and notebook computers have multi-level (2, 4, 8, 16, 32 or 64 levels of grey) black and white or colour (usually 256 colours from a larger palette) screens. For many activities, a monochrome screen is quite acceptable but graphic, presentation and technical software often uses colour to advantage.

- More important than colour for many users is the built-in ability to connect an external display. This allows you have a colour display when required, or to connect to a projection system for presentations.
- Bright, fast screens take lots of power (affecting battery life) but are useable under a wider variety of work situations. Ensure that you can easily see the cursor under normal working conditions; the cursor often seems to 'disappear' on slower LCD screens, particularly when moved quickly.
- The screen must be viewable under your normal working conditions. I often work in small groups, thus the *wide viewing angle* of my PowerBook's screen is particularly helpful.
- WYSIWYG (What You See Is What You Get) displays (Macintosh and MS Windows) allow you to easily change the on-screen type size for easier viewing. When I am tired I usually do my word processing in 14 pt, resizing to 10 or 12 point before printing the file.
- Ensure that the screen brightness and contrast (and colour) are easily adjustable. Controls should be near to hand, yet recessed so that they will not accidentally be changed.

Memory: Modern computers simply cannot have enough memory. MS Windows, for example, may run in 4MB but requires at least 8MB of RAM for effective operation.

Computers are seldom sold with their maximum RAM installed. Even if you don't immediately install the maximum, you will probably be glad to have 10-20MB in the near future.

Floppy disk drives: I wouldn't buy any computer without some form of removable file storage for easy backup and file exchange. On conventional portable DOS computers this will be a 3.5" 720K or 1.44MB floppy disk drive. The newest models may have a PCMCIA slot which accepts credit card style memory packs. Since the standards, and capacities, of PCMCIA cards are rapidly evolving you should look for at least a type II capability.

Hard Drives: 120MB capacity drives seem to be the most common size currently being installed in computers sold in North America. The smallest drives (1.3 and 1.8 inch) have not yet achieved these densities, thus notebook and subnotebook drive capacity may be a compromise between cost and capacity. Quality does cost more!

- Consider using a compression utility to effectively increase the drive capacity.
- The hard drive MUST be shock-resistant and auto-parking—capable of withstanding a fall of at least 30-60 cm without damage.

Batteries: Manufacturers are very aware that battery life is very important to many users. While nickel cadmium (nicad) rechargeable batteries are currently the most common, they sometimes have difficulties maintaining a full charge unless they are fully discharged regularly. [They seem to 'remember' how much they were used at the last charge and use that as their new maximum.]

Newer nickel hydride cells, used on some better engineered portables, are more effective, and deliver more power per unit of weight, but are also more expensive. New combinations are constantly being tested; look for other battery types in 1993-4.

- Look for a system which allows you to continue working at the same point where the battery power failed and/or where you can change batteries without turning off the computer.
- Consider getting two power adaptors (one for the office and one for the road/home) to avoid having to crawl under the desk to disconnect the power adaptor.
- Many portable computers operate on 110 or 220 volts AC at 50 or 60 Hz. They only need a plug adaptor to operate almost anywhere in the world. Otherwise you will need voltage, and possibly frequency, converters as well. [The 'shaver' outlets in overseas hotels do not have the amperage to operate a computer.

Input/Output Ports: Many users will want to connect their portable computer into the same local area network (LAN) as their desktop computer. Often a network card is used, requiring a standard expansion slot. Other alternatives include the Xircom Pocket LAN adaptor which is smaller than a pack of cigarettes and connects externally.

- Ensure that your computer can connect to an Ethernet or other appropriate LAN if there is any possibility you will be requiring LAN service. This is particularly important if the portable is also your desktop computer.

You may also want to connect to a large screen display or to an external display system (overhead projector display tablet, projector, etc.). A built-in capability is much easier to use than an external adaptor and avoids carrying extra pieces of gear.

Serial and parallel ports will normally be provided. Look for a SCSI port or a proprietary expansion port if you intend to use an external hard drive, tape back-up unit, or other high speed device.

Modems: Internal 9600 bps modems, and FAX/modem combinations, are now the standard for portable computers. Telephone company regulations (and Australia's somewhat unique telecommunications standards) require manufacturers to submit their products for certification, a step that may take some time for a new model.

Modems and LAN adaptors may also be provided using PCMCIA cards and most older 'pocket' modems will still work quite acceptably with all Aussie commercial and Bulletin Board services.

- Check for Australian certification and software compatibility before purchase.

MultiMedia: The current 'flavour of the month' in computing is multimedia. This implies the ability to combine sound, motion (graphics, video and animation), colour and computers. None of the current notebook or subnotebook computers are multimedia machines, although some of the larger (laptop) units come close and Apple's promised new PowerBook with a built-in CD-ROM drive may set a new standard for portable multimedia.

Ergonomics and Convenience

Your portable computer will only become an indispensable part of your daily life if it is properly designed and constructed.

The screen must be adjustable for use in your normal working environment, whether that is flying on an airplane or working out in the Aussie sun from the back of a Ute.

The keyboard must be easy to use (see above), preferably with a comfortable edge for resting your hands on.

A built-in pointing device is critical. Most users suggest that the pointing device needs to be in the centre of the keyboard or just below the space bar—micro joysticks and trackballs are both popular with users.

The computer must be well balanced, both for use on your knees and when being carried.

The computer must run cool. Few portable computers have a cooling fan, thus all the heat generated must be dispersed in other ways, often through the bottom of the computer. Try to avoid buying a computer that will be too warm to use on your lap—if it gets that hot it will also likely have other heat related problems.

Portables used to have a carrying handle, today they are likely to have a sturdy (usually padded) carrying case. Ensure that the case will easily accommodate everything that is necessary for your normal use (computer, mains power adaptor, diskettes, cables, modem, manuals, etc.).

The carry case must be light enough for convenient carrying but sturdy enough for normal use and abuse. Try also to obtain a discrete carrying case—one that doesn't announce to the world that you are carrying $5,000 worth of theft-prone computer.

Finally, one of the best accessories you can have for your computer is a heavy duty cable and lock for securing your computer when it is not in use.

Australian PC World Notebook Comparison

The *Australian PC World* issue of Dec/January, 1993 has a cover article reviewing IBM/MS-DOS notebook computers. The information in the table below has been taken from that article, with the Macintosh PowerBook added for comparison purposes, to indicate the range of notebook computers now available in Australia.

Since this table is arranged by categories, and each category may represent several computers in the review, all specifications are indicative only.

CPU	Cost	Battery Life	Features	Comments
20MHz 386SX/SL	$3,000-$5,400	>2 to <3 hrs	2-4MB RAM (Max 5-10), 60-120 MB Hard Drive, 16-64 level grey.	Toshiba T1800 has 'best keyboard' and 'very good display'.
25MHz 386SX/SL	$3,500-$10,000	>1 to >3 hrs	2-4MB RAM (8-20 Max), 80MB Hard Drive, 32-64 grey or 256 colour.	Compaq LTE was the only computer reviewed with a built-in trackball.
PowerBook 160 68030	$5,000	~3 hrs	4MB RAM (Max 8), 80MB Hard Drive, 16 level grey LCD, built-in trackball standard.	PB 160 and 180 have built-in support for external displays.
25MHz 486DX	$7,500	<3 hrs	4MB RAM (Max 20), 120MB Hard Drive, 64 level grey LCD.	Texas Instruments 4000, average speed for class but excellent battery life.
33MHz 486DX	$5,000	<1.5 hrs	4MB RAM (Max 16), 120 MB Hard Drive, 32 level grey LCD.	Slower than the average 33MHz 486DX desktop but 4 times faster than slowest 386SX tested.

Portable Printers

When compared with my first office-based printer (1979), an LA-30 weighing approximately 50 kg, the thermal printer that served my portable computing needs for many years was a dream come true. It was small and light, worked from mains power or batteries (several 'D' cells located inside the platen), and was Epson compatible. Its faults included fussy setup and paper handling, and a print output that quickly faded in the heat, but it did give me a printed page on the road.

Printer technology has improved significantly since that time and it is now possible to get lightweight ink jet printers that can give near-laser quality on the road. Unfortunately, my experience suggests manufacturers seldom supply universal power supplies (120/220 volts) and the printers are still often fussy in setting up and in handling paper.

In my experience, it is usually possible to find power for printing, thus a battery-powered printer is not critical. I have used various lightweight desktop dot matrix printers when travelling by auto (save the original packing carton if you intend to take them by air) and sometimes roll my Apple StyleWriter (minus the cut-sheet paper feeder) up in a towel and stow it in the middle of a hard-sided suitcase—bulky and somewhat fragile, but reasonably light and it delivers excellent quality.

The Kodak Diconix 701, from its reviews (*PC Magazine*, Aug 92), looks like an acceptable DOS printer for both office and road. Weighing 7.0 lbs with both battery and mains adaptor, this 300 dpi (dot per inch) ink jet printer delivered 48 cps (characters per second) in quality mode, has a cut-sheet feeder and costs approximately US$ 549. HP and others have similar, but not so highly rated printers, at approximately the same price.

Some Personal Recommendations

I'm now convinced enough of the value of portability that I wouldn't recommend a desktop computer as the first computer for most novice users these days.

In practical terms, the cost of portable computing is coming closer and closer to the cost of desktop-bound computing, and the quality of portable computers is likely to be somewhat better than for comparable desktop units—miniaturisation does have some benefits. Sooner or later most of us start carrying our computers—portable computers allow you to do this more conveniently.

Conversely, I wouldn't recommend that everyone rush out and buy the smallest, flashiest, miniature computer available.

If you need to run MS Windows-based software, you should get the fastest 386 or 486 based computer you can afford with at least 10-12MB of RAM. Expansion capabilities are important.

If you want a lightweight computer to carry in your briefcase for word processing, spreadsheet and file management tasks, look at the wide range of notebook class computers. Remember that the Macintosh PowerBooks can read and write IBM/MS-DOS disks, and many Macintosh applications can import/export DOS file formats.

Users of business presentation software (slide shows, limited DOS/Windows animation) can use any of the colour portable and notebook computers with the right accessories for the display unit being used. Multimedia producers and users should probably wait a few more months for the next generation of machines with CD-ROM drives.

If all you want is occasional portability, consider one of the heavier, but very durable, first-generation laptops such as the Toshiba 1200. With or without a hard drive, this type of machine will provide good monochrome DOS-based portable computing, and should be readily available on the second-hand market.

Finally, the subnotebook computers are currently at the 'cutting edge' of technology—and their prices reflect this. Buy them only if you have a very deep wallet or a need for very lightweight computing, perhaps for field or clinical work—they would be quite appropriate for bedside data collection in a hospital, for example.

Additional Information

The purchase of a new computer, any kind of computer, requires you to identify your real needs, work patterns and budget.

You must then check the variety of available options to determine which best meets your needs. Reading the computer magazines regularly will help provide the information to do that.

Australian PC World, *Australian PC Magazine*, *Australian Mac World*, and several other Australian-based magazines provide coverage of the local market and often include product reviews. Unfortunately, the reviews often seem to lack both the rigour and the depth of their US counterparts.

PC Magazine and *MacUser*, American magazines but readily available from a news agent or library, have the most reliable reviews of computer equipment, and perhaps more important, provide an indication of the direction the markets in Australian will likely be taking within the next few months.

The *PC Magazine* issue of 24 Nov 92, for example, carried an advertisement for 'the World's First 486 - 33 MHz Notebook in Active or Passive Color'. Technical details include 9" color LCD, simultaneous LCD and external SVGA, 5.9 lbs w/battery, 2 hr battery life, 2-10MB RAM, 85MB hard drive (max 130MB), 3.5" 1.44MB floppy, several ports (1 serial, 1 parallel, 1 FAX/Modem, 1 trackball, 1 docking station), inverse 'T' keyboard layout. Cost from US$ 2,800 (passive matrix), 1 yr warranty.

Computer Primer Series

Choosing the Solution

Liza Reinberger

One of the major issues facing many health care professionals and particularly MRAs (Medical Records Associations) is the storage, organisation and retrieval of information. As database managers of large quantities of critical information the challenge is to manage that information efficiently. Computers are powerful tools to help us get the information we a re asked for, and to present it in a useful way. In today's world of 'doing more with less' there are few alternatives to computer based tools. The computer industry has shown a continuing trend of providing increasingly powerful and sophisticated systems at a fraction of their former cost. This process is bringing computer solutions within the reach of many hospital departments.

This paper discusses the major issues facing you, as a health care professional, when you are responsible for evaluating and selecting computer equipment and software to help you in your job. It describes an approach you can take to manage and control the process of choosing a computer solution that meet [sic] your needs□. The paper mainly addresses the processes involved in evaluating departmental applications, but much of it is directly applicable to any computer system selection.

The Selection Process

The process of choosing a software solution can be divided into five stages: planning, preparing, sourcing, evaluating, and selecting

Throughout the selection process, try to keep a number of key points in mind:

- Keep each stage separate

  Ensure you clearly understand what you want from the system before you set your requirements. Complete your evaluations of each of the products before you begin to compare the results.
- Keep lines of communication open

  Consult as many people as practicable at each stage, and make sure key people are informed of your progress.
- Be professional

  Respond to all communications promptly. Prepare for each step and demonstration thoroughly. Expect the same commitment from the vendors involved. Ensure you inform vendors exactly what you expect from them when you request information, plan a visit of set the scope of the demonstrations.
- Be confident

  Software applications should be treated just as tools. You are the professional using the tool, so if you disagree with the vendor, you are probably right.
- Organise information

  As you accumulate information, build up a file for each vendor, with key contact names and positions, addresses, phone and fax numbers, and additional comments you may have. Product literature, vendor responses and evaluation notes should also be included.

Stage 1: Planning

Computer products should only be bought to help you do your job. The first thing everyone associated with the purchase needs to be clear on is the reason for buying the product.

Try not to confuse the SOLUTION with the PROBLEM. Your starting point should be to determine what problems you wish to address and how the system is going to fit in with the longer term plan of your department.

To help you with this task, form a small selection team from relevant personnel such as colleagues, users and management. This group can provide valuable input in the planning stages and throughout all stages of the selection process.

With part or all of the selection team, evaluate and document the existing system and include information such as:

- How it currently operates
- How well it is accepted

- Outline of current problems
- Areas where it is unable to meet demands
- Areas that need improvement
- The flow of information and how data is collected
  - Time critical operations
  - Inputs and outputs including management information requirements
  - Data volumes
  - Regulatory requirements
  - Ad hoc and standard reporting.

Additional information could be included such as:

- Your objectives and scope of the project
- Your budget
- What time constraints you may have
- Anticipated improvements in departmental efficiency
- What internal and external changes you anticipate in the short, mid and long term and what impact they will have.
- How the purchase fits in with the strategic business and/or technological plans of your department and hospital.

Within this document, you should include a schedule of tasks and target dates for each activity in the five stages.

You should try to identify the people responsible, include milestones you want to achieve and any deadlines to which you are working. Allow time for holidays, busy periods and continuation of other activities.

On completion of the first draft of this document, circulate it to your management, users and colleagues for comments and suggestions, and amend it until you have agreement.

Stage 2: Preparing

Once you have completed the planning stage, you can decide on the functional requirements of your computerised solution.

Together with some or all of the selection team, there should be a brainstorming session to identify what everyone wants the system to do and how the system should be doing it. Even though some suggestions may be impracticable, they should still be put into a "wish list" before reviewing.

Discuss and agree how important each item is (you will probably go around this two or three times), logically group them, record them as a checklist and then assign a weight and/or a priority.

The weight is a number that reflects the relative importance of each item of functionality; for example, a checklist may comprise 50 functional items with a maximum score of 500 points. Each item might have a weight between 1 and 20 depending on how important it is judged as being. Priorities such as 1, 2 and 3 (denoting mandatory, desirable and optional) could be used.

The checklist should try to force similar responses so in the selection process you are not left comparing apples and oranges. Remember, though, sometimes responses genuinely may not fall into the categories you have indicated for good reasons such as database design and additional functionality.

Some information may be required from vendors that is not subject to weighting, such as policies, plans and system performance. This information may be obtained via a vendor questionnaire. You will need to inform the vendor of the volume of information which the system will be required to store.

Avoid writing requirements with a particular solution in mind as it may distort your results and cause you to downgrade a good (but different) solution.

Circulate your checklist and questionnaire for comment to users, colleagues, management and any consultants you may have. If you have access to computer staff, consult with them as well.

Use your checklist as a guide throughout the selection process but consider reviewing it if you discover functionality not previously identified.

It is a good idea to use a word processor or a spreadsheet to build up your checklist and vendor questionnaire. This lets you modify them easily and expedites transfer of information to vendors and team members either by hard copy, electronic mail or diskette. Similarly you can get their responses via the same routes. There are several software packages available from US suppliers providing word processing and ad hoc reporting capabilities and a base set of requirements that can be changed to suit. You can enter scores against the requirements and, based on your evaluations, comparisons between products will automatically be calculated.

Stage 3: Sourcing

Now that you have established what you want and know how you are going to evaluate the product, you need to find out what is available on the market.

There are many ways to source software applications. Some examples are trade shows, journal advertisements or reviews, the good old grapevine, user groups, other hospitals or similar organisations, your respective health department, suppliers of other software, universities or colleges, the Yellow Pages and professional associations.

When sourcing software, be inclusive. Try not to eliminate any at this stage unless they clearly do not apply to your needs.

Eventually you should end up with a considerable list of products that are at least worth looking at.

Do not be afraid of contacting overseas suppliers. They will tell you their local distributors (if any). Generally, the best way to contact them is via fax.

Initial request for information should try to identify key employees in the company, a fax number and their direct phone number, in addition to requesting information in the form of:

- Information over the phone
- 'Demo diskettes'
- Marketing information, brochures, etcetera
- 'Spec Sheets' for software, hardware and operating system
- Capabilities overview

or you can:

- Buy a manual
- Attend a training course.

Once you have a good initial idea of suitable products you may choose to send the checklist and questionnaire to vendors. The responses you receive can be used in the next stage of the selection process. Give them reasonable time to respond and you should verify that the vendor's responses are accurate.

Stage 4: Evaluating

Now you have established the functional requirements and identified suitable vendors, the next stage is to evaluate the products against your checklist.

Avoid selecting products on the basis of marketing literature. However well written they will not give you a feel for how the system works in practice. It is often both tedious and misleading to wade through large volumes of brochures, design specifications, and so on.

For a preliminary review a "demo diskette" is a good option; however, keep in mind that the diskette may not accurately reflect the capabilities of the product.

Reviewing a live system is usually the best approach, but is the most complex and time consuming. Try to include a period of time during the demonstration where you use the system yourself. Attempt to discover all the product has to offer, run reports and develop a script to push the system to the maximum of its functionality. Try to ascertain that it does all it is advertised to do. Response times are difficult to test in a demonstration environment and user or vendor statements may be required to validate claims.

You may wish to arrange a review of the system at a user site or establish a free trial period in your department. Try to run the demonstration on the configuration you intend to purchase under normal to extreme operating conditions.

Products may generally be evaluated under the following categories:

Hardware

You are looking for a tool to solve problems, and this will consist of software. Hardware should be selected to run the software you have selected and not vice versa.

You should try to establish whether the hardware and supplies are vendor specific, and if so what future do they have in the company's long term business plans.

Determine how readily (and at what cost) the hardware can be upgraded so that it is faster, has more disk space, more memory, and so on.

Depending on how you are going to use the application, you may need to know how easily the hardware supports multiple users and, if so, up to how many. You may also need to know if the hardware is portable.

Check the sort of failure record the hardware has as this may be good indication of how careful you may need to be with warranty and maintenance contracts.

You may need to know of any special requirements the hardware may have for installation; for example, air conditioning, controlled humidity, special power supplies, raised floor. You should check how much space the hardware needs and what environmental restrictions you may have.

Software

You should check whether the software is able to run on different hardware platforms or whether it is restricted to one vendor's hardware. Also check if the product uses special software languages or tools only known to the vendor.

An important facility may be interface capabilities; that is, two way transfer of information to mainframe, departmental, word processing or spreadsheet systems. An increasing number of vendors support interface protocols.

The main health care information exchange protocol is HL7. This provides a standard to allow health care systems to exchange information with each other. It is maintained by a voluntary user/vendor/consultant committee in the US, established in 1987. A new standard called MEDIX is currently under development by IEEE.

It is useful to find out if the product is widely used. Establish the age of the product and its development history. Visit the reference sites and meet with users, but remember user lists supplied by vendors do not normally include dissatisfied customers.

It is also valuable to establish the vendor's policies with regard to upgrades and revisions to the product. In particular, it is important to check on the pricing of upgrades.

The way in which the product was designed and developed may be an important factor. Of interest may be the specific development methodology employed, quality plans, qualification tests; for example, unit, system and performance tests. These factors should be documented and access to these documents may prove to be of interest. Proof that the documented information was adhered to may be required.

Human Interface

A well designed software application will reduce operator errors, increase human and computer processing time. Alternatively, poor design will decrease the effectiveness of users and increase the period of time it takes for a user to become competent. To ensure good human interface the following points may be taken into consideration:

- Ease of use
- Response times for screen transmission, report printing, filing or saving
- Availability of online help at screen, field or key word level
- Pop up or pull down windows for code options, help, special instructions, etc.
- Good screen design, eg. fields appropriately located and labelled
- Appropriate and consistent use of colour
- Suitable navigation methods, eg. menu driven, direct screen access or both
- Designed for minimum user keystrokes
- Support multiple data entry mechanisms, eg. mouse, trackball, bar codes, touch screen
- Option for expert or novice mode
- Incorporation of meaningful icons.

Documentation

The information provided with and on a software application is extremely important as it defines the product and instructs how to use it. Documentation includes just about anything which conveys information about the product to the user such as:

- Tutorials (preferably an integration of online and hard copy)
- Installation and administration guides
- User guides
- Programmer's guides
- Quick reference cards
- Online information databases
- Error messages and screen prompts.

Depending on the nature of the documentation and your requirements, the material should be:

- Presented in the most appropriate medium
- Readily available either online or hard copy
- Formatted so it is easily readable
- Clearly written, unambiguous and understandable
- Logical and consistent presentation throughout
- Included as part of software upgrades.

Flexibility

The ability of the product to cope with both internal and external demands for change is an important factor and the effort required to modify the system should be minimal. It may be useful to know how modifications are to be made and whether they can be carried out by you or the vendor. If future extensions or modifications are envisaged, you may need to ensure that the design of the system facilitates these changes.

A degree of user definition of the product should be permitted. You should be able to set it up around the way the hospital operates; for example, define own codes, editing rules, and so on. The facility to carry out minor customisation changes such as screen colours and error messages is a nice feature and may be considered important.

Functionality

In addition to specific requirements drawn up during Stage 2 of the selection process, general functionality that could be judged as essential depending on your needs may include:

- Availability of a query language to support ad hoc reporting or online inquiry capabilities
- Management information and processing statistics
- Provision of inquiry facilities online or via reports
- Comprehensive set of reports
- Online or batch processing
- Provision of date formats, units of measure, spelling, etc., appropriate for Australian use
- Comprehensive editing capabilities, test and checks.

Security and Integrity

If security is a concern, check the security facilities offered. At a hardware level, machines can be turned off and locked to prevent theft and/or unauthorised access. Software should be able to restrict users either at a functional or information level or both for example by a hierarchical password system.

Back up and recovery facilities offered by the hardware and operating system should be clearly understood. The system should be capable of being fully recovered from most hardware failures without any loss of information. If it is not possible for the system to fully recover it should inform you of the point to which it was able to recover.

Support and Contracts

As this part of the evaluation process varies tremendously, it is probably better to consult with others on contractual issues or have financial staff in your hospital arrange it. Support may be derived from within your hospital (eg. MIS Department, the vendor or specialist firms) and may include:

- Training
- Installation
- Supply of magnetic tapes, printer ink, ribbons, etc.
- Bug fixing
- Inquiry facility, eg. hot line.

It is important to ascertain how product revisions or upgrades will fit in with the original contract.

If the system does not fully meet your needs, it is valuable to know if it is possible for you to add features without invalidating your support contract.

Costs

There are a number of possible additional costs associated with the purchase of a computer system. You should check which of them apply and try to gain a picture of the overall cost. Typical additional costs include:

- Optional features
- Modifications
- Installation
- Training
- Converting existing files
- Loading information into the system
- Operating costs
- Design and printing of new forms
- Multiple and single user charges.

Stage 5: Selecting

Once you have completed the evaluation of the proposed solutions, you are faced with the task of selecting the one that best suits your requirements.

It is generally better not to compare products until you have evaluated them separately. This allows you to evaluate each one on its own merits rather than against a particular solution.

Make sure that all checklist items and vendor questions have been answered and no information is outstanding from vendors.

It is useful to create a short-list of the most suitable products. This can be done by comparing the weighted scores from the checklist and by discussing the responses to the vendor questions. Short-listed systems should provide all mandatory items from the checklist and should exceed a predefined cut off score. A short list should consist of two to four systems; any more, and it becomes unwieldy.

If it is proving difficult to decide on a solution, the selection team may need to list the perceived shortcomings of each offering and draw up a list of questions for the vendor. You may well need further demonstrations of shortlisted systems.

Usually, after a second round of demonstrations and discussions you will arrive at a single selection. If not, however, you may find yourself in the situations where two (or more) products appear equally good or nothing is acceptable.

If two or more seem equally good, then go back over your checklist results and compare them carefully. Also compare the replies to your vendor questionnaire and your impression of the vendors. If you still cannot separate them, then probably either will be satisfactory.

You might like to consider choosing the product that:

- Is supplied by the more committed, enthusiastic, professional and/or businesslike vendor
- Offers your key users the most functionality
- Has the best upgrade service
- Is the most cost effective (in the long or short term)
- Offers additional functionality that can be used elsewhere in your hospital or department.

If no system seems to match your requirements, then review your checklist. It may be you are asking for something that is not available. Discuss your checklist with the short-listed vendors and allow each to tell you why they cannot meet your requirements, and when they anticipate being able to do so.

If it is not feasible to amend your requirements, choose the product where the vendor will commit in writing to an acceptable timetable for delivery of the missing functionality. Alternatively, you may need to consider developing a system from scratch specific to your needs.

However, if you genuinely feel that nothing meets your needs then defer your purchase. You will have learned and established a lot during the selection process, and next year something better may be available.

Conclusion

Computerisation is a very important part of developing the service your department offers to the rest of the hospital. It is therefore vital that you select the right computer tools for the job.

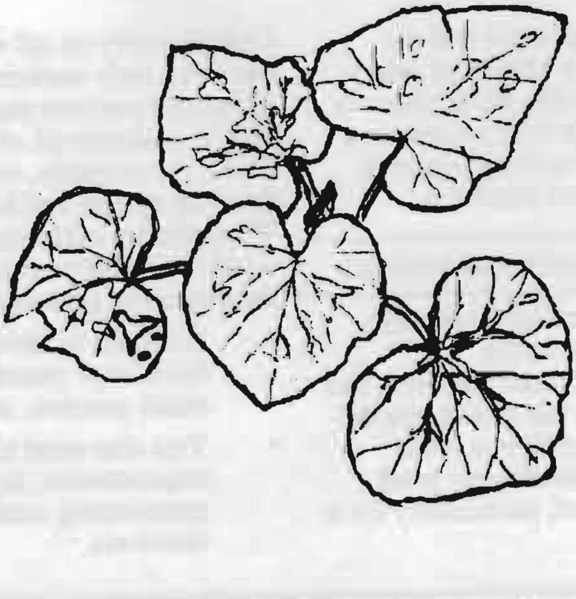
By following the stages described in this paper, you should be confident of your ability to plan and prepare for the acquisition of a computerised solution, source the products available, evaluate and select the correct one for your department's needs.

Following successful installation, do not stop there. Market yourself and the extended services your department can now provide and ensure everyone who was part of the selection process is kept informed of the success of the solution chosen.

Notes

Liza originally presented this as a paper at the 14th Conference of the Medical Record Association held in Brisbane, 29 October–1 November, 1991, and it was published in the *AMR Journal*, 22:1, 1992, 15-19. Reprinted with permission.

While this paper specifically refers to the acquisition of a computer records system, the process described should be suitable for the acquisition of any large system — a Hospital or Clinical Management System, a Patient Care System, etc.



For all practical purposes related to selecting a computer system, a General Practice is simply a small business.

- The practice employs a number of staff requiring personnel and associated financial management records.
- The clientele/patients of the practice requires maintaining both short and long term personal records in addition to payment records.
- As with any other small business, the general practice purchases supplies and other materials, as well as outside services, and needs to keep records of these transactions.
- The practice has a continuing need for access to sources of up-to-date information relevant to the unique requirements of its clientele and staff.
- Finally, the practice is required to maintain a certain level of records for taxation and other government requirements.

The general practice is somewhat unique in that, unlike many small businesses, there may also be a need for client (patient) education facilities.

This Primer provides a very brief look at the steps in selecting computer systems to maintain the required records and access the required information sources. The operation of such a computer system is also briefly examined.

Information Systems

A general practice information system is an integrated collection of all the records that are necessary for the proper functioning of the practice in a form that is accurate, secure from tampering or disaster, easy to use and appropriate to the needs of the individuals operating/using the practice.

It is important to look at the information needs of any business as a single, integrated system rather than as isolated functions.

For example, it is ridiculous in ageneral practice for the receptionist to have to enter the patient's name and address into two separate systems to retrieve personal (medical) and financial records.

In an integrated system the patient's name would only have to be entered once.

This doesn't mean that all of the functions in a system have to be supplied by a single vendor, although that sometimes provides a more functional system.

What it really means is that data types and codes must be consistent from function to function, and the system must have adequate controls (data locking, levels of security, etc.) so that shared access to data files is possible and both information and queries can easily be transferred from one program component to another.

Financial Records

Financial records in a general practice include accounts receivable and payable (AR) and salary records. Some practitioners bill the government or an insurance fund directly while others work on a cash only basis, however, the resulting financial records are not unique to medical practices.

Know your needs and select a system accordingly.

If an accounting package had sufficient capacity for the volume of your business, could accommodate the variety of accounts required, and would generate a coded patient bill to indicate the type of procedure performed, AND you were sufficiently computer literate, almost any good accounting system could be used, particularly for a small practice.

Unfortunately an off-the-shelf accounting package can often only answer some of your needs. An integrated practice management systemshould be able to maintain all of your records. Then you could, for example, enter procedure codes and have the system automatically generate a bill. When the fee schedule requires changing, all that would be required is to change a single data file for the system to generate bills using the new figures.

- It should be obvious that a system designed for a large practice might not be useful in a small practice, and vice versa.
- You also need to be aware of the requirements, legal or otherwise, for maintaining audit trails or other special functions.

Patient Records

Almost invariably, medical/health information systems are designed around the financial requirements of the institution. Unfortunately this may mean that the non-financial aspects of the system are less well designed, and may even be totally non-functional.

A good patient record system ensures that you have only one record for any patient and that all data entered is reasonable. It should also be easy to use, have functionality appropriate to your needs and be reasonably priced. It should also provide a secure working environment, both in terms of the data and the hardware/software itself.

Archival facilities, and the ability to quickly recover records from the archives, is very important with patient records. Both financial and patient records must be maintained for a statutory number of years. The practitioner must determine how long every category of information must be kept, in what form, and where.

Networks and Data Communications

Normally the staff in a general practice will want to share at least some access to data records, even if only to avoid duplicating information. The general practitioner, for example, will normally want to see the patient's clinical records, the receptionist will need to access the same patient's demographic data and the accounts clerk will have to update the patient's financial records.

If all the information was on a computer system with only a single access point, then everyone would have to go to that point to access the records. This is obviously inefficient.

The solution is to provide multiple access points to a single database. This could mean a multiuser computer with several terminals or several computers linked in a network to a database located on a common file server.

Increasingly health professionals require access to databases and other off-site information systems. Computers can access other computer systems through direct connections (dedicated telephone lines) or via a modem.

A modem is simply an electronic device that converts digital data streams from the computer into analog data that can be transmitted across the telephone lines. A compatible modem is required at each end of the connection—the second one converts the data stream back into digital format.

Some general practitioners use a modem connection to link with a local hospital, or even a financial service bureau which maintains their financial records. Others use the computer for ordering supplies, electronic mail, exchanging messages with colleagues using the computer, or for accessing medical databases such as MedLine.

Staff and Patient Education

Materials on poisons, drug education, etc., are available via modem, or increasingly, on CD-ROM, for local use. These materials, and purpose designed educational programs and databases, are valuable for both staff and patient education.

Their use will increase the load on the computer system, and probably require additional levels of security, but may have significant benefits to your practice—particularly in health promotion.

Data Security

The difficulties inherent in protecting patient data from unauthorised access in a computerised system is one of the reasons cited by hospital practitioners for their reluctance to install a hospital-based computerised information system. There is no reason to suggest that the attitudes towards computerising a general practice will be different.

In a recent article medical practitioners stated that the reason why they didn't worry about similar unauthorised access to a manual system was that 'doctors' handwriting is so bad that no one can read the paper record' and the records cannot be found anyways because 'so many records are lost [misfiled]' once they are entered into a hospital record system.

The literature suggests that there are two reason for this negative response to computerisation. First, people often believe that computerising the records will make them more accessible to outside agencies—government 'snoops' and quality control bodies in particular. Second, computer users are, in general, quite fearful of being made to look incompetent through their use of computers.

Identifying and changing these attitudes will be part of the implementation strategies required when computerising either hospital or practice.

All users of the system have the right to know that:

- data records are accurate and up-to-date;
- only authorised individuals have access to their records; and
- records will not be destroyed in the event of a disaster.

Accuracy of Records: The accuracy of the data records is a function of the accuracy of the information entered into the system—manual or computerised. Specifically,

- the staff collecting and entering the data must be properly trained in their jobs,
- the facilities for collecting the data (interviews, tests, etc., and their associated records) must be appropriate and functional,
- the data must be accurately entered into the record system, and
- the data must be double checked to ensure that what was entered is the same as what was intended

Data Checks: A properly designed information system will have some automatic data checks built into the system, but they will only be partly successful in ensuring accuracy. For example, while it is quite possible to ensure that a newborn baby's weight is within a standard range, the computer cannot prevent an incorrect but valid weight being entered.

Up-to-Date: Keeping the computerised records up-to-date requires the same system as the manual records. Staff must be responsible enough to inform the personnel office when they move, for example, and normal office routines must be designed to solicit changes in patient data, even when the data for most patients doesn't change.

Access: Locked computer rooms, passwords, unique user identifiers, and data encryption are the normal methods of ensuring that unauthorised persons do not access large computer systems. These systems usually also have a hierarchy of access levels on a 'need to know basis'.

There are two problems with such a system for the general practitioner. First, smaller computer systems often lack appropriate security facilities—except for physically locking up the whole system and controlling access to every terminal, connected computer, modem, phone line, etc., any reasonably computer literate individual can access the system.

Second, someone needs to be able to maintain the system. Larger computer systems depend upon the supposed professional ethics of their computer system operators to prevent their disclosing information gained as part of their work. Control may be harder when the system operator is a 'junior', college student or similar non-professional, and more often than not, is a part time support person.

Preventing Disasters: A properly designed information system will have procedures for backing up the data on a regular basis. This will usually require additional hardware as well as magnetic or other media (tapes, diskettes) for storing the backup copies.

The duplicate copies should never be stored in the same place as the original data. Large installations will have an off-site vault or other safe storage facility. Small installations might simply keep duplicate copies in a second location, typically the home of one of the staff members.

Remember that physical security is just as important for the duplicates as for the original. Therefore it might be reasonable to purchase a small fireproof safe for the home of the staff member storing the backup data.

If your data is important enough to require security procedures, backup copies require equal security.

Disaster prevention includes the use of power conditioners and uninterruptible power supplies, emergency power systems. Anti-theft locking systems, air conditioners, fire alarm and fire control systems, etc., must also be considered.

Selecting a System/Vendor

There is a whole industry built up around selecting a computer system and its vendor. A variety of books and other support materials also exist, including several other titles in this series of Primers. Since the computer industry generally operates on the principle of *caveat emptor*, it is your responsibility to know what you need before you approach any vendors (or consultants).

In brief, selecting a system requires that you identify, and quantify your needs before you make a decision. Note that 'needs' are different from 'wants'—and that the newest and flashiest might not be the most appropriate.

Once you know you needs you can obtain information on all the systems that appear to meet or exceed your needs and make a choice based on some combination of:

- required, desired, and optional features,
- requirement for, or availability of, extra support (eg. need for special graphics cards or touch screens, vendor training available),

- industry standards,
- integration with other facilities,
- need for and/or ease of modification,
- upgrade path/costs,
- level of staff available to operate, or additional staff requirements to use/maintain,
- perceived learning curve before use,
- availability of local support and service,
- reputation of product/vendor (including availability of source code or repair parts in the event of vendor failure), and
- cost to purchase, operate (including training costs), maintain (repair) and replace.

Special purpose computer systems for general practitioners are available from a number of vendors. One consideration when looking at such a system, or indeed any system, is whether the vendor requires you to purchase the whole system from the same source. Your computer system becomes much more expensive if you have to discard your current system (computers, printers, network and modem facilities, and sometimes even your office furniture) because the vendor supplies a total package solution.

In the final analysis cost is never the most important consideration—the cost of the data itself, and its replacement, is ALWAYS greater than the cost of the computer system. In addition, every computer system purchaser, the general practitioner included, will find that security of data, vendor reputation and support (short term and long term), and ease of use will all be more important than the initial cost. If you can determine the relative costs of these items you will have a more accurate indication of the true long term costs of a system, and thus have a better basis for evaluating a potential system.

Staff Training

Fear of the unknown, and a reluctance to make a fool of yourself, is quite rational and very common among new computer users.

Over the lifetime of an information system it will probably cost more to train staff to maintain and use the system than it did to purchase the system. This training must take into account people's fears and address attitude changes as well as more technical operating skills.

Implementing/Operating the System

Even if you live in a major centre and a vendor installs your system, someone must maintain it on a daily basis. This means that someone in your practice must become very computer literate, able to both operate the system under normal conditions and to identify and solve problems when they occur.

You will lose considerable productivity during the installation process. It is recommended, for example, to operate both new and old accounting systems in parallel for one full cycle, normally a year, to ensure that there aren't any problems with the new system. This takes extra time and work.

At the very least, the new system will disrupt established procedures and may require a total rethink of others. Procedures (and personnel identified) to resolve problems will avoid the computerisation totally disrupting the practice.

Also recognise that your needs change over time. A system that was perfectly adequate when designed will require updating as these needs change. Such changes could be as simple as a change in fee schedule or as complex as the discontinuation by the vendor for support for your hardware or software.

Unanticipated Side-Effects

The literature suggests that there are many potential benefits to computerisation, but that some of them may not be obvious when you start.

Several hospitals, for example, have found that computerising their patient care system improved patient safety and enhanced quality assurance. The requirement for a valid medical practitioner's computer password to be entered before a script will be filled by the pharmacy ensures that practitioners take full responsibility for their drug prescriptions, and the resulting audit trail helps track over-prescribing and other abuses.

Computerising your practice will not be any different. While you can plan for many things, you must be prepared for any surprises that arise.

M&C UCQ CQCUS

Computer Primer Series

Exploring New Software

Installing a new software package, whether for evaluation or general use, is relatively simple. Many software packages come with their own installation programs—you simply run the INSTALL program and indicate where you want the program files to be stored.

This primer provides some hints on how to install and use a new software package.

Have Fun! Using a new piece of software should be an exploration, an adventure, not a chore.

Steps to Take When You Receive a New Software Package

- Gather everything together that you need to use the product.

  This includes program diskettes (copies, not the originals), documentation, tutorials, blank formatted data diskettes, a suitable computer for running the program, etc. Note that most programs describe the required equipment (including memory requirements, etc.) in either the introductory section (often called 'Getting Started') or an appendix on 'Installation'.
- Read the written documentation.

  Many programs also have a 'READ.ME' file on the diskette that contains updates to the documentation and many newer programs have 'On-Line' help facilities. Reading the written documentation will usually direct you to the special tutorials, demonstrations, or help files.
- Boot up the computer and install the program.

  Some programs have special INSTALLation programs that will semi-automatically copy the program onto your computer and ask you for the information required to 'configure' the program for the special conditions of your computer.

  You should be able to install the program and display the opening menu or copyright notice. If you can't, re-read the documentation, looking for special hardware or memory requirements.
- Start learning to use the program with the supplied tutorial, if there is one, otherwise try running the software itself.

  Do not skip sections—work through the tutorial completely. Computer based tutorials often take you through several sample problems in a step-by-step manner. Demonstration files are often provided when there isn't a computer based tutorial. The printed documentation will contain instructions for the use of these demo files.
- Next, try using the software to solve a sample problem. For example, if you were testing a new word processor, you might try typing in a two page report for one of your classes or for work, and print it out on your printer.

  As part of this process, try using the 'help' or other aids as you go along. Refer to the written documentation as required.
- Enter the data or text, edit (make changes), save the file to disk, and print as appropriate.
- Make notes on good and bad features and any problems that you find—what you find useful about the program as well as what you think the program should have been able to do.
- Go back and re-read the documentation to find out why you were not able to do any of the above items. Rework your sample project if you find out that you had made errors.
- Write up a report on your experience.

Proforma: Modify the proforma on the following page to suit your own reporting needs and make photocopies as required.

The form is designed to record your experiences when testing software packages. Save completed forms, along with any product literature or sample output, for refreshing your memory at a later date or for comparison with other similar products.

Installation Tips

- Always set the copy protection on the diskettes that you are using. Make a duplicate (backup) copy of any diskettes before using them and work from the duplicates.
- Make a copy of your AUTOEXEC.BAT and CONFIG.SYS files (or the equivalent SYSTEM files on a Macintosh or other computer) before you install a new piece of software.

Some products make changes to these files as they are installed. You need to have a copy of the original files in case you need to revert to a previous state.

- Whenever possible, check program and other diskettes for known viruses before installing any new software. Purchasing software from reliable vendors or publishers is your best protection, although no source is 100% reliable.
- Put new applications into their own sub-directory or folder, not into the root or main directory or the desktop.
- Read ALL installation documentation before attempting any new software installation, re-read when you encounter problems.
- If you still have problems, call the vendor or publisher, particularly if one or more of the diskettes cannot be read by your computer.

Proforma: Personal Software Experiences [Expand sections as required]

Description

Product Name:

Application: Purpose:

Producer/Source:

Cost:

Disk Format: Program Code: BASIC ( ) COM/EXE ( )

Memory Requirements: Disk Requirements:

Other Special Requirements:

Features [Check and detail]

Tutorial [ ] Help Function [ ] Function Keys [ ] Menu Driven [ ]

Command Language [ ]

Data Interchange: Text Files [ ] Other [ ]

Other Features:

Test Procedures [Detail steps followed in testing the product]

Comments

Ease of Operation:

Problems and solutions:

Personal Evaluation and Summary

Date: Reviewer:

Continue on the back if required. Attach sample printouts, published evaluations, etc.

M&C UCQ CQCUS **Computer Primer Series** ahia

Basic Applications—Word Processing, Database Managers, and Spreadsheets

This *Primer* provides a basic introduction to the three most popular applications for personal computer users. It explains their basic uses, some tips for better results from their use, and concludes with information on selecting the right program for your needs.

Word processors allow you to manipulate text, database managers allow you to manipulate lists, and spreadsheets allow you to manipulate numbers.

These functions are also often found as integrated applications in a single program.

Word Processing

Word processing involves the use of computer software to manipulate words, sentences and paragraphs to create useable documents. A word processor (word processing program) is the computer software (tool) that enables a general purpose computer to mimic a typewriter.

All using a word processor...

Doctors in clinical practice can prepare patient information brochures; secretaries and teachers in schools can prepare school newsletters and special event posters; students can prepare assignments, and professionals of all kinds can prepare reports.

The word processor has several advantages over the familiar typewriter:

- a document may be saved on a diskette or other storage medium;
- a document can be easily changed;
- changes can be made to a single item or to a number of common items throughout the document with a single command;
- portions of a document can be easily deleted, copied or moved to a different part of the document (cut and paste);
- a document can be easily reformatted to a different page size, style or type font;
- two or more individual documents can be easily merged;
- margins can be specified for the resulting document;
- spelling can be checked [semi-]automatically; and
- special features such as automatic page numbering, automatic footnote placement, etc., may be available.

A word processor is far more efficient than a typewriter for preparing standard form letters and lengthy letters or reports, and for updating reports.

A top typist with a typewriter can only match the performance of a word processor when preparing short letters.

Uses: The uses for a word processor are legion — just think of anything that could be done with a typewriter and...

The word processor that was used to prepare this document formats text in columns, puts boxes around specified materials, provides minimal facilities for placing graphics, and automatically generates page numbers and the like. As well, it has a spell checker and a thesaurus, although the latter gets little use.

Spell Checkers Do NOT Understand

As the following example shows, spell checkers can only determine that a word is spelled correctly, not that it is used correctly.

```
The fare man with the read hair
through his Czech over their.
```

Producing long reports, such as are required for a funding agency, an environmental or planning agency, or a solicitor, is where the word processor really comes into its own. A typewritten document must be laboriously retyped every time an error is found (and there are always errors to be found), but with a word processor the source file is corrected and a new copy printed within minutes.

With a word processor you can produce your own patient/client/staff education sheets. Updates and changes are easy. Personalised letters can be produced for several individuals with similar needs. Patients who have not returned for a smear or blood pressure check, for example, can all receive individualised letters explaining why it is important to see you again.

Word processed documents can also be linked to a database containing information on patients, clients, students, etc. This allows the system to automatically generate letters or memos when some specified condition has been reached—four weeks after the last examination, for example.

Some database managers, such as the clinical record systems being promoted for maintaining patient records in a doctor's surgery, have word processing functions built-in. Such systems allow very tight integration with the database.

Other uses for the word processor include producing up-to-date lists of equipment and facilities; lists of specialists, suppliers, and contacts; and timetables (a database manager could also be used for these purposes).

Styles: Style sheets are collections of format commands—paragraph indentation, spacing, fonts and sizes, etc.—that can be applied to portions of the text file to simplify preparing the document. Simply select the text to be designated and apply the style—and the format is applied in one action.

Outlining: Some word processors allow you to prepare a point order outline for a document, and then, after you have filled in the outline to write the full document, collapse back into the outline for ease of revision and reorganisation (eg: move whole segments of the document).

Adding Illustrations: Many of the word processing packages on the market today allow graphic material to be easily included with the text. This improves the appearance of the material and provides for better communication. Too many illustrations, or illustrations that do not relate to the textual material however, can detract from the intended message.

Some word processors have built-in functions to create simple illustrations, others require you to prepare the illustration in a 'paint' or 'draw' package. Photographs and other complex illustrations require lots of memory to manipulate their files, but are usually handled in the same manner as simpler illustrations.

Choosing Type Styles: The first Macintosh™ computers introduced computer users to a variety of type styles and sizes. While many users abused the choices available, creating truly abysmal newsletters, brochures, and posters, most users appreciated that a more limited variety made a publication more interesting and easier to read.

Some type faces are used for general publications—look at the use of Times and Helvetica fonts in various sizes in this publication, for example. Other fonts have more specialised uses:

- Architect looks like hand printing;
- Courier duplicates a monospaced typewriter face;
- Rickshaw and **Western** are novelty typefaces; and
- Zapf Dingbats provides special characters such as: ❑ ♠ ➽ ✳ ✲.

Tools for Different Purposes...

Desk Top Publishing (DTP): The process which allows a computer user to produce print-like output using standard computer tools. A typical system uses either a text formatter, word processor or a page layout program to format the text and illustrations, and either an inkjet or a laser printer to produce a medium quality (300 dpi—dots per inch) master copy for duplicating.

Professional publications usually employ page layout programs to produce high resolution (1200+ dpi) imagesetter files. These files are then processed by a commercial printer.

Editor: A basic computer tool, used extensively by computer programmers, to prepare a computer file. As with a typewriter, the user must usually do all the formatting (tabs, spacing, etc.).

Page Layout Program: A computer tool, often called a desk-top publisher, which formats text and illustrations according to desired page characteristics.

Text Formatter: A computer tool that processes a text file, usually containing special formatting commands as well as the desired text itself, to yield a printed copy that has been formatted according to the embedded commands or a special style. TextForm, for example, uses embedded commands such as <NP> to indicate the format—start a new paragraph in this case. The text formatting program may also be able to place illustrations in specified locations in the output.

Word Processor: A computer tool which enables the user to enter and save text, retrieve and modify the text, and print the text onto paper using a selected format.

WYSIWYG: 'What You See Is What You Get', the concept that the printed output will look exactly like what you see on the screen, subject only to the differences in resolution of the screen and the printer. [See *Text Formatter*]

Word Processing Tips

- The word processor is NOT a typewriter. With a word processor you should continue to type as the letters reach the end of the line. The word processor will automatically 'wrap' your text to the new line as appropriate.

  The <RETURN> key is only used to end a paragraph.
- Leave a blank line between paragraphs (press the <RETURN> key twice) for better appearance.

  A single space (the <SPACE> bar is at the bottom of the keyboard) between sentences improves appearance (typists used to leave 2 spaces, this is too much with proportional spaced fonts).
- Type in your text with the display unjustified (all lines even on the left but ragged on the right). This allows you to spot errors more easily and is usually easier to read than a justified line.

  Avoid lines of ALL CAPS and <u>underlines</u>. Use **bold** and *italics* instead for better appearance and readability.
- Type your text in without worrying about how the final product will look. You can fix the paragraph indentation, underlining, etc., when you have finished entering your text.
- Save your work often. Computer problems can occur. If you save your work every 10-20 minutes you will minimise the amount of work lost when a problem occurs. Use different names for different versions of your work.
- The computer can reformat your text to fit several different page sizes. Ensure that the word processor page is the same size as the paper that you are using. An Imperial (or American) size page is usually 8.5 x 11 inches, while a Metric A4 size sheet is 8 x 11.5 or 11.66 inches. This results in a need for different page lengths and margins.
- Each brand of printer is somewhat unique. Ensure that the printer being used will print your text properly and that you are using the correct printer 'drivers'. This is particularly important when you have selected a type font that differs from the printer's built-in fonts. Such fonts may be treated as graphics.
- Word processors usually save their text in a proprietary format. If you wish to transfer text from one word processor to another you must save the text in an file encoded as ASCII or TEXT and load that file with the new word processor. Unfortunately the details of fonts, character size and spacing, bold text, etc., may be lost in the process.

  Good word processors now have the ability to convert text from one proprietary format to another without losing the special characters and formatting (type styles and sizes, etc.) information. Check the manual for details.

Database Managers

Database managers are perhaps the most useful of all the general purpose tools available on the computer, and some computer systems, exist only to host one or more databases.

A *word processor* deals with words, sentences and paragraphs. While we can prepare lists using a word processor, they cannot be manipulated as easily as with a database manager.

A *spreadsheet* deals with cells, rows and columns, and contains special functions to make mathematical calculations easier. Many spreadsheet programs permit the user to sort and rearrange information, but again, they do not have the flexibility of a good database manager, particularly for preparing reports from the data.

A database manager allows you to:

- build and maintain a list of almost any kind;
- sort the information into any specific order;
- query the database to find the answer to questions; and
- output the results in a variety of report formats.

There are many kinds of lists (databases), ranging from a simple list of names and telephone numbers to the massive files maintained by the tax authorities or a municipality.

With the database manager we use the term 'file' to mean the collection of data we are using (this can include various computers files, including definition, data and index files). The information for one individual is contained in a 'record' (often displayed as a row in a matrix) and each discrete piece of information is labelled as a 'field' (displayed as columns in a matrix).

The computer can store numerical and coded information more economically than it can store text characters. Thus fields are commonly defined by the type of information that they contain. Special field types include text, numeric, date and logical (true/false).

Database Design: A database involves a compromise between the limits of the computer and the need to allow for any possibility.

Most Australian surnames, for example, are no more than 15 characters long. It might seem reasonable to assume, therefore, that a surname field should be 15 characters wide, especially since allowing extra characters in a large database quickly consumes disk space and slows access to the information.

On the other hand, imagine the problems that would result if your database was used in an area with a lot of individuals whose who had hyphenated (Featherstone-Smith) or long names.

Similarly, imagine how much disk space would be wasted in a file containing 10,000 names if the average name was only 6 characters long.

You must also decide how to represent different types of information. A shoe size, for example, could logically be represented by a one or two digit numeric value if we didn't know about half sizes and shoe widths.

Database users often code information for convenience and economy of storage; male and female might be represented by a number or single letter code (0/1 or M/F), and yes/no answers might be entered as a single character in a logical field (T/F).

Design of a Database

A database for maintaining the grades of students in one of my classes, similar to the database necessary for basic patient information, might be designed as follows:

Field Name	*Field Type*	*Width*	*Decimals*	*Notes*
Surname	Character	15		
FirstName	Character	12		
IDnumber	Character	9		Numbers & letters
Assign1	Logical	1		Pass/Fail– Y/N
Assign2	Logical	1		Pass/Fail– Y/N
Essay	Logical	1		Pass/Fail– Y/N
Read_1_6	Numeric	2	0	Record # of errors
Read_7_12	Numeric	2	0	Record # of errors
DatePassed	Date	8		
Total Characters per Record		51		

Field names have been chosen to be self-explanatory, field types have been chosen to fit the information that will be stored in the fields, and the widths to accommodate the size of the data item being contained in each field. Note, for example, that the student IDnumber, a combination of numerical and character data at UCQ, has been given a character type rather than numeric as would a telephone *number*.

You can almost always change the database design, even after you have entered the data, but working with the database will be easier, and save you significant time, if you design the database on paper before you start structuring it on the computer.

Common Database Terminology

Each database type has its own advantages and disadvantages, particularly when storing or searching for information. It is much quicker to find an item, for example, in an indexed file than in one that doesn't have an index.

Fixed Length vs Variable Length Records: A database system with a fixed length record allocates the same amount of space for each field regardless of content. A 20 character fixed length SURNAME field would store 18 blank characters to pad out the field for an individual with the name 'Li'. Alternatively, a variable length record requires a special character (one that cannot be confused with data) to separate each field and record, also taking a certain amount of space.

Random Access versus Sequential Access: A random access database utilises an index to allow the user to move immediately to any record in the file. This is particularly useful for 'real time' applications, such as in a public information system.

A payroll system, on the other hand, will almost always be accessed in 'batch' mode and can process the records in their stored order (rather than alphabetic or some other imposed order).

Flat File: A flat file system has all of its information contained in a single file, with a single record for every case or individual, much as a simple card index system has a single card for each case or individual.

A simple mailing list has a flat file structure.

Relational: We can think of a 'relational' database as consisting of one or more rectangular matrices where all the information on a horizontal row is related (deals with one individual) as is all the information in a vertical column (each column contains one specific item such as the individual's age). Matrices are related through a field containing data that is unique to each individual and is common to both matrices. Motor vehicle records and criminal records might be related, for example, through a common field containing the individual's tax number.

Tree Structure: Another method of storing information resembles an inverted tree structure, typically accessed by asking branching questions.

Tips for Using Databases

- Plan what information will be in your database and how you will use it before you start working on the computer.
- Choose field names that will be short, easily typed, and descriptive enough to be easily recognised. BDATE, MDATE and DDATE would be quite reasonable for a genealogical database, but BIRTH_DATE, MARRIAGE_DATE and DEATH_DATE might be better for a general use. BD, MD, and DD would not normally be satisfactory.
- Choose field lengths and types carefully. Fields that are excessively large waste too much disk space. Fields that are too short require too much use of abbreviations or codes. As for field types, things are not always what they seem. Numbers in particular are often better stored as text unless they will need numeric manipulation. A numeric field for shoe size, for example, cannot accommodate a shoe size of 7B.
- Define small fields where the data will require manipulation. It is much easier to combine the three individual fields containing title, first name and surname when printing out mailing labels than it is to try and alphabetise names in a single field containing entries like "Mr. John Doe".
- Design the database and data entry forms for convenience. An on-screen database entry form that matches the data collection form will be much easier to use and result in fewer transcription errors.
- Use common abbreviations and maintain a codebook or log which lists the abbreviations and codes used. It is very embarrassing to forget what the codes in a database mean.
- Build a small database, test your data and prepare the most important reports before starting the major task. It is easier to make changes to a small database than it is to restructure a large database.
- Consider 'last updated' and 'notes' fields.
- **Be Consistent!** Many government and business databases, for example, store all their textual data as UPPER case characters to make retrieving the data easier.

A poorly constructed database, for example, might not let you find an item such as 'Cancer' if you searched for 'CANCER'.

Numeric Processing with a Spreadsheet

A spreadsheet is a computerised version of the accountant's paper and pencil 'spreadsheet':

- the spreadsheet can be as large as the computer's memory will allow, usually several times larger than a sheet of paper;
- the spreadsheet automatically calculates the sums and other mathematical functions required, freeing the user from being a human adding machine;
- the spreadsheet can be easily changed, allowing the user to investigate a variety of 'what if' situations; and
- information from a spreadsheet can easily be reused for other purposes (reports, charts, graphs, etc.).

The spreadsheet is typically arranged as large sheet with numbered rows and columns identified by the letters of the alphabet. Each location, or cell, in the worksheet can contain text, numbers or formulas. Thus the spreadsheet has two views: the numbers and text as displayed; and the text, numbers or formulas that the cells actually contain.

The way in which the information is displayed can be changed without changing the actual data in the cell. Thus the number .05 might be displayed as 5E-2, .05, $0.05 or 5%. A quick look in the cell itself, however, would reveal that the actual value in the cell is still .05 [Look in the spreadsheet program's manual for CELL FORMAT, BLOCK FORMAT, or WORKSHEET FORMAT for additional details.]

Other aspects of the display, such as the column width, can also be changed as needed. [See CELL WIDTH]

Data can be entered into the spreadsheet through the keyboard, however we can generate secondary data as well through the use of formulas.

Good spreadsheets make maximum usage of such generated data and never bury primary data within a hidden formula.

As an example, a spreadsheet to determine a pharmaceutical bill might have the price in cell D16 and quantity in cell E16. The total cost could then be calculated using a formula located in cell F16. The cell F16 would then display the result of the calculation, although moving the cursor to cell F16 would show the formula (D16*E16) on the editing line. Most importantly, all the original data is fully displayed in the worksheet.

Special formula functions are available to perform calculations. Two examples of such functions are @sum(), which sums the range specified; and @if(), which checks the validity of the specified expression. The item or range to be examined is designated in the brackets.

Check the format for entering formulas and functions for your spreadsheet. Some programs start a formula with a '+', others with '='; some require you to type in function names, others let you choose from a menu selection.

An additional feature of a spreadsheet is the ability to prepare your own instructions (called macros) for execution when you require.

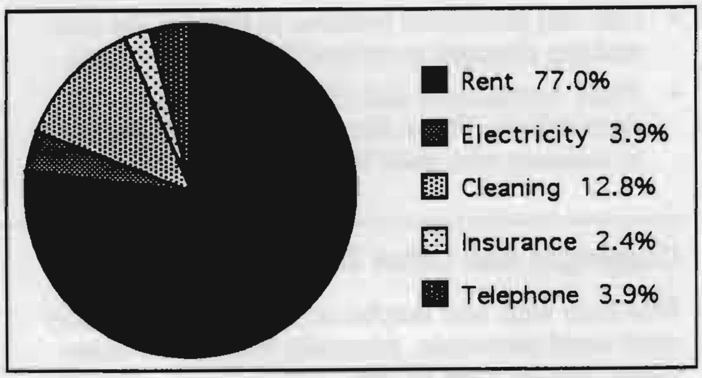
This simple budget demonstrates a basic use of a spreadsheet:

```
     A                    B            C
1
2    BUDGET FOR NEW OFFICE
3
4    Rent              3000
5    Electricity        150
6    Cleaning           500
7    Insurance           95
8    Telephone          150
9
10   TOTAL           $3,895
```

Note that column A is wider than the other columns; the text in column A aligns left, and the text in cell A2 overflows into the next column since the cell in that column is empty.

The other cells contain numbers, except for the cell B10. It contains a formula, @sum(B4..B8), which tells the spreadsheet to display the results of the formula which sums (totals) the contents of the cells from B4 to B8, inclusive. The numbers in column B align right.

Spreadsheets can also display the data in graphical form. We use the text in column A for the labels and the numbers in column B for the values to create the pie chart that follows.



On IMB/MS-DOS computers, the various spreadsheet functions can usually be accessed by pressing the function keys (F1-F10) or by using a command menu (start a command by pressing the '/' key).

Your input is usually displayed at the top of the screen; press <ENTER> or one of the cursor (←↑→↓) keys to complete the entry. The menu commands will also display along the top of the screen; select by pressing the first letter of the command or by highlighting and then pressing <ENTER>. Typically, pressing <ESC> (escape) will stop the current activity and return to the normal view.

Spreadsheet Tips

- Use labels for all entries in the spreadsheet (every entry should be visibly identified).
- Organise your spreadsheet so that it is neat, logical and coherent.
- Check all formulas with dummy data to ensure that they work properly.
- Use the simplest versions of formulas. In particular, use ranges (eg: B1..B5 or B1:B5 depending upon your spreadsheet) instead of individual cell designations. Use range names (eg: JAN_COST, FEB_COST, DISCOUNT) where possible.
- Put all constants in labelled cells and use the cell reference in formulas rather than the constant itself.
- Work top to bottom and left to right.
- Check that all figures (numbers) are entered as numbers and not as labels. Labels cannot be used in calculations, even if they look like numbers.
- Save your work frequently. Get into the habit of using different names for different versions of your spreadsheet to provide additional backup. Always save your previous work before adding new functions so that you can recover easily when the new function fails to work.

  If working with a budget or other cyclical data save your sheet in an archive file at the end of every cycle (month, week, etc.). The archive file should be stored in a safe location. Again, this allows you to recover from a major data loss.

- Use cell protection features to prevent the user making changes to critical formulas and data.
- Place instructions and identifying notes in the spreadsheet. These should include general notes to indicate who built the sheet, the purpose of the spreadsheet, explanations of every formula, constant, and macro used.
- Some newer spreadsheets use a multi-page or pseudo three dimensional format to make it easier to consolidate data from several sources.

Copyright and Other Ethical Issues

Wordstar was, and maybe still is, the most widely used word processor, primarily because so many illegal copies were in use.

Computer software such as word processors, database managers, and spreadsheets were not developed as a community service!

The programmers and software publishing firms make their living from the development and *sale* of computer software. 'Borrowing' a copy of a program from a friend may be cheaper than purchasing the same software from the supplier— in the short term. In the long term, however, if enough people steal the software rather than purchasing it, there will be no incentive to develop new features and applications.

Similarly, the *Copyright Law* applies to data typed into the computer just as it does to a photocopy. Your work receives copyright when you produce it; respect the copyright of others by observing the copyright regulations and providing credit to other writers (and artists, photographers, graphic designers, etc.) as appropriate.

Selecting the Right Program

Selecting a Word Processor: There are a wide variety of word processing and text formatting programs available, including some designed for specific users (primary school students, mathematicians, etc.). Others are more general.

The most expensive word processor is not necessarily the best one for your needs. All the common word processors will have some way of copying, changing and moving text; automatically creating headers and footers (those special banner lines at the top and bottom of a page) and page numbers; forming the text into pages of different sizes and with varying margins. Everything else is extra!

- Business people often have a need to create personalised documents—mail merge, in the jargon—personalised junk mail to many recipients.
- Academics appreciate the ability to print several files in a sequence, with page numbers, etc., properly maintained.
- Students and academics want to be able to automatically format footnotes (or endnotes), tables of contents, and indexes.
- Newsletter editors and educators want to be able to easily produce multi-column materials, and to print in portrait (vertical) or landscape (horizontal) format.

And on it goes... I use several different word processors in the course of a week. One is simple and serves to produce much of my daily correspondence and short reports. Another works better for longer documents such as this *Primer*, that will be printed using a variety of type sizes and fonts. Yet another is used only to be compatible with several of my colleagues.

If you have special needs—if, for example, you will be using a lot of illustrations, or using information retrieved from a database manager, you should probably choose your other tools before settling on a word processor. Knowing what type of files will be need to be imported will aid you in selecting the correct word processor.

Selecting a Database or Spreadsheet Program: The same considerations apply for selecting these programs as for the word processor.

- Quantify your needs (needs, not fanciful wishes) and preferences,
- Look at the range of products to determine their capabilities and ease of use,
- Test your selections with material similar to what you intend to be preparing and on a hardware configuration similar to your own, and
- Make a choice based on logic and need.

Integrated Packages: These applications are also typically available in 'integrated' packages at a significantly lower price than purchasing discrete programs. Integrated packages are good value for many users who do not need advanced functions.

Many users in a large organisation, for example, will only need the level of functionality available from an integrated package. Some staff will need more functional packages, but the overall cost saving may be several thousands of dollars.

Developing Computer Assisted Learning Materials

Computer Assisted Learning, or CAL, is the presentation of educational experiences using a computer and any combination of teaching techniques including didactic, question and answer, simulation and problem solving.

Good CAL materials increasingly use a combination of sound, text, graphics, animation, and other visual media. CAL materials may be purchased, or developed locally. This *Primer* explains the development process.

Preparing CAL Materials

Preparing CAL materials requires you to know:

- How students learn.
- What materials are to be presented using CAL techniques and where they fit in the curriculum.
- How the content should be presented for best understanding.
- How to use the development tools.

Lecturers may not have instructional development skills, and even if they have skills related to the preparation of print or other materials, these skills may not be appropriate for preparing computer-based training materials.

The development process is iterative—prepare some materials, test them through usage, and either revise those materials or prepare new materials with a better understanding of their use (see illus).

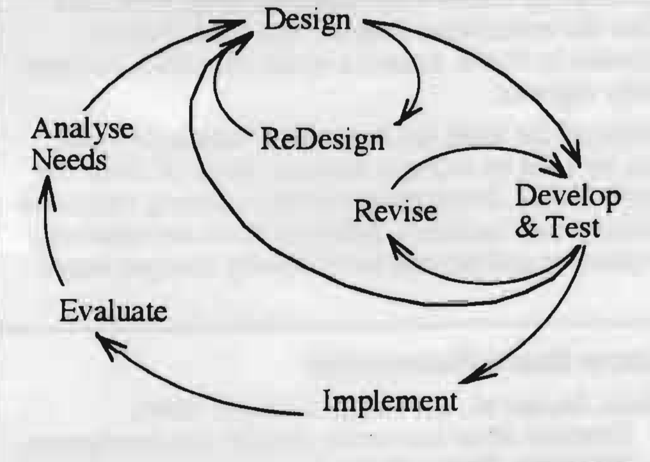
Analyse Needs: Setting the instructional objectives is the first step in designing resource materials, whether for the computer or not. This involves, in part, answering questions like:

- What knowledge does the student bring to the activity?
- What is the purpose of the activity?
- What specific concepts is the activity designed to reinforce?
- What level of competency is required from this activity and its prior lecture?
- How can the student demonstrate this competency?

Design: Once you know what is needed, you can brainstorm possible scenarios to achieve those ends. An effective case study, for example, requires an opening scenario or situation that 'grabs' the student's attention. This scenario is typically followed by knowledge or attitude testing questions. The student's responses to these questions may determine which replies or other activities the student subsequently receives.

> Always have several people, including prospective users, critique your work at every step. It is far easier to go back and relook at the needs or the design early in the process than it is when actual materials have been developed.

Develop: This stage results in a well-developed plan for progressing through the educational unit. It should include most or all of the content material, specifications for graphics and other materials, and directions for navigation through the instructional unit. At this stage, the unit could still be implemented using any one of several tools, techniques, or even media.



Simplified Model of the CAL Development Process

Implement: In this stage the instructional materials are converted into computer courseware, the materials for direct use by the students themselves. Any special computer commands (sometimes using a programming language) that are required for successful implementation must be entered at this time.

Graphics and other materials must be prepared, scanned into computer files, and added at this time. Spell checking, grammar checking, and similar quality control procedures must be done before the materials are released to students.

The implementation stage must include extensive testing to ensure that the units function as planned, are consistent, and recover gracefully from errors. While students are very good at finding all the problems within instructional materials as they use them, the materials should be as error free as possible before release to ensure that they assist rather than hinder learning.

Testing can be very effective if novice users are given the materials and asked to work through them according to the prepared instructions. Observe their work and use their difficulties as a guide for immediately revising the materials.

Evaluate: Evaluation determines that the educational goals have been met in an interesting, reliable, and economical manner.

CAL Development Team

An ideal CAL development team would probably consist of content expert(s), instructional designer(s) and technical support staff (artists, programmers, typists, evaluators, etc.) as the best instructional materials result from several individuals working together to develop materials.

Many institutions have a technical staff employed for this purpose, perhaps in a centralised CAL unit (instructional designers, graphic artists, programmers and courseware developers).

Alternatively, final year computing 'Project' students and a more limited CAL technical staff can assist in this process if much of the work will be done by lecturing staff. This is the process that has been successful at the Faculty of Health Science, University of Central Queensland.

Share your ideas with your colleagues (staff and students), assisting them in turn on their projects. It is far easier, and less frustrating for you and your students, to seek assistance whenever you first encounter a problem.

CAL Development Tools

There are many other computer-based tools for developing courseware, many of them patterned after the mainframe-based *Plato* CAL system popular in North America in the late seventies and early eighties.

Some of the tools are reasonably interactive and can be used by relative novices, more of them are professional development tools requiring extensive training and facilities. Many of them are relatively expensive and several have royalty charges based on the number of copies of the courseware (lessons) produced.

Some of the Health Science materials have been developed using HyperCard on the Macintosh. HyperCard is an application tool that uses the analogy, or metaphor, of a *stack* of *cards*. Developers can create and manipulate the cards in a variety of ways. HyperCard, and its HyperTalk programming language, permits quite sophisticated applications to be developed by/for novice users.

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Computer Primer Series

DTP: Desk Top Publishing or Desk Top Editing?

This *Primer* illustrates what can be done with a good word processing (WP) package—note that I said word processing, not desktop publishing (DTP), package. Three years ago there was a significant difference between word processors, which formatted words into lines, paragraphs and pages, with the occasional box or line for emphasis, and desk top publishing software, which formatted pages containing both text and graphics. Today the difference is not as significant and most advanced word processors incorporate basic DTP functions with ease.

Unfortunately neither WP or DTP software packages provide any assistance in actually designing a publication. Good design is still something that must be learned through training and experience. Thus while DTP publications may permit relatively low cost publishing, the results can often look very amateurish.

Line Art: Copyright free source.

Desktop publishing, is also somewhat of a misnomer—the time required for printing from the computer and the costs of (single-sided) multiple copies on a laser or ink jet printer means that DTP is really DTE—desktop *editing*.

The computer (computer, scanner, laser printer and appropriate software) is normally used to prepare a master copy—a printer's 'dummy' or even more often, 'camera-ready' copy—which is then printed and published conventionally.

For newsletters and other low cost publications, the photo-copier is the primary printing device. High capacity copiers can produce several thousand copies per hour with minimal production costs and reasonably unskilled labour.

This primer looks at some basic techniques for desktop editing, particularly tips and techniques that will allow you to improve the quality of your desktop produced and edited publications.

Background

In the beginning was the manuscript... and the manuscript was prepared and illuminated (written and illustrated) by hand!

With the invention of the printing press, multiple copies of manuscripts, now called books, were reasonably easy to produce, and thus were *relatively* inexpensive. Book printing has always been labour intensive—suitable only for titles requiring large numbers of copies. Manual type setting and block cutting evolved into mechanised procedures but the economics remained stable. Books were, and still are, reasonably expensive and time consuming to produce.

Silk screen and lithographic printing permitted small numbers of copies, or very large images (billboards and posters), to be produced inexpensively, but were still very labour intensive. The typewriter evolved as a means of producing a small number of copies of textual material at reasonable cost, but was also labour intensive. As well, both originals and copies lacked quality.

During the 1950s and 1960s schools and similar institutions often used an inexpensive duplication system—the 'spirit duplicator' (dye transfer process with methyl hydrate as the solvent)—that was quick and easy to use, could produce images in colour (colours were individually applied to a transfer sheet, or master, and printed in one pass), and could even reproduce low resolution photographs. The print run was small (20-250 copies), resolution was low, and the image tended to fade over time (unless protected).

The stencil duplicator (Roneo and Gestetner), a mechanised silk screen process, gave a larger print run, and could incorporate scanned images in later years, but used a messy ink process and the resolution was still very low.

A variety of copy processes subsequently evolved for supplying better quality, or less expensive, reproduction for business and education. Today xerographic and similar processes are the most common, providing a good quality copy at reasonable price. The same basic process is used in both photocopiers and laser printers, however photocopiers typically produce better quality black and white copies faster and less expensively.

Some copiers (and laser printers) can produce a monochrome colour image but full colour images require special copiers and are still very expensive. 'Spot colour', the use of colour for emphasis still generally requires a proper printing process (or else two passes through a copier, one pass with a non-black toner cartridge).

Photographic quality images, in black and white or colour, are reasonably easy to edit on the desktop (provided you have the appropriate software and a fast computer with lots of memory) but producing an image on paper is still difficult to accomplish at a reasonable cost with current equipment, although the new 'gray scale' printers are almost acceptable.

As this discussion has emphasised, reproduction quality is one of the major issues in low cost publishing. At the lower end of the scale we can move from a master copy printed on a dot matrix printer to an ink-jet or laser printed master. This gives us acceptable quality for text and line art, but, as the image to the right illustrates, is barely adequate for photographs.

We must design our publications intelligently and prepare our illustrations to fit the limitations of the system being used. Since getting the next level of quality involves professional techniques and a major increase in expense, it is beyond the scope of this Primer.

Scanned image from a colour photograph.

What Do You Need?

Initially your needs will be determined by whether you will be self-publishing materials, or preparing materials for commercial or other publication.

When I prepared the 'camera-ready' document for inclusion in a printed Conference Proceedings, or as part of a set of my university's student notes, for example, the publisher provides me with a list of specifications for an acceptable document. They do all the design work and I must obtain facilities that will meet their requirements.

Just as frequently, though, the materials will be for publication by either my Department or one of the several publications that I regularly edit and produce. In these cases, I must both design and produce the publication, and my limited facilities will often restrict what can be accomplished.

While 'needs' are very personal, and changeable, producing training materials and the occasional newsletter requires a set of tools that will easily and inexpensively produce multiple copies of text and images with sufficient quality that the reader isn't distracted by the medium itself.

- Preparation of text and illustrations must be simple and quick.
- Hardware and software costs must be minimised and resources normally serve several purposes.
- The ability to vary fonts, and the size and style of text, is essential.
- The ability to combine text and illustrations on the same page and to make changes to the layout and design of the page is important.
- While we have learned over the last two decades to 'make do' with a black image on white or coloured paper, the ability to add spot colour would be highly desirable.

Computer based systems that include a scanner, a laser printer, a photocopier, and appropriate software will provide all of that except the colour, and as noted above, even adding colour is possible through the use of replacement non-black toner cartridges. Unfortunately, such a system isn't cheap and can be quite wasteful (throw-away toner cartridges, etc.) and limited to a few copier models.

- Basic computer with normal graphic screen, adequate memory for graphical software (*Corel Draw* or *Canvas* type programs), and a large capacity hard drive — 105MB and larger).

- Scanner with OCR and graphic scanning software, minimum 300dpi, preferably flatbed and gray scale or colour.
- Word processing program, desktop publishing program, paint/draw/CAD program(s).
- Laser printer with minimum 300 dpi resolution.
- Photocopier, preferably with the ability to incrementally resize images from approximately 50% to 200% (not at fixed stages), A3 to A3, easily replaceable colour cartridges.

The addition of a large display screen, colour capability throughout, and reproduction quality components—quality good enough for producing glossy paper publications—will significantly increase the cost (from $10,000 to $30,000)—and the output quality.

Most users will send their edited files to a service bureau to obtain highest quality (1200 dpi or better) output—including colour separations—when printing on glossy paper as reproduction quality hardware (eg: 1200 dpi printers) is too expensive for casual use.

A less expensive ($3,500-$5,000), but still very useable system for training materials, newsletters and similar quality publications, would include:

- a basic monochrome computer without an extra-large capacity hard drive,
- a hand scanner, monochrome and perhaps only 150 dpi, with included software,
- a reasonable word processing program, basic drawing program (perhaps shareware),
- a 'letter quality' or better printer (today probably a slow 300+ dpi ink jet), and
- photocopy services as required from a local copy shop.

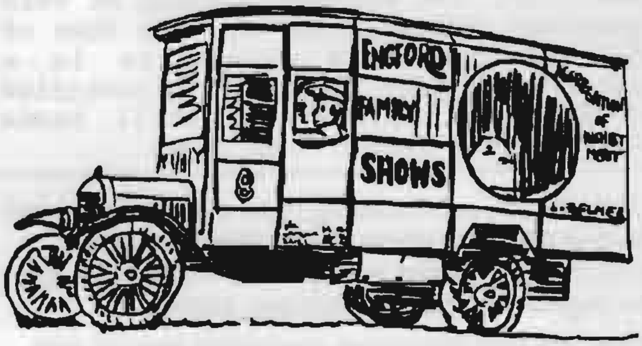
I used a basic system such as this for several years to produce both newsletters and training materials. The word processor I was using wouldn't format multiple columns, so I set my page width at the desired column width, printed the resulting pages, trimmed the wide margins, and pasted them side-by-side for a multiple column page.

Illustrations were prepared separately and pasted into a space left in the word processor output. Occasionally, the page was run through the printer twice, once to print text and the second time to print the illustration. Normally I prepared my pages approximately 10% oversize and reduced them on the photocopier to fit the printed page—thus increasing the apparent quality of the output.

My current setup is more convenient, and produces a better looking document, but I certainly produced acceptable results over several years using the less sophisticated system.

Selecting Hardware and Software

The first task when selecting a desktop publishing system is to determine the type of publications to be produced. Complexity increases the cost!



Line Art: From a Pencil Drawing

Basic training materials, local newsletters, simple sales flyers—black and white text and simple illustrations—need only a word processor and basic level hardware. Text-based will not even require significant hard disk or memory resources.

Putting your extra time (your time to learn a new software package is valuable too) and resources into a good graphics (Draw or Paint) package will increase publication quality and productivity more than upgrading the hardware.

Unfortunately, graphical software requires extra memory and a faster processor, sometimes also a maths co-processor, to run the program effectively. Graphic files also require enormous amounts of hard disk space.

- If your computer will run the software, you can often make a greater speed improvement by upgrading the hard drive than by upgrading the computer's processor, unless you are working with large and complex illustrations.
- Local vendor support is often more important than price unless you live in a capital city. Your local computer dealer may not be able to repair your scanner when it breaks down, for example, but s/he likely knows where there is another machine you can use until yours is fixed.
- Adding high quality photographs and/or colour significantly increases the complexity of the system required. Professional guidance is likely necessary to select appropriate hardware, software, and outside services.
- Talk to one or more current users and try to get 'hands-on' use of particularly expensive pieces of hardware before you purchase. In particular, ensure that the combination of hardware and

software will actually work together, particularly if you are working across platforms (a DOS-based scanner and a Macintosh-based drawing program, for example).

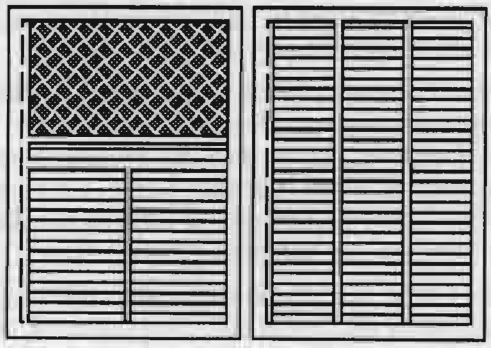
- Use a service bureau, rental equipment, or other means of testing your production procedures before you purchase expensive hardware or sophisticated software.

Layout and Design

The design of a publication combines the page size and layout (see next page for typical page formats), the typography (size and style of type) and illustrations, the purpose of the document, and the characteristics of the intended audience.

- A reader for small children, for example, would probably have an A5 page size, use a minimum 18 point serif font, and many illustrations. Such a reader would probably have a single column layout fitting the large type size.
- A technical paper would also normally have a single column layout, but on A4 paper with a 10 point font. The use of illustrations would be minimal and their layout would be quite formal. The small font size and the long line length results in a density of type that makes such a document very hard to read, but a technical paper is designed for record purposes, not for casual reading.
- A layout using two unequal columns on a three column grid, with 11-12 pt type, works well for training materials. The narrow column contains headings, 'teasers' for the text, and icons (a book icon to indicate a reading, a pencil icon to indicate student work, etc.) to indicate activities required. The wider column is the width of two columns on the grid and the space between.

Normally the narrow column would either be consistently on the left side, or on the outside edge (left on a left hand page, right on a right hand page) in a book. The two formats would not be mixed in a single document.



One/two column mix with photograph and caption (left) and a three column grid (right).

This Primer series uses 12 pt Times type on a mixed one and two column grid. The one column format is used mainly for the 12 pt Helvetica headings and for larger illustrations with their captions. The line is somewhat short for the type size but doesn't look as dense as 10 pt would.

When computers were first used for DTP the only output devices had typewriter-style (monospaced), rather than proportional, typefaces. Today most computer systems do have access to proportional fonts as well as different type sizes. Good design requires that we take this into account—as Robin Williams says in the title to her very useful style manual: 'The PC is not a typewriter'.

Monospaced Fonts

This line is in a monospaced font (10 pt Courier). Note that every character has the same width, and that spaces are the same width as the letters. Even the bold type in the heading has letters of the same width.

The lines are also based on a fixed spacing. Unlike everywhere else in this Primer, there are two spaces between sentences to aid readability.

Monospaced fonts should never be justified; the strange spacing of this paragraph demonstrates why. The rest of the text in this Primer is in a proportional font and could be justified if desired, although it still reads easier with a ragged right edge.

Lines, boxes, and choosing fonts are important, but leaving adequate white space—for interest and good design—is just as important when designing the page to attract, and maintain, attention.

When the first Macintosh computers arrived with their wide variety of fonts, desktop publishers violated all of the classic rules of design by including several different fonts and sizes on the same page, failing to keep their design simple and consistent, and generally using the system as if it was an over-priced typewriter. In simple terms, they knew nothing about good design principles, although some desktop posters of the era were interesting examples of collage technique.

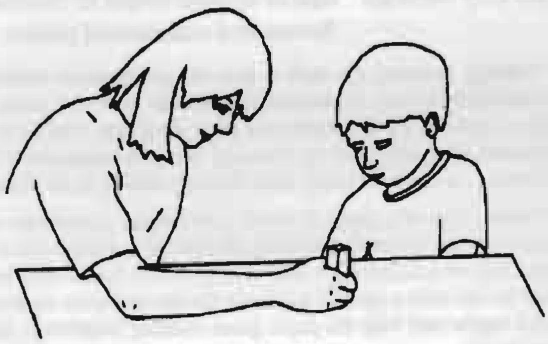
Including Illustrations

Most of us don't have very much artistic talent but we can trace reasonably well. To produce many of my illustrations I first trace the main details from a photograph (translucent draftsman's tracing paper and pencil), then I add freehand detail and shading.

I then scan the pencil sketch into the computer using a handheld or flatbed scanner and 'enhance' it using a computer drawing program. For the enhancement I either use the proprietary software that comes with the scanner or a drawing package such as *Canvas* to get rid of background marks, strengthen some of the lines, and generally improve the appearance of the image. This process often involves looking at an enlarged view of the sketch (on screen) and clicking individual points (pixels) 'on' or 'off'.

The enhanced image is then 'imported' (copied electronically) into the text file and the two are moved around, sizes changed, etc., until I have a reasonable layout.

Our university graphic artist prepared this illustration of a woman and child using one of the new electronic cameras (the image was recorded electronically rather than on film), a laser printer and a flatbed scanner.



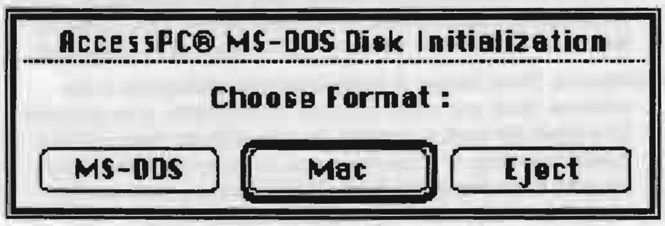
Line Art: From an inked drawing prepared by tracing an electronic collage of two photographs.

He started with the two photographs in the next column, neither of which was quite the pose desired, combined them electronically to create a better composition (in a computerised darkroom program), and printed the combined image on paper using the laser printer.

He then traced the (combined) photographic image onto another sheet of paper to make a pencil sketch, made an ink tracing of the pencil sketch for better reproduction quality, and scanned the result.

Incidentally, the three photographs were converted to the equivalent of line art when they were scanned for inclusion in this Primer. Their quality was considerably better as a paper print from the laser printer.

Images captured from a computer screen are another source of illustrations for training materials. The illustration below is from a training manual for novice computer users, and took only a few seconds to prepare.



Copyright and other Legalities

There isn't enough space in this Primer to detail all of the legalities of copyright and the other issues that can arise in preparing desktop publications.

You should be aware, however, that you cannot copy materials produced by other people without their permission—preferably written permission.

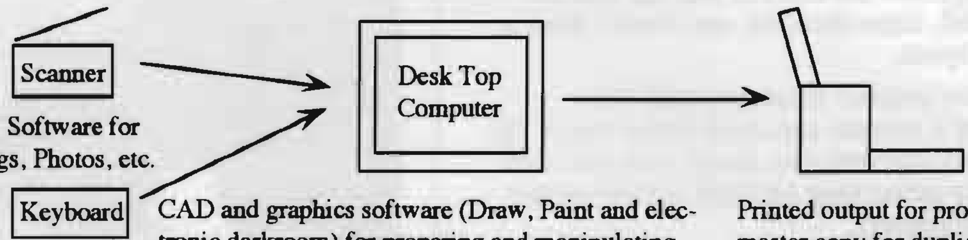
Copyright on visual materials is particularly tricky. You cannot, for example, prepare an illustration loosely based on a photograph or poster design if you didn't create the original poster/photo.

In general, you cannot include any illustrative materials (sketches, technical illustrations, photographs, cartoons, artwork, photographs, etc.) from another publication without specific permission from the copyright holder.

Corporate logos are another problem. Some corporations will not even allow their logo to be used on a model of their product or to be depicted in a photograph or other illustration. They argue that the logo identifies the company, and if they don't protect the use of the logo, they have opened themselves up to misuse of the company's name.

Prospective editors should also be familiar with guidelines on sexist language, libel and slander, etc. A knowledge of commercial law, particularly the laws regarding the inclusion of a company number and the like may also be important.

Desk Top Publishing Terminology



OCR and Graphics Software for Text, Line Drawings, Photos, etc.

Direct text entry, and indirectly through modem and diskette.

CAD and graphics software (Draw, Paint and electronic darkroom) for preparing and manipulating graphic images. Word processing and DTP software for manipulating text and graphics.

Printed output for proofing and/or master copy for duplicating. Disk, tape or modem output to Service Bureau and commercial printer.

Binding: stapling, gluing or otherwise fastening printed sheets into a pad, booklet or book. Common fasteners include plastic or wire coils, heat sealed plastic 'posts' and various friction devices. The cover is often clear plastic or plastic coated.

CAD Software: Software for Computer Assisted Drafting (Drawing)—can be used to produce two or three dimensional drawings, depending upon capability.

Camera Ready: The final proof image that will be used for the preparation of the printed copy. Originally the camera ready copy was photographed by a special camera to make a negative for preparing the printing plate.

In common usage today, the camera ready copy is the master copy that is used by a high speed photocopier for 'printing'.

Coated Paper: A paper that has been coated with a layer of ink-absorbent china clay. Often called art paper, such paper is essential for highest quality printing, even with a laser printer.

Colour Separations: The special negatives prepared from a colour photograph or illustration to enable the image to be printed in colour. Traditionally prepared using colour filters, separations can now be prepared using computer software.

A colour image is printed by running the page through the press four times, each time with a different colour of ink (cyan, magenta, yellow, and black). The combinations of colours in any one area creates other colours. Green, for example, is produced by a combination of cyan and yellow dots. [Look at the colour comics or a newspaper photograph to see the dots.]

Continuous Tone Image: A continuous tone photograph is the common black and white or colour photographic print prepared by a photo lab from a negative. In a good photo there will be a continuous range of tones from pure white to solid black, with the gray tones providing detail. Pencil sketches must also be treated as a continuous tone image to capture detail.

Copy Editing: Marking the draft to give the printer exact directions for setting each line. Directions will include type size, style, italics and bold fonts, column and page sizes, etc. This step, originally done manually by the copy editor as instructions for a typesetter, is fundamentally what desktop editing is all about.

Copy Paper: Any of a range of wood pulp papers, sometimes made from recycled materials, used for photocopies. Better copier paper will be a clean white and very dust free. Most copy paper must be fed with a specified side up for the first pass on double-sided copies and with the paper grain running lengthwise for best results.

Draft: One of several versions of an uncompleted project. The *final draft* is the version that goes to the printer or service bureau.

Drawing Software: Programs which allow the user to create an image composed of lines rather than a bit pattern. Typically such software creates images that are defined mathematically, and can be easily manipulated for scaling, etc. A good draw package, for example, will allow an illustration to be scaled up in size while retaining the original line weight. See also *CAD* and *Paint Software*.

Dummy: A mock-up showing the size, style, and layout of the final document.

Font: The name for a particular typeface (character set)—Times or Helvetica, for example. Most fonts are available in several different sizes (heights and widths), weights (width of line—normal or bold), and styles (normal or italic). A san serif font lacks the small projections on the ends of horizontal and vertical lines of a character which make them more identifiable, and thus easier to read.

Halftone Photograph: A photographic illustration prepared from a special 'screened' negative. The resulting photo will contain only black and white tones, with the apparent shades of gray formed by varying the size of the dots composing the photo. [Look at a newspaper photo with a magnifying glass to see the dot structure.]

Computer software can now simulate the halftone process with a variety of patterns for printing the image.

High Contrast Image: An image composed of black and white lines only, without any grays. A pen and ink drawing or a 'line' drawing prepared using a computer drawing package is a good example.

Justification: The practice, used with textual materials, if inserting various sized spaces between words and individual letters so that all lines have exactly the same length.

Also called, right justified. The resulting text is usually harder to read than text with a ragged right edge, and is often full of 'rivers' of white space running down the column.

Laser Paper: A good quality copy paper specially manufactured to be dust free and dimensionally stable for use in a laser printer.

Lithography: A printing process that uses a flat surface (often a metal or plastic plate stretched around a circular roller), originally a large flat stone, to produce an printed copy from an image drawn on the surface using a greasy medium. The process depends upon water and ink not mixing—ink is rolled onto the wet surface, but adheres only to the greasy image, and the inked image is transferred to a piece of paper.

Paint Software: Computer software that allows the user to make a bit image—an image prepared by turning 'on' or 'off' the individual dots which comprise the picture. The spray can tool within most paint packages, for example, leaves a trail of dots resembling a sprayed line. See also *CAD* and *Drawing Software*.

Paper Sizes: The common size of paper used in a technical report, letter, or photocopier is A4 (210 by 297 mm). Folded in half to make a sheet with the same proportions, it results in an A5 page. A3 is larger, twice the size of an A4 sheet (297 x 420 mm).

Copying four A4 pages onto the two sides of an A3 sheet results in a 4 page document that can be folded to make a much neater package than individual sheets stapled together.

Perfect Binding: A relatively inexpensive process that uses hot glue or plastic to bind a stack of paper. Most magazines, paper bound books and notepads are perfect bound, which is why pages can be easily removed.

Postscript: A page definition language. Text and images are described in mathematical terms as combinations of lines which form objects; the objects can be empty or filled.

Proof: A supposedly correct copy of a photograph or printed material. The proof is used to check for accuracy, colour balance, size, etc., before sending the file to the printer.

Proof Paper: A high quality paper with minimum grain and a 'filled' surface for use in a laser printer when making 'camera ready' copies.

Proportional Type: Text characters whose width varies with the complexity of the character. In the typeface used in this Primer, for example, a 'w' is much wider than an 'i'.

Style Guide for Desktop Publishing*

- Use only one space after periods and any other punctuation that separates two sentences.
- Use proper quotation marks—‘’ or “”—instead of ' and ", marks which are more properly used for indicating feet and inches, etc.
- Use apostrophes ('), dashes (—), bullets (•), and other symbols, accented characters, etc. (™, ©, ®, £, ¥, ∞, ≠, ≈, °, ç, Ú, Æ, etc.) rather than their typewriter substitutes.
- Start paragraphs with indents and style sheets, align text with tabs rather than the space bar, and keep indents and line spacing consistent.
- Keep the text simple. Avoid using more than two type fonts on the same page unless for a special effect, and use italics and bold text sparingly.
- Justify text only if the line lengths and type sizes allow it to work properly. In this Primer, for example, the right hand edge has been kept ragged, except within boxed text where justification normally creates a better appearance. These lines, however, provide a good example of poor use of justification.

* Adapted from Williams, 1992.

Recycled Paper: Any paper made from recycled materials. Recycled paper is usually not suitable for use in a photocopier or laser printer as the fibres are very short, resulting in a rough and dusty surface. A deinked paper has been chemically treated to remove the ink from its previous use.

Service Bureau: A company supplying text and graphic services for the desktop publishing industry. Some are operated in conjunction with printers, others work independently. In either case, they provide facilities to transfer computer files to the printed page, and to combine text and other images.

Materials may often be supplied to the service bureau on disk or via modem. One of the major difficulties with using a service bureau is ensuring that the same fonts (brand and type) are used by both the desktop editor when designing the page and the service bureau when printing the page.

Uncoated Paper: Any paper which has not been coated with a clay or plastic finish. Uncoated papers can be quite smooth if they have been polished with machine rollers.

References

Blatner, David (1991). *Desktop Publisher's Survival Kit*. Berkeley, CA: Peachpit Press.

Includes a disk of utilities useful for compressing files, converting from DOS to Mac format, file merging, etc.

Gosney, Michael et al (1990). *The Gray Book: Designing in Black and White on Your Computer*. Chapel Hill, NC: Ventana Press.

Hedberg, John G (1990). *The Desktop Teacher*, HERDSA Green Guide #10. Campbelltown, NSW: HERDSA.

Hedberg's basic design concepts are particularly useful.

Williams, Robin (1992). *The PC is not a Typewriter*. Berkeley, CA: Peachpit Press.

This small book should be required reading for every would-be desktop publisher, including the thousands of ex-typists and others who persist in thinking that because they know how to type they also know how to design a printed page. A companion to *The Mac is not a Typewriter*.

Computer Primer Series

Multimedia Basics

Multimedia, the buzz word of the nineties, the current technological fad and the darling of the techno-nerds, the newest saviour of education and the future of all interaction!

- What is it?
- Why should we be interested?
- What can we do with it today?

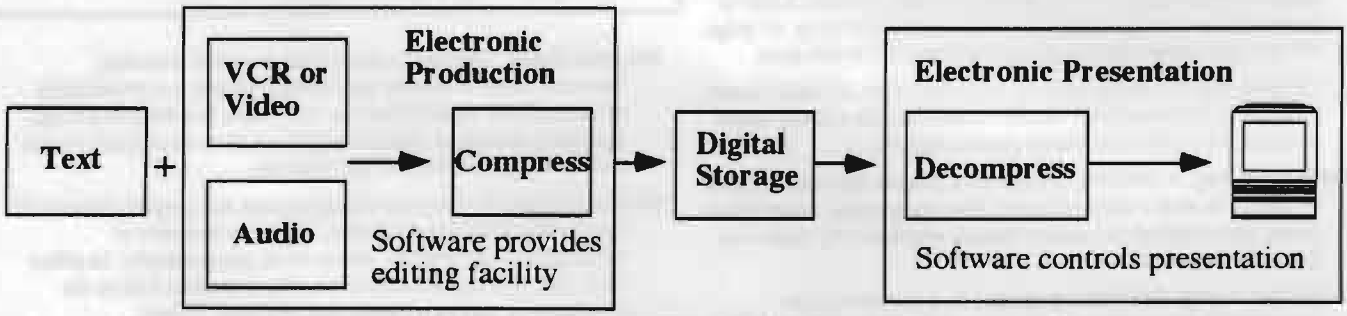
This paper has been written to help the novice understand what is involved in *computer controlled* multimedia applications. It is generic, the use of specific brand names and products should be understood as representative of what is in use. I generally refer to educational (and training) applications, but the concepts are the same for entertainment, business and other applications.

Multimedia, the term, is commonly used to refer to both the presentation systems (hardware) and the presentation, or content, itself. When talking about computer controlled multimedia it is also necessary to consider development hardware and the applications software (authoring systems, presentation and hardware control).

To be effective, an educational multimedia system must

- be low cost,
- have good quality sound output,
- include text, pictures (video as well as still pictures and illustrations), and animation, and
- allow for interaction between user and presentation (today usually using a mouse; it also requires the content designer to be aware of the user's needs).

Sound input for voice control, and/or a pen-based input device, would make the system more intuitive and easier to use. Colour often isn't essential but it does add information that makes the material more meaningful and thus better for learning purposes.



Creating, Editing, and Presenting MultiMedia Productions

The process is very similar to the conventional process of movie editing, except that everything is stored, manipulated, and presented digitally.

Historical Background

Multimedia is not new; it wasn't new back in the 60s when I spent hundreds of hours developing multi-screen, multi-projector, multi-channel, tapeslide presentations. They were merely the easiest technology at the time for developing maximum impact educational presentations as 'magic lantern' and film shows had been in previous eras. What was usually missing then was the potentially interactive nature of computer controlled multimedia.

The development of a multimedia presentation has always been time-consuming and equipment intensive. A 'simple' four screen, stereo sound, tapeslide presentation might have required several thousand slides, 8 projectors, 4 fade-dissolve units, 4 huge projection screens, a multi-channel sound system adequate for the presentation room, and a control system (often merely a human following a pre-determined sequence) for coordinating the slide changes. The best presentations were transferred to film or videotape for ease of use but thereby lost the wide/multi screen effect.

Today, multi-screen TV presentations (as in the Myers store in Brisbane and on the stage behind most popular entertainers) may still be presented in much the same manner with perhaps 16 TV screens (stacked 4x4) and 16 coordinated tape playback units. With a decent budget the several images can be combined onto a single delivery system (film for slide shows, tape or digital recordings for video). An *Imax Theatre*, with its wrap-around picture and sound, is one such system, eliminating much of the hardware duplication.

MultiMedia at Expo '92

The *Australian* Computer Section of 19/5/92 described a multimedia presentation prepared by Siemens to show their technological evolution over almost 150 years. 2500 slides were computer generated for the 'multivision' presentation which used 63 projectors and a revolving platform in a circular theatre.

Rock videos and television advertising were two of the major beneficiaries of the research and theories of the sixties, with *son et lumiere* (sound and light) shows and entertainment theme parks being the more educational and widespread outgrowths of the same work. They are found in almost every country and for a wide variety of historical and educational purposes.

These systems normally provide a passive interaction between the media and the viewer. The viewer is generally not able to affect the direction of the presentation, regardless of how much the viewer is otherwise affected by the presentation.

A few presentation systems incorporate viewer feedback, usually at critical decision points in a film or play, to change the direction of the presentation. The presentation system then runs the option selected and continues to the next decision point. Many different story lines are therefore possible and, depending upon the audience, every performance could theoretically be different.

A similar system is used for books that allow the reader to choose which of several options would be taken at the end of each mini-scenario/scene. Each option directs the reader to a different page for the continuation of the story line selected.

The search for maximum impact and involvement continues.

- Museums almost all now use realistic dioramas, combined with sound and smell, to give the viewer an impression of habitat; science and technology exhibits usually allow the user to manipulate the exhibits.
- Virtual reality (VR) is an attempt to create fully interactive environments; it provides the ability to experience (and manipulate) an environment that isn't physically present (and may not exist except in a computer).
- HyperMedia techniques allow each viewer to 'navigate' a presentation on a unique path, following non-linear 'links' between concepts.

Presentation Systems

From an educational point of view, the ideal display unit will be an inexpensive, handheld computer unit with a colour screen, sound (input and output if possible), and a high capacity storage unit (likely a CD-ROM). To be useful, this unit would require a wireless interface with a 'lesson server' that held the files required (even an optical drive does not have sufficient capacity for presenting extended lessons). The unit would also need to operate for 8-10 hours without recharging.

A major limitation of multimedia systems has been the amount of equipment and cabling required. Can you imagine the difficulties facing a community health educator or a primary school teacher with a class of 20 who wants to use multimedia? Twenty computers, colour monitors, keyboards, mice, hard drives, CD-ROM drives, and headphones (do you want to listen to 20 different sounds being output at once?). Now add the required power points and access to a network!

The mind boggles at the possibilities for confusion when the teacher directs the students/viewers to connect to the network and start executing the designated software.

A single self-contained, lightweight, wireless, presentation unit is essential for the future!

Fortunately, we can get 40-60% of the required functionality today, costs will come down with increased volume of sales, and new models will include even more functionality.

Macintosh computers currently have a number of the required features built into every unit; the Powerbook series of laptop computers has the ease of use, power and light weight required. Apple has also indicated that they will be introducing consumer products within the next year that will utilise optical storage facilities (CD-ROMs), thus making them functional for multimedia use.

Some IBM/MS-DOS laptop computers have a colour screen that is suitable for animation (but not live video as they are generally restricted to a limited range of colours, are slow to respond to changing images, and are expensive and power-hungry), and many computers have some form of sound output. Unfortunately, the open architecture of the DOS computer means that sound and video facilities are not currently integrated, but must be added in with extra boards (and complexity). DVI (Digital Video Interactive) is making headway and a Quicktime player has been announced for use under Windows.

Nintendo games units and Amiga computers provide some of the best glimpses of what is possible in the future but they don't have flexibility or market push. We will probably have to wait until the IBM-Apple alliance puts RISC (much faster and more powerful) processors onto the low-end market before we have units with the speed and capacity to present colour video and sound together for educational and training purposes.

Currently Macintosh has the best integrated system and most competitive pricing. Any Macintosh computer has the ability to deliver courseware prepared on any other Macintosh although the presentation is limited by the hardware standards of the machine used for developing the presentation and the presentation speed on an introductory level machine might not be acceptable.

A good developer would therefore develop the courseware using a high level (fast processor and large memory) machine for presentation on a lower level machine. This does not necessarily cause problems with colour if the developer remembers to choose colours that display as shades of grey.

Current Basic Multimedia Presentation Systems

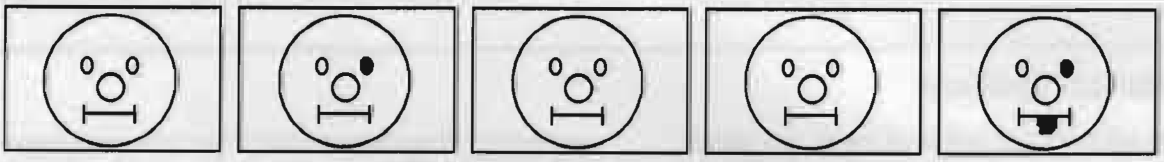
A 'multimedia capable' Macintosh Classic with 40MB hard drive, colour monitor, keyboard, mouse, basic software, built-in sound capability and Apple CD-ROM drive cost $2,990 ($2,559 ex tax) in July 1993. This would provide acceptable playback of most currently available multimedia materials on the Macintosh platform.

On the DOS platform we need a machine capable of running Windows software (386/486, 8-12MB) plus a high resolution monitor, video accelerator, sound card and amplifier. Costs would be higher.

Sun, DEC, and other similar workstations also have the required capabilities but are hardly economical enough for use outside of specialised facilities.

DOS-type machines require a higher level machine for both development and presentation—try running Windows, for example, on a low level machine—courseware must be developed very specifically for different display formats, and both live video and sound output are still problematic.

Courseware and Authoring Terminology



A Simple Animation Sequence

I have been using *courseware* to refer to the end product of the authoring process… the actual materials that students see for their lessons. Such courseware might be organised with structured lessons, left open-ended as a resource to be explored like an encyclopedia or database, or presented as a simulation or animated sequence.

Authoring tools (specialised software) allow us to sequence materials, keep information on use (including testing the user's knowledge at any time) and control the presentation, especially where a variety of media are being used reasonably simultaneously (maybe one window displaying a video clip, while another has an animated drawing of the same process, and yet another has a text explanation of the process, all synchronised to the video).

Hypercard, distributed free with all Macintosh computers, is an example of what is required from an authoring tool. It provides easy access to a variety of external resources (sound, video, etc.), runs on any Macintosh computer, and does not have either a high purchase cost or a requirement to pay royalties. As with any tool, Hypercard has its limitations, and is not normally used by commercial courseware developers.

Animation refers to a series of images (drawings usually) which change over time to show a process. A simple animation sequence (see above) is familiar to kids who put a series of stick figures on the corner of successive pages of a book and flip the pages to see the figure move. Current technology allows animation to be very complex and realistic as can be seen in many current popular films.

Animation sequences are often used to simulate processes that would be too complex, too expensive, too dangerous, or too difficult using other means. It would be expensive, for example, to provide oscilloscopes and similar equipment to external (distance education) students for electronic experiments. Instead a computer-based lab simulation could be used, with animated sequences that simulate the test equipment, dials, etc. Social simulations are more difficult.

A *simulation* is a tool for simplifying reality. Some simulations, as with the game of chess, are very stylised; others, such as a computer controlled dummy for practising artificial respiration or a modern jet aircraft simulator, can be quite realistic. Simulations are interactive and choices made by the user affect the outcome of the simulation.

Courseware Development

There have always been a limited number of commercially prepared courseware packages for the multimedia user. As with film, video, textbooks and computer software, the available multimedia courseware seldom fits perfectly with an individual user's needs. The usual option is to prepare your own courseware to fit your own needs.

QuickTime

Quicktime is a relatively new extension to the Macintosh operating system that does image and sound compression and decompression *on the fly*. Quicktime vastly improves the functionality of tools for adding video clips to an application, typically compressing 1 minute of live video (in a small window) into a file of 2-3MB. A still image file of 1MB is typically compressed to 15-40K without losing critical image data.

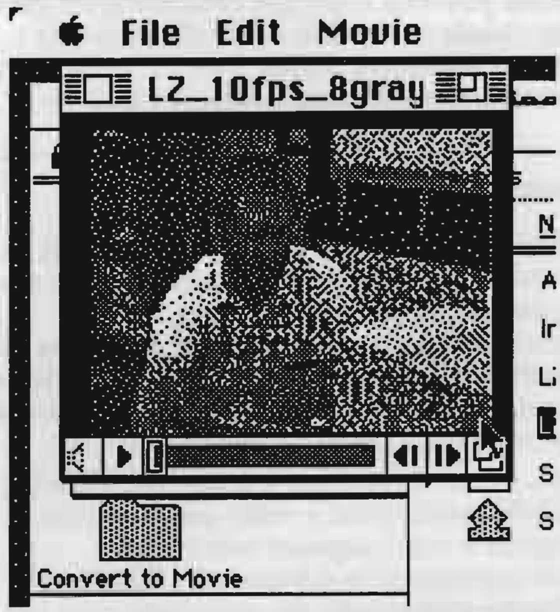
A quicktime video clip, running on a machine with full colour capability, would display in a window occupying perhaps 1/10th of the screen at 10 frames per second, quite adequate for synchronisation of sound and video and large enough for many applications.

Interestingly, the accompanying sound may require more storage space than the video itself as video images often have considerable duplication from frame to frame, simplifying compression.

Quicktime is distributed free with Macintosh applications that require its use and will work on any Macintosh computer. The Quicktime Developer's CD is available from the Apple Product Developer's Group for $300 [member price] and contains technical reference materials as well as examples of potential uses.

Facilities to play Quicktime materials will soon be available for DOS-type computers.

Preparing a tapeslide presentation was difficult enough back in the 60s; first you had to obtain the sound and pictures, then fit them into the delivery system. Trying to develop courseware using the 1980s multimedia technology was similarly difficult as it often required the teacher/developer to 'blast' ROMs, laser disks, CD-ROMs or proprietary cartridges. The equipment required for development was expensive, a single copy of a laser disk or CD-ROM for presentation could cost $2,000-$10,000, and the resulting courseware could only run on a single platform.



Sample Quicktime Movie-Viewing Window

The various buttons allow the movie to be run continuously or viewed as single frames.

Today the picture is changing. Apple, and the Macintosh software developers, have released a variety of products and tools that will allow users to combine a variety of image sources into a single presentation. Quicktime and similar systems have reduced storage requirements to a level where a CD or a hard drive can store live video and costs have dropped for low-volume runs of CDs.

There are a variety of authoring tools for developing the courseware. *Authorware* and *Macromind Director* have been two of the major tools for the Macintosh developer, with *Hypercard* being used by lower budget developers and end users. *MacroMind MediaMaker*, and *DiVa VideoShop* are two of the several tools for easily integrating video, text and graphics, and permit easy reorganisation of a presentation. Courseware is often developed on a high-end Macintosh and then ported to the DOS environment.

Most of the laserdisk and CD-ROM source materials currently available come from conventional information providers testing the market with potential commercial materials. Probably the best know materials are the American ABC-TV disks on the last U.S. election; more recent news materials include the Gulf War and CNN's prototype monthly news review (only issued once). Medical and art schools have produced collections of source materials—they have requirements for high quality slides or video, in colour, that can be easily accessed.

If a suitable collection of source materials exists for your needs you are indeed lucky. Purchasing a copy of the source (laser disk or CD) brings provides you with copyright permission for the use of the visuals on the disk—provided you don't make any additional copies. This isn't a significant restriction. Even if you are unhappy with the presentation software (system to access and manipulate the information on the disk), generally you will only want to develop a unique means of access to the disk, not copy the source information.

If you develop your own CD-ROMs or laserdisks you will probably still want to separate the source information (on the disks) from the tools to access the information (programs running in your computer and stored on the local or network hard disk drive). This maintains maximum flexibility as you can easily load a new version of your accessing software onto the network or stand-alone hard drive, whereas putting the same software onto the CD or laserdisk freezes it. Inexpensive, erasable, optical media may change this process somewhat but currently is still not economic.

Developer's Tool Kit

Computer: The multimedia developer needs the most powerful computer affordable to avoid those long caffeine breaks while waiting for the computer to digitise a graphic, etc. A Quadra 900, currently the top of the Macintosh line, would be the current preferred Mac option, although a mid-range machine (Centris) is quite acceptable.

- In a recent experiment, a Macintosh CI with 20MB memory and a video card was able to digitise a video segment with sound accompaniment at 4 frames per second (fps); a Quadra with exactly the same video card and software was able to digitise the same video at 10 fps. [Note that there may well be other hardware and software configurations that would give considerably faster captures on mid-range machines. This comparison was done with available facilities.]

  An LC with a different video card was later able to capture 4-8 fps, although the accompanying sound was not as good.
- If the video source is controllable, such as with a CD-ROM player or a frame accurate VCR, up to 25 fps is possible for live video even with mid-range computers. The trade-off of file size versus performance usually means that 10 fps is adequate to give the impression of motion without excessive flicker.

Data storage system: minimum 600MB to 1GB of high speed (probably magnetic) storage; CD-ROM player, etc. [Note that approximately 600MB of storage is required for assembling the video files for a transfer to CD-ROM.]

Video capture card: for digitising video input; 24 bit colour is important for video (video accelerators may also be required).

Video production facilities: as required (VCR, camera, studio facility, etc.).

CD-ROM Production

CDs are an ideal storage medium for multimedia courseware. Compact, but with the capacity to store 120 minutes of video or thousands of individual images (text pages, graphics or scanned pictures) on a single disk, they are an idea storage medium for images for student access.

Costs in early 1992, **exclusive of the cost of obtaining the original images on a suitable medium**, for preparing a *one-off* (single) copy of a CD-ROM in Australia may be as low as $800, with an additional $200 providing 4 duplicates.

The resulting one-off CDs are not as robust as commercially mastered CDs, but would be quite functional for in-house training programs or field-testing teacher-prepared instructional materials. Commercial versions could be obtained once the one-off version had been tested for approximately $2,250 for about 100 copies and $3 per copy thereafter.

Anything that can be put into a computer file format can be included on the CD, thus the software to control the display can be included as well as still images, live video, and sound clips. Production usually involves assembling the materials onto a large capacity disk drive (formatted to be exactly the same size as the CD) which is subsequently shipped to the CD production facility.

CD-ROM production machines are now economical enough for purchase by in-house producers (under $10,000) but are still too expensive and too technical for general users.

Scanner: slide and/or graphic scanner for still materials; 256 gray scale capability would be minimum today, with a preference for 24 bit colour.

Audio capture card: if not built-into the computer (required for non-Macintosh machines). Audio output would probably also be required for DOS-type systems and higher fidelity audio amplifiers and speakers might be desirable.

Software: A variety of software tools to capture materials (interfaces to the audio, video, and still material hardware), develop presentations, and deliver the resulting courseware. The video software, for example, should provide full video editing capability. The authoring software should be able to display your materials and permit the user to interact with the materials in whatever way you have defined.

Testing: Hardware and software facilities identical with the deliver system being used. If, for example, development was being done with a CI or a Quadra, and the delivery on colour LCs with hard drive and external CD-ROM drive, the development team would need a similar machine for testing the courseware before delivery.

Future Developments

I have indicated that current hardware and software systems can deliver approximately 60% of our multimedia needs now. It is estimated that within 2-3 years there will be economical systems to provide all of our *current* needs.

- Apple has indicated that they will be delivering a consumer type multimedia delivery unit with an optical drive (likely CD-ROM) by Christmas '93.
- Apple has recently supplied a mid-range MultiMedia Developer's machine (Centris) with built-in video acceleration, and Power PC (1994) machines will be fast and relatively inexpensive— 'comparable to DOS prices'.
- DOS platform developments are occurring very quickly and some manufacturers have been targeting the multimedia market with machines with built-in sound, video chips, etc.
- Speech recognition and speech synthesis research has been progressing at a fantastic rate. I have seen a videotaped demonstration of pilot systems that can reliably recognise several hundred words, regardless of the speaker's accent, and developments are being made in text-to-speech systems (storing text is much more economical than storing the same message in a digitised form). The challenge now is to add intelligence (AI) so that the computer recognises what you meant to say rather than what you actually said!
- It is possible now to produce semi-intelligent interfaces to computer generated graphic environments such that the user can 'tour' a facility such as a museum and interact with the computer environment to obtain additional explanations, etc.

Develop for Today —but Remember Tomorrow

The real trick for the developer is to prepare materials that are useable today, but will still be useable tomorrow. Within the Macintosh environment, this might include preparing courseware to run on a 9" black & white screen, but selecting options that will allow the same materials to be run on larger screens. Similarly, colour that is captured as a 24 bit image will be viewable on any Macintosh, albeit poorly on a monochrome screen, and will display optimally on even the highest resolution screens.

Courseware should either be easily updatable or use features that can easily be activated when they are useable.

As mentioned above, placing source materials on CD-ROM or similar media, and keeping the display software on magnetic (erasable) media, facilitates this process.

References

Ambron, Sueann, and Hooper, Kristina (eds) (1988). *Interactive Multimedia: Visions of Multimedia for Developers, Educators, & Information Providers*. Redmond, WA: Microsoft Press.

Ambron, Sueann, and Hooper, Kristina (eds) (1990). *Learning with Interactive Multimedia: Developing and Using Multimedia Tools in Education*. Redmond, WA: Microsoft Press.

Apple (1986). *Human Interface Guidelines: The Apple Desktop Interface*. Reading, MS: Addison-Wesley.

Apple (1989). *HyperCard Stack Design Guidelines*. Reading, MS: Addison-Wesley.

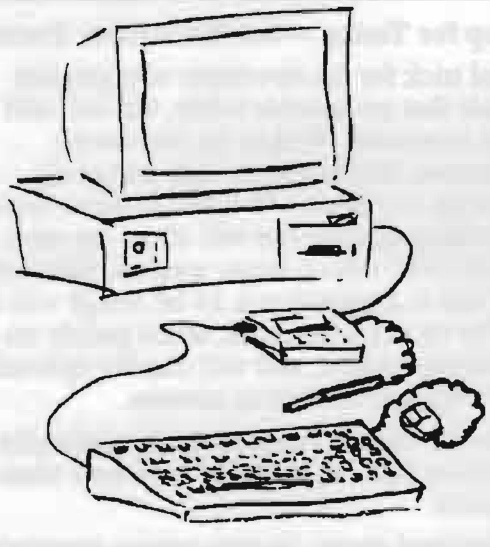
Apple (1991). *QuickTime Developer's Kit, Vs 1.0*. Cupertino, CA: Apple Computer, Inc.

Barcode Technology

Barcodes are self-contained messages which use the width and spacing of printed bars (lines) to encode their messages. The messages are read by light wands (pens), light guns or fixed scanners which convert the light reflected from the bars and spaces into digital codes. Barcodes use parity and/or checksum information to improve accuracy.

While barcodes are only one of several forms of machine-readable messages in common use they are fast, reliable and inexpensive in many applications.

Barcodes are not generally useful for large amounts of data—large data sets being slow to read and inconsistencies in printing and scanning produce problems—but they are very useful for applications such as inventory control where there are large numbers of discrete and uniquely identifiable items.



PC with wand type scanner and interface

Many barcode applications require scanning directly into a computer for immediate processing—the customer at a grocery store checkout counter, for example, wants to know immediately what the grocery item will cost—but there are applications, particularly for stocktaking and similar activities where the information collection occurs over a wide physical area, where portability of the data collection device (barcode reader) is useful.

This primer looks at barcodes and their use. It examines several different barcode formats and their applications, and relates barcode technology to the general field of pattern recognition.

Why Barcodes?

Getting machine-readable information into the computer, depending on the application, is often many times faster and more accurate than using manual techniques. In addition, machine-readable information can often be directly input to the computer as it is generated by other systems.

Manually entered data, on the other hand must be checked for accuracy, a particular problem with transcribing hand-written data.

It would be ideal if the computer could read the same data as humans, however computers have the same problems as humans in deciding whether a particular character is an S or a 5, a B or an 8. In addition, optical character readers (OCR), only work reliably when the typed or printed line to be read is straight and precisely oriented with a consistent height and regular (2 dimensional) characters. OCR systems do not yet have the capability of reading handwriting, and do best with stylised OCR character sets such as those used on the bottom of cheques for account and bank codes.

Mark sense (also known as optical mark reader, or OMR) and barcode technologies are one dimensional systems developed to overcome some of these problems. Both technologies offer improved data entry accuracy within their areas of utility.

OMR forms allow semi-skilled human operators to enter information, but require a large pre-printed data input form. Each character, in each position, requires a full character set of options (the character is read as a position on an imaginary line extending from the timing mark). OMR forms are relatively expensive as they must be very accurately printed in two colours. The character position template, printed in a non-readable colour, requires accurate alignment with the machine-readable timing marks.

Barcodes encode relatively large amounts of information in a small space. Since the barcode symbol is the same for its full vertical height (vertical redundancy) and the codes used usually have built-in check digits, barcodes are extremely reliable. The barcode symbols can be printed with a wide variety of printers—dot matrix, laser, thermal, inkjet, etc.—although data density and scanning accuracy is improved with better quality printing methods.

Scanning for Pattern Recognition

Pattern recognition is one of computing's basic research areas, and implementations include everything from the search and replace function in your word processor, to fingerprint recognition for security systems, object recognition in robotics, optical character recognition for rapid text input, and speech and handwriting recognition.

Scanning of the basic pattern (characters, objects, etc.) can be accomplished using LEDs, lasers, and other purely electronic devices, or by optical systems (video cameras, etc.).

- Checkout counters in Australia are almost all equipped with some form of LED or laser device for reading product tags. Units in supermarkets will read UPC (Universal Product Code) barcode labels, units in libraries and clothing shops will generally read MRC (machine-readable characters) codes which provide stock inventory and pricing data. Banks use a similar system, with a special character set, for cheque processing.
- Red light cameras at traffic intersections, for example, are simply video cameras which operate as data input devices. The computer program scans the video image for recognisable license plate characters. Optical image systems for robots function in the same manner, providing an image that the computer can scan for a recognisable pattern, usually a part to be manipulated.
- Educational institutions, research groups, and various lottery groups, etc., use special machine-readable forms for individual tests and survey data. These OMR (optical mark reader) forms are usually prepared by marking in blanks on a position-dependant matrix corresponding to the desired data.
- Hand-held and desk-type data input tablets are used with a stylus and position and/or sequence recognition software for recognising either codes or handwriting. The newest pen-based computers, for example, have a combined display and data entry screen which can be used for inventory, survey data, and similar data collection functions.
- Other applications include identifying hand-written numbers in the defined boxes on 'standard' envelopes for sorting mail by post codes, and scanning the large bar codes attached to railway wagons for identifying loads delivered to Queensland sugar mills.

Photocopiers, FAX machines, and graphics scanners use similar technologies, but they use the resulting image without any pattern recognition. The complete image of a page, for example, is scanned by the FAX machine, compressed and sent over the phone line for decompression and printing by the receiving FAX machine.

Database Management

In most of the applications above, the scanned image required computer processing to either provide input to a database, or to be matched against a stored database for further processing.

In a retail store there are typically several aspects to the database involved. The computer uses a product and price table to look up the current price to charge the customer. As well, it will normally adjust the inventory to reflect the sale, triggering a reorder advice at some predetermined stock level. The banking system similarly uses the scanned data to adjust inventories—its own and customers' accounts.

Robots, and optical character, mark, or pattern recognition systems match the current image against a stored data set—typically either a small database of acceptable patterns, or descriptions of acceptable patterns. In other words, a database of objects using one of the same two formats we have with graphics software, either a bit (Paint) image or a description (Draw) of an image.

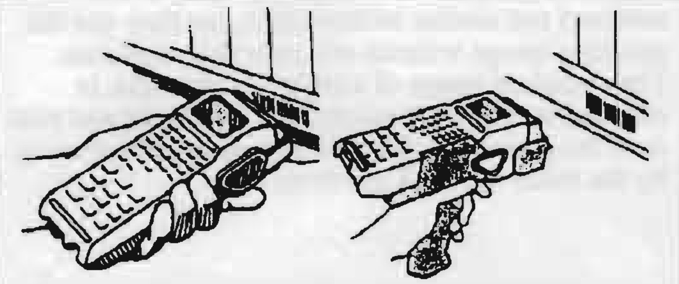
The database design for an application is beyond the scope of the primer. The success of the application may, however, be just as dependent on the database management as it is on the techniques of data entry. The accuracy of the pattern matching in a grocery store, for example, requires

- the use of very explicit standards for the printing and application of the barcode image,
- a very fast response time for matching (or rejecting) the image,
- an accurate database of product prices, and
- the ability to manually override the system in case of recognised error.

Scanning Systems

Handheld barcode readers are household items in many Australian homes—Panasonic (and perhaps other) brand infra-red remote controllers are equipped with digital scanners to remotely program your VCR. They are a *contact* reader, the scanning unit must touch the barcode symbol itself during the left-to-right scan. The scan pattern and speed is thus up to the user—make an incorrect scan and the unit 'beeps' at you, requiring a rescan. Other light wands and pens operate similarly, although some systems allow the user to scan in either direction (bi-directional).

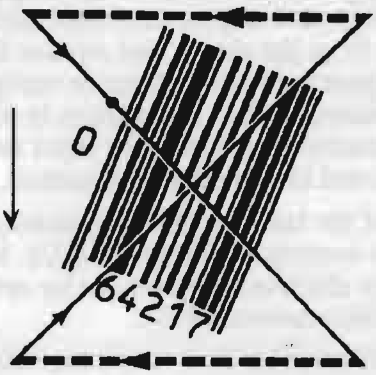
A gun or wedge scanner is a fixed beam scanner, often with a depth of field suitable for reading codes on curved surfaces. Target stores in Australia have one or more such scanners located around the store for shoppers to use to verify prices. Their scanners, connected directly to the computer and a display unit, require the gun to be placed directly on the barcode symbol; it is then activated by pressing a 'trigger' (button) on the side of the unit.



Hand Scanners have many variations—some must contact the symbol, others have a greater depth of field. Illustration from supplier's literature (Epic Data).

Fixed location scanners are available in a variety of types and scanning systems. The most common units are the under-the-counter 'X' pattern scanners used for grocery checkout counters. Library applications often use a single beam laser scanner mounted on a small stand so that the operator can place a book and its bar code symbol at a reasonably fixed location underneath. Units in locations such as this typically use compact lasers for scanning and have a wide depth of field. Scanners may use a fixed (beam is always in the same location, no moving parts) or a moving beam (the beam moves across the symbol, typically through the use of a rotating mirror).

Less compact scanners, fixed or movable beam, usually omni-directional scanning, are feasible for industrial applications such as identifying railway wagons trackside, sorting boxes of liquor in a warehouse delivery system, or keeping track of steel sheets in an assembly line.



Half of a UPC symbol showing the effect of an 'X' scan pattern on a moving package—one beam reads the symbol. Source: Dr Dobb's Journal

Typical office or business installations use the scanner as an alternate input device. The scanner either connects directly into the keyboard, between the keyboard and the computer, or into one of the I/O ports (see illustration on page 50).

Intelligent handheld readers are available to both scan and interpret the barcode symbol, storing the information internally for later use. Grocery stores often use such units for stocktaking; clerks scan the UPC symbol and then enter a quantity manually using the keyboard on one side of the unit. Similar units are increasingly being used overseas for entering bedside data from a patient identification bar code and a combination of barcode work sheets (printed barcode sheets with standard data entry codes) and the keyboard.

Scanning barcodes would be quite easy if all we had to do was *count* the number of bars. Unfortunately, we also need to know the *width* of bars, and usually also the spaces. This means that scan timing is important.

The user of a wand scanner, for example, must pass the wand across the image at a constant rate, neither too fast nor too slow for the system to read the information. The user is also responsible for ensuring that the wand passes across the complete symbol. Hand-scanned symbols are typically quite short, avoiding the problems that result from an inconsistent speed in a diagonal scan—a short space or bar could be misread as wide if the scan speed was slow or jerky and the diagonal extreme enough. Automatic systems may require large symbols and/or more sophisticated equipment.

Consider, for instance, the problem of scanning the symbol on a box on a moving conveyor belt. If the belt always travels at a consistent speed it will be easy to calibrate the scanner. The problem changes, however, if the conveyor belt changes speed depending upon its weight or centre of

Ladder

1234567890 1936

Unidirectional (A single scan beam will read without turning object)

Picket Fence

000XTESTX000

Omni-directional (One of the two symbols can be read from any direction)

100000

Symbol Orientation: Illustrations from supplier's literature: *Auto.ID.News*, 3:1, and *Bar Code Technologies: Present State, Future Promise*, 2nd ed (Telford, PA: Accu-Sort Systems, Inc)

gravity of the box, as happens in liquor warehouses. Relatively light cartons of beer have a low centre of gravity and can be moved quickly. Cases of wine are stored with the neck down, resulting in a very high centre of gravity and a need for slower handling to avoid breakage.

Similar difficulties arise in almost every application and have resulted in a variety of solutions, including omni-directional scanning equipment, such as the common 'X' pattern and the more recent 'starburst' pattern.

Barcode Symbologies

Barcode symbols have developed to meet the needs of various commercial and industrial applications, thus have a variety of formats. This section examines four of the most common symbologies to illustrate the characteristics and potential of barcodes.

Each symbology has a particular character set—some are strictly numeric, some encode numerals plus a few special characters, and others are alphanumeric (both alphabetic characters and numerals). As well some codes represent each character as a discrete symbol. In such a discrete symbology a series of characters would be represented by a sequence of symbols with intervening spaces, much as a list of single digits separated by spaces. Codabar is an example of a discrete symbology.

Other codes represent a series of characters in a continuous sequence, with no spaces between characters, other than the leading or trailing space that forms part of a such a symbol. Continuous symbologies require an explicit end of message pattern to terminate the last character. Continuous symbologies require less space to encode a message since they do not need a inter-character space. UPC is an example of a continuous symbology.

It should be obvious that a discrete symbology (Codabar, Code 39) can encode a message of any length, albeit requiring a considerable amount of space, as each character is read independently. Some symbologies have a fixed length message, often because of the need to incorporate security measures. The UPC/EAN symbology variations permit encoding messages of 6 to 13 digits, however, not all scanners can decode all variations and specific applications would seldom intermix variations. Other symbologies (Code 128 and others, see references) can encode messages of any length.

Most symbologies only encode one character at a time; others increase information density by coding two characters at a time, one in the bars, another in the spaces (Interleaved 2 of 5).

UPC

1 23456 78901

UPC Subset A, without guard bars

The UPC (universal product code) is one of the earliest and best known barcodes. Developed by

US grocery stores in the late sixties, the UPC was adopted as an industry standard in North America in 1973, and in slightly modified form as the EAN (European Article Numbering) code in 1976. The UPC/EAN system has had widespread adoption, particularly with the trend towards smaller and lower cost electronic components, and has led to wider use of barcode technology in other applications.

The UPC symbol is a numeric-only system, able to encode digits in odd or even parity. The symbology could be used to encode any numeric information (one version of the symbology allows variable length messages), but it is generally used to encode a 5 digit manufacturer (left side of the symbol) and a 5 digit product (right side of the symbol) identifier. This 10 digit symbol is preceded with a number system digit and followed by a check digit based on the preceding 11 digits for a total of 12 digits. Coding is based on both bar and space widths. The symbol also contains left, centre, and right 'guard bars' (the two longer narrow bars in each location).

0 12345 67890 0 12345 67890

The UPC Symbol decodes into two separate halves, each with a different parity—the central guard bars serving both halves

- The UPC bar height must be greater than the width of six digits to allow omni-directional scanning.
- The longer guard bars maximise the scanning tilt angle.
- Each half of the symbol can be decoded individually as right and left halves use different parities (there are two different codings for each digit, depending upon parity).
- Each digit is coded as two bars and two spaces within a seven unit module; bars and spaces can be 1-4 units wide; odd and even parity codes are the inverse of each other.
- The 10 digits of the encoded message are normally also printed below the symbol to permit manual entry if the symbol cannot be machine-read.

1 234567 89012 1234567

EAN Subset 13 and Subset 8

The EAN system is a superset of the UPC that results in symbols encoding either 13 (with a country code) or 8 digits.

Codabar

Codabar

A12345A

The Codabar symbology was another early development (1972) and reflects the state of computer technology at the time. It is used in library, blood bank, photoprocessing and air parcel express applications, and is a discrete symbology with 16 different characters (numerals 0 to 9, and the $: / . + - characters) plus 4 stop/start characters. Codabar self-checking characters are constructed from four bars and the three intervening spaces.

- The numerals, and the two characters $ and -, are encoded with one wide bar and one wide space, all other elements are narrow.
- The other four special characters (: / . +) are encoded with three wide bars and no wide spaces.
- The four stop/start characters (a, b, c, d) are encoded with one wide bar and two wide spaces.
- Any of the start/stop characters can be used in a message; different combinations of characters can be used to provide additional information.

The traditional Codabar symbology uses 18 different widths and is difficult to both print and read with inexpensive systems. Rationalized Codabar is just as secure but uses only two element widths, wide and narrow. Ames Code and 2 of 7 Code are two other variations using two element widths.

Interleaved 2 of 5

12345 123456 123456

2 of 5 code, interleaved 2 of 5, and interleaved 2 of 5 with bearer bars.

The 2 of 5 Code is a simple, self-checking, discrete code which uses five bars—two wide and three narrow—for each character. Spaces, containing no information in themselves, can be any width, but are typically equal to the narrow bar. Narrow bars have a value of 0 and wide bars a value of 1. 2 of 5 Code is used for inventory, airline ticketing and photofinishing envelope identification.

Interleaved 2 of 5, used for warehouse and heavy industry applications, particularly the automotive industry, uses the 2 of 5 code but encodes characters in both the bars and the spaces. Odd number digits are represented in the bars, even numbered digits in the spaces (composed of the same elements, two wide and three narrow). Interleaved 2 of 5 is also self-checking, but, as it requires a bar to delineate the width of the trailing space, is a continuous symbology.

Interleaved 2 of 5 works best with fixed length systems as there is a fair probability that a partial scan would decode into a valid message. To overcome this, some applications use 'bearer bars', bars top and bottom that cause an invalid start/stop code for a partial scan.

Code 39

12345 **Code 39**

Code 39, also known as 3 of 9, was the first alphanumeric symbology and is used in many commercial and industrial applications, including extensively within the health industry. It is a discrete, self-checking, variable length symbology that can be printed with a wide range of printers.

- Code 39 characters contain five bars and four spaces (9 elements), three of which are wide.
- Code 39 has 44 characters (0 to 9, A to Z, space, and the . * $ / + - % characters), including a stop bit (the * character).
- The intercharacter gap should be kept small to avoid incorrect partial reads (confusing P and *).
- The full 128 ASCII character set can be encoded using a variation that combines the special and alphabetic characters into two character codes.

The health industry has defined an optional modulo 43 check character for increasing data security. The use of this check character is encouraged, especially where symbol print quality is poor.

Code 93 is a higher density code that complements Code 39 and can be intermixed with the proper (auto-discriminating) equipment. Code 93 removes certain ambiguities from Code 39 and uses two check digits for increased reliability.

Barcode Printing

It should be obvious that higher density codes require better quality printing than lower density codes. Any grocery shopper will also be aware that the scan rate, and reliability, is very dependent upon the reflectance of the package, the background colour, and the surface smoothness. A can of soup, for example, is usually harder to scan than a box of breakfast cereal, the frost must be scraped off a package of frozen food before scanning, and it is almost impossible to get a good scan from a transparent packet containing any dark object unless the UPC symbol has been printed on a light background.

Many applications permit printing the barcode symbols on self-adhesive labels for application to the item being identified. This allows better control of both print media and print quality, even with low-quality printers. Commercial barcode label printers can supply high quality labels on a wide variety of media and most product label or box printers can provide appropriate barcode symbols.

Laser and inkjet printers are taking over many of the on-demand applications where dot-matrix printers have traditionally been used but the best results are still obtained from dedicated barcode printers using special print media (thermal and thermal transfer, paints, etc.). Look closely at any high density barcode symbol with a magnifying glass and you will see that the print quality is high, with consistent widths and print densities, and minimal symbol distortion. The symbol background is also controlled, sometimes by printing the background in a special ink as well as the symbol.

Dot-matrix, and to a lesser extent laser and inkjet, printers can only be used for low to medium density symbols on normal labels and paper. The printer ribbons (or other 'ink' material) must be closely monitored to ensure that bars are uniformly dark and widths remain constant. Coloured and unbleached papers are likely not useable for reliable results.

Barcode symbols must be painted with non-fading materials when used in exterior applications. Even then, the symbol must often be washed before scanning to get a reliable reading. This is possible in some applications, but can be too expensive, or inconvenient, in others. Queensland sugar mills, for example, wash the barcode symbols on arriving cane wagons. This may be inconvenient but is relatively inexpensive and doesn't harm the load of raw cane.

Conclusion

Technologies for machine-reading are changing almost daily. Only four or five years ago OCR users commonly accepted a 5% error rate and the necessity to 'train' OCR systems. Today there are several OCR systems which can automatically adjust for a wide variety of sizes and variable spaced fonts with 1-2% error rates. As technologies improve we can expect even better rates and perhaps different technologies.

Barcode technologies remain appropriate for applications where the messages are generally fairly short and the variations very large. Airline baggage handling, for example, is an area where barcode technologies seem ideal. Already the relatively small number of destinations worldwide permits the use of barcoded tags displaying airport codes for high-speed automatic sorting and destination verification. The number of passengers requiring unique identifiers is, however, almost infinite. A barcoded ID tag, perhaps coded to the passenger's ticket or computer file number, would permit tracking of individual items.

Similarly in the health field, barcoded identity tags for hospital patients and codes for common procedures would provide better quality assurance and could assist with bedside data collection, particularly when using modern diagnostic and monitoring systems. Simple chores such as recording temperatures and blood pressure, for example, could become more reliable using the technology.

North American railroads, on the other hand, abandoned their barcode experiments in the early seventies after the expenditure of millions of dollars, simply because it was too difficult, and therefore too expensive, to maintain the wagon identification symbols in good order.

In most applications, however, barcodes are relatively inexpensive, very reliable, and as simple as they are, seem destined to be with us for a long time.

Suppliers

This listing includes the barcode industry association and several suppliers of barcode technology known to the authors in Australia at the time of writing. No endorsement of these vendors is intended, nor do the authors accept any responsibility for errors or omissions in this listing.

Applied Electronic Systems Pty Ltd (Accu-Sort Systems). Brisbane, QLD. Phone (07) 208 6911, FAX (07) 808 7426.

ASP Microcomputers. 736 Waverley Rd, Chadstone, VIC 3148. Phone (03) 568 0988.

Auto-ID Manufacturers [industry association]. FAX (02) 958-2579.

Barcode (Qld), Richard A Sherwin. Phone (07) 343 8894, FAX (07) 849 5026.

Bearquip, Scott Pirret. 10 Vista Park Dr, Buderim, QLD. Phone (074) 456 088, Brisbane 008 800 712.

Epic Data Australia. 30 The Avenue, Hurstville, NSW 2220. Phone (02) 585-0077, FAX (02) 585-0191. John Holliday. 9/21 Upton St, Bundall, QLD 4217. Phone (075) 315657, FAX (075) 922261.

Intermex Pty Ltd. Unit 14, 818 Pittwater Rd, Dee Why, NSW 2099. Phone (02) 971 6099, FAX (02) 971 2799.

References

Harmon, Craig K, Adams, Russ (1989). *Reading Between the Lines: An Introduction to Bar Code Technology*. Peterborough, NH: Helmers Publishing, Inc.

This is a very complete and readable general introduction to barcode technology and includes chapters on symbology, bar code design and media, printing, reading, and system design.

Palmer, Roger C (1991). *The Bar Code Book: Reading, Printing and Specification of Bar Code Symbols*. Peterborough, NH: Helmers Publishing, Inc.

Technical information useful for the system designer or technology developer.

Savir, D, Laurer, G. J. (1977). 'The Characteristics and Decodability of the Universal Product Code Symbol'. *Dr Dobb's Journal*, April, 36-43.

Describes the coding and symbology of the UPC and its decodability, particularly as regards scan patterns and symbol size.

Computer Maintenance

Almost any computer owner will tell you that learning how to use your computer applications (word processor, electronic mail, etc.) isn't enough—you must also learn how to perform the minimal maintenance tasks to keep your personal computer functioning.

Owners and users of small computer systems or local area networks (LANS), such as those in a clinic or hospital, will similarly need to be aware of basic maintenance techniques unless they have a full time computer service staff.

Many users learn this lesson at an inconvenient time—the computer breaks down over a weekend or just before a holiday—and all find that good computer repair shops are few and far between, even in a capital city. Shops also charge quite justifiable, but significant, fees for work that the average user should be able to easily perform.

In my experience there are a number of practical maintenance chores that most users can, and should, know how to do. These include

- performing regular file backups,
- installing new software and hardware,
- general cleaning, and
- knowing what to do when a major problem occurs.

This Primer provides guidance in performing routine cleaning, and some limited hints to try when the problems are major. You should also consult the manuals for your computer hardware and software, as well as any information provided by your vendor(s) or computer system operators regarding warranties, maintenance, and safety.

The information in this Primer generally relates to any personal computer, but that many details are specific to an IBM/MS-DOS type.

A Personal Experience

Two examples from my personal experience indicate the importance of understanding how to maintain your computer. The first happened in a capital city with the national repair service for a brand name computer, fortunately still under warranty. The repair service didn't have manuals for my computer, and the staff had not received training in repairing personal computers—they didn't even know how to turn one on.

The actual problem turned out to be relatively minor, but if I hadn't been able to run the basic diagnostic tests, and explain their operation to the repair staff, my computer would have been shipped to 'head office' and been out of service for several weeks. Luckily, I knew how to run the tests from reading the manuals supplied with my computer, I just didn't know how to fix the problem identified.

Original illustration by Len Cook, UCQ. Used with permission.

More recently, my computer refused to start, and the screen displayed the message: *'Invalid drive specification'*. I could still boot from a floppy disk so the computer itself hadn't crashed, it just couldn't *find* the hard drive with the startup files. The computer's SETUP information appeared to be correct (I checked from my backup diagnostic floppy diskette), but the diagnostic tests supplied with the computer couldn't locate the drive either. Having tried the basic tests, I turned off the computer and followed the advice in the computer manual:

> *'If the drive still does not work correctly, open the system unit and make sure that both cables are properly installed between the fixed disk drive and the disk controller board (the circuit board closest to the disk drives). ...Check for proper power cable attachment.'*

I remembered to disconnect all the cables from the computer first, properly grounded myself, and opened the system unit. It was then a simple matter to identify all of the cables going to and from the hard drive, press them firmly on their connectors, and close up the system again. When I retried the computer, it worked, and I had saved a repair bill.

Warranty Service and Maintenance

Most computers and major peripherals (printers, monitors, etc.) are covered by a limited warranty for at least a few months after purchase. More reliable systems (and usually therefore more expensive) have longer warranties and fewer restrictions. Always have any repairs or other service work (boards installed, etc.) done by the designated warranty service centre during the warranty period.

Major 'brand name' manufacturers often have a network of 'authorised' dealers whose staff are factory trained in the repair and operation of their systems. Apple's educational and corporate dealers, for example, are required to have repair staff trained by Apple. Other major manufacturers may contract with national repair services to provide warranty and continuing support.

It should be obvious that profit margins are too small on lower priced brands to provide the same level of support as that provided for the more expensive brands. As well, some Australian distributors do not provide the same level of support as their US parent companies.

It's *Your* Responsibility!

Ultimately *you* are the only person who can be responsible for the proper operation of *your* computer system.

- Read the manual first. Often the answers to your questions/problems can be found there.
- Be aware of safety requirements and follow them completely. This includes following safe practices for the electrical power supply and the high voltages within monitors, etc.
- Always completely unplug the computer and any connected devices before opening up the computer—regardless of the reason.
- Get assistance from knowledgable friends or colleagues if you aren't sure about what you are doing, and
- Call in the experts before you make the problem worse.

Finally, don't be afraid to ask for help. Another person will usually find the most obvious faults—often as simple as an improperly connected plug.

Disclaimer: The author and the publisher assume no responsibility for your application of the advice and information contained in this Primer. Maintenance really is *your* responsibility!

General Operation

Computers are sensitive electronic instruments and must be kept in a clean dry place, free from dust, bugs and interference from other electronic devices. Increasingly, computers are 'networked' to other computers through a local area network or a modem and the telephone system. Maintaining your computer may be affected by the network as well as the desk/room where it is located.

Extremes of climactic conditions are very hard on the use of a computer:

- the summer heat may cause the computer to malfunction—usually by giving erratic or erroneous results, use an air conditioner or room fan during those months. Alternatively, get a better fan installed inside the computer;
- high humidity, smoke and sweat will cause corrosion and other damage, avoid storing or using a computer in a damp location, and never smoke near a computer;
- careless handling can damage the computer, ensure that all users know how to properly handle the computer, restrict food and drink near the computer;
- power fluctuations will damage chips, traces and the video tube, use a proper CVT (constant voltage transformer or power stabiliser) AND a spike suppressor (spikes are the short bursts of high voltage which cause a light to go bright) if your power supply is variable (rural and industrial areas particularly);

  turn the computer off and unplug from the power point during a storm;
- dust and bugs will damage the moving parts of the computer and the diskettes, keep the work area very clean, cover all components of the computer system with a dust cover when not in use, clean the work area (and inside the computer, printer, etc.) regularly.

Power Supply: The computer likely requires 230 volts plus or minus 10% and a frequency of 50Hz plus or minus .05Hz. Variations (surges and brown-outs) come from lightning strikes and other electrical equipment being switched on and off.

Be safe: Disconnect the computer from the power line, the telephone line, and all other devices during a lightning storm.

Portable computers often come with 'universal' power adaptors, allowing you to connect to 110-

240 volt supplies at 50 or 60Hz. Check the label on your power adaptor for compatibility before using it on a new power supply.

Most urban electrical systems are fairly stable. Power fluctuations occur most often in industrial areas, factories and rural areas.

Local electricians or computer vendors can give you guidance on power requirements, grounding of equipment, power conditioning (also called power stabilisation), etc., as required. Most technicians, for example, suggest that computer power supplies are now (1993) constructed well enough that power bars with 'surge' protection are not required.

Check the power requirements for all the units to be stabilised before purchasing power conditioning equipment. A CVT (constant voltage transformer or stabiliser) of 500va, for example, will likely operate one PC and a monochrome monitor, but probably won't also operate a colour monitor or printer.

Low cost UPS (uninterruptible power supply) systems are essentially a battery and voltage converter to supply a few minutes of power after a power failure. This is intended to give you enough time to save files and properly shut down your computer. Better quality systems condition the power as well—generally they constantly charge the batteries, enabling them to supply all the power for the computer.

Avoid extremes of heat and cold: The operating temperature of the computer is roughly 10 to 30 degrees Centigrade. While a computer may appear to function outside of this zone, errors may occur.

During the summer it may be necessary to use a room air conditioner or an extra fan while the computer is operating. This cooling is for your computer, not you. Make sure that the cooler air is passing through your computer.

In general, if the room temperature is uncomfortable for you, it will also be uncomfortable for your computer.

Avoid very high or very low humidity: The computer requires a humidity range of 20% to 80%, non-condensing.

Try not to use the computer if the humidity is low enough that there is static electricity being generated OR if the humidity is high enough that water condenses on the outside of a cold glass, window, or cool computer component.

Care of hard drives (also called fixed disks): Hard disk drives are particularly vulnerable to damage from being jarred when moved.

Operate the computer on a stable desk or table. Keep all cables neat, never allow cables to run across an aisle or other passage way.

Do not drop the computer or allow it to be banged when being moved.

> Your hard drive, and the information that it stores, is more valuable than all the other components of your system. NEVER move a computer or computer desk when the computer is on, as moving the hard drive increases the risk of a disk crash.

Interference: Locate your computer components and all magnetic media well away from sources of magnetism and electronic interference.

The emissions from a colour television, for example, can affect some hard drives. The magnetic coils in a stereo system speaker can erase a diskette.

> **Not IF, but WHEN**
>
> The electronic components in your computer are quite reliable. Reputable vendors normally 'burn in', or operate, computers for several hours continuously to ensure that they are functioning properly. If they survive the first couple of days, and have a stable power supply, they will generally operate reliably for many years.
>
> Mechanical components are quite different.
>
> Disk drives, for example, will break down. The question really isn't *if* your disk drive will fail, but *when*. The manufacturers recognise this with their MTBF (Mean time between failures) ratings and usually replace, rather than repairing, failed drives.
>
> **Be prepared! Back up your files regularly!**

'Burning In' A New Computer: Ensure that your hardware vendor has checked that all computer chips, memory boards, floppy and hard drive connectors, etc., have been properly installed.

Double check all connectors between the system unit and monitor, printer, etc.

Ensure that your power cables (or power bar) are connected to a properly grounded power circuit with sufficient capacity to operate the computer and other appliances on the same circuit. Ideally, the computer should be on an isolated circuit so that it isn't affected by the operation of your air conditioner, workshop tools, etc.

Turn on and operate your new computer continuously for the first two or three days to ensure that everything is functioning properly. Check all the sub-systems (memory, drive, monitor, printer, etc.), using the vendor's diagnostic software if available.

Maintain a record of all faults, and get them checked by the vendor immediately.

Practical Computer Maintenance

Cleaning: Clean the computer with a slightly damp cloth. Never let any kind of liquid run into any part of the computer.

Do not spill liquids on the computer or the keyboard. In other words, keep soft drinks and other beverages away from the computer unless you are willing to accept the consequences—usually a major repair bill.

- Check batteries regularly, replacing or recharging as recommended by the computer manufacturer. Remove batteries before storing units for more than a few days.

Daily Maintenance

- Clean the computer and work area with a damp, not wet, cloth.
- Record all computer problems in a computer log book, follow-up problems, repair if necessary.
- Pay attention to unusual sounds, smells, and operating changes, recording and correcting as required.
- Store diskettes, etc., in a secure and clean, dry location, making back-up copies if required.

Weekly Maintenance

- Clean all equipment, housings and the display screen with a damp, not wet, cloth.

  Never spray cleaners directly onto electronic equipment—spray the cleaning cloth and use it for removing dust, finger marks, etc.
- Inspect all cables and connections for tight fit, damage, etc. and repair as necessary.
- Check batteries on portable equipment.
- Make proper back-up copies of all important data and store in a safe location.

Monthly Maintenance

- Clean inside printer, blowing out accumulated paper dust, etc.

  Use a vacuum cleaner on the outside of computer, printer, etc., but keep it out of equipment. Most vacuum cleaners can be reversed to work as a blower for getting rid of dust a accumulated bug parts inside.
- Check back-up copies of diskettes to ensure that they have not been damaged or lost, check documentation (manuals and instruction sheets) for completeness, check stocks of new diskettes, printer paper, etc., for replacement.
- Check CVT and surge suppressor for good maintenance and proper operation.
- Make monthly back-up copies of all important data and store in a safe location off-site.

Every Six Months

- Clean inside computer. Disconnect power cords from computer, open computer case and remove spider's webs, bugs, etc.

Caution

There are high voltages and other hazards inside computers and monitors.

- Leave monitor servicing to the experts.
- Always disconnect all cables before opening the computer case.
- Watch where you put your hands.
- Keep metal tools out of any place where you could accidentally cause a 'short' circuit between two electronic components. In other words, you don't want your tools to touch two components at the same time!

Blow out accumulated dust and foreign particles. Replace cover and reconnect power.

- Fully inspect computer and accessories. Have professional inspection and repair if there have been operating problems.

Annual

- Make proper annual back-up copies of all important data and store in a safe location off-site. Financial records, for example, must often be printed out on paper for annual reports and income tax records.
- Check insurance renewals and locate all items on the inventory (small items, tools, etc., seem to disappear if you don't check their location occasionally), equipment replacement, supplies and maintenance budget, etc.

As Needed

- Have professional inspection and repair when problems occur.

Trouble Shooting

If you have problems with your computer system you should:

- Consult your computer manual for advice on how to handle problems and error messages.
- Run the diagnostic tests on the system diskettes supplied by your computer manufacturer and follow the advice provided.
- If the problem is still not resolved, consult your computer vendor, the vendor's approved maintenance service, or a local repair service.

Make a record of problems, and their solutions, so that you can provide correct information about a problem to a repair service when required.

> **Be Observant**
>
> A careful computer user observes how the computer operates when it is running normally—what messages flash up on the screen during the boot process, etc.—and can tell when the computer first does something unusual.
>
> It is particularly important to be observant during the POST (Power-On Self-Test) and other startup routines. It is difficult to know what has gone wrong unless you know what should happen when the computer is working properly.
>
> Don't wait for a disaster to occur, prevent problems before they happen!

Not a 'Boot' Disk

Floppy diskettes seldom contain the computer programs to start up a computer session. Therefore, if you have left a 'data' diskette, a diskette without these programs, in the floppy disk drive, the computer will be unable to complete the startup, or boot, process.

Remove the floppy diskette from the floppy disk drive and reboot the computer—this may require pressing the <F1> key, the reset button, or simply pressing any key—read your screen for directions.

Computer Doesn't Run

Turn off the computer. If there was a 'flash' or you can smell acrid smoke, leave the computer off until it can be checked by your repair centre.

If there wasn't a flash or smoke, check

- that all the power cables (or battery) are properly connected, and
- that the switch at the power point (or on the power bar) is on.

Check also that the voltage setting, usually a switch on the back panel of the computer, is correct for your location.

When you have checked all the cables, etc., try turning the computer on again.

If it still doesn't work:

- If your computer has a removable fuse holder (small round cap) on the back panel, gently twist the fuse holder and remove the fuse.

  There should be a thin 'wire' visible in the glass tube. If the wire appears broken, or if the glass looks burned, replace the fuse with another fuse of the same size and rating (marked on the metal end of the fuse). The fuse usually makes electrical contact through a spring—push and twist the holder to re-install the fuse and holder.

  The fuses, if any, for many computers are inside the case and may not be accessible to the user.

When you have replaced the fuse properly, try turning the computer on again.

A similar process can be followed if your monitor, printer, modem or other peripheral doesn't turn on.

Listen for a hum or other noise to indicate that the unit is 'on', even though it doesn't seem to work—the problem may be in another unit. I can tell, for example, that my computer is working properly when it 'beeps' and accesses the disk drive(s) during the boot-up routines, even if I have forgotten to turn on the monitor. Similarly, I can tell if I have forgotten to turn on the printer.

Monitor is ON, but Doesn't Display

Make sure that the monitor cable is properly connected, then check the brightness and contrast switches. The most common cause of monitors seeming to fail is someone changing the switches.

Note that some computers have two sockets where the monitor cable can physically connect to the back of the computer, especially if you sometimes use a different monitor. Ensure that the cable is connected to the correct socket for the specific type of monitor you are using.

Colour monitors often require a special adaptor card (or board) for their operation. This card must be properly installed (usually by the vendor's technician) for the monitor to work.

If the monitor has been working properly it is possible that the board has worked loose, follow the steps below for checking connectors, plug-in cards, and chips inside the computer.

Keyboard or Mouse Doesn't Work

The commonest problem with a keyboard or mouse is that it isn't properly connected.

Turn off the computer and check all connections before turning the computer on again. Remember that many keyboards have two connectors—one at the keyboard and the other on the back of the computer.

If some keys work, but others do not, check that your keyboard is properly configured—some keyboards have a switch underneath to switch between computer types.

If your mouse connects through a special mouse 'card' or an I/O (Input/Output) card, you may need to follow the steps below for checking connectors, plug-in cards, and chips inside the computer.

Some computers have a keyboard lock, usually located on the front of the computer. This lock must be turned to the on position before the keyboard will work. Other computers have a software program that denies access unless you provide the correct password. Usually this will be obvious from the screen message.

Printer is ON, but Doesn't Work

First check to see that the printer cable is connected, and that it is connected to the proper connector—there will often be more than one connector to which it will fit (the other ones may be for your modem or other peripherals).

A parallel printer (dot matrix or ink jet) must be connected to a parallel 'port' (connector). Serial devices (laser printers and modems) connect to a serial port and may need changes using the MODE command. See your DOS manual for details.

If the printer works, but prints garbage, you may need to check the printer driver (software program) supplied with your application program. See the application's manual for details.

Sometimes applications will leave the printer in a confused state when it is finished printing a job. I have a graphics program that does this—nothing following will print properly unless I reset the printer, usually by turning it off and back on again.

Modem is ON, but Doesn't Work

First check to ensure that the serial cable and the telephone line are firmly connected, then check your communications program to ensure that the required settings (baud rate, parity, etc.) are correct. You can also check the switches on an external modem to see that they agree with the software settings.

A modem is a serial device and may need system changes using the MODE command. See your DOS manual for details.

Listen through the modem's speaker for a dial tone and/or the sound of the number being dialled. If you hear variable pitched tones AND your telephone is not a touch tone type, you must send 'pulse' commands to the modem for dialling. See the manuals for your communications software and the modem for details.

Most modems respond to the 'AT' command set, explained in the modem instruction manual. If typing 'AT' (in caps, but without the quotes) at the keyboard gets an 'OK' response, the problem may lie on the telephone side of the connection.

Modems (and fax machines) are susceptible to lightning strikes if they have been left connected to the telephone line. A modem that has been hit by a lightning strike will likely have to be replaced.

Invalid Configuration Information Message

The normal configuration information (number and type of disk drives, memory type and extent, etc.) is stored in CMOS memory and maintained by a small internal battery.

Unfortunately, some computer operations, some electrical faults (particularly spikes), and the installation of new peripherals will either change, or require changing the setup information. Sometimes the setup CMOS will be accessed by pressing a specific keyboard sequence during the boot-up process, other times you will have to run a specific program. Check your computer manual for the operation of the supplied setup programs.

Macintosh users will sometimes find that data stored in system files will be corrupted. The required configuration files can be replaced after booting the computer from a floppy diskette.

Setup Information or the System Date is Lost

Most computers have a battery inside the case for maintaining power to the CMOS memory (stores the normal setup information) and the system date. This battery usually has a three-five year life. Check your manual for replacement procedures.

Hard (or Floppy) Drive Cannot be Found, or Doesn't Work Correctly

Most of us fail to backup our data regularly enough and the various 'lost' drive messages therefore almost cause heart failure. Keep your backups up-to-date and treat your hard drive as a sensitive and precious icon—replacing the data on it will cost more than any precautions against loss.

- If you have a hard drive problem, try starting the computer using your back-up boot diskette. If it starts properly, try reading the directory for the missing drive and record what happens to the system as it looks for the hard drive.

Verify that the setup information is correct for the drives that you are using. Check your manual for the operation of the setup program.

> NEVER run destructive tests, FORMAT programs, etc. Leave them for an experienced user or a qualified repair technician.

Sometimes the operating system simply gets confused. Run the system diagnostic programs to see whether they can find the disk drive (hard drive or floppy). Check your manual for details.

[DOS only allows two (internal) floppy drives to be connected to the computer at a time. If you have more than two floppy drives, or units defined as floppy drives (a removable cartridge unit?), your vendor will need to supply special drivers and you may need special cabling.]

- A very common problem with drives is that one of the cables works loose. If the computer starts ok from a floppy diskette, and/or the setup information is correct, but the drive still doesn't work properly see the section below.

Checking Connectors, Plug-in Cards, and Chips Inside the Computer.

If all else fails, turn off the power and disconnect *all* cables.

> **Be Extremely Careful**
>
> It is very easy to damage components through static electricity or bending connectors.
>
> - Avoid unnecessarily touching components inside the computer.
> - Be particularly careful to avoid bending connectors or other components—heat makes some of them quite brittle and prone to breaking under light pressure.

- Open the computer case, carefully saving the screws and other connectors.
- Wash and dry your hands to minimise body oils. Ground yourself by touching your grounded anti-static mat or a metal water pipe.
- Make sure that all the cables and connectors are fastened properly. The drives will be clearly visible, check both ends of all cables.
- If you have been experiencing problems that have been traced to a possible loose board or chip, use firm pressure to ensure that the appropriate board or chip is properly connected. Avoid flexing the circuit boards as this can cause 'traces' (the electrical conducting paths) to separate or break.

Close up the system, reconnect the cables, and retry the computer. If it still doesn't work, call your service centre.

Application Program 'Hangs'

A 'hung' application program generally means at least some lost data. Ensure that the program is genuinely hung—sometimes the screen display will have been stopped by you or the program—and reset the computer if required.

Try the <CTRL><ALT><DEL> reset sequence first, then the computer's <RESET> button. Reset by turning the machine off and back on again only as a last resort.

Check for damaged data files and proper operation of the computer and peripherals before restarting the program.

Continuous Operation

Electronic components can be damaged by turning off and on, therefore many computer users leave their computer on all the time, or at least all day.

If you must turn electronic components off, leave them off for at least 30 seconds before turning them back on again.

Personalise Your PC: Autoexec.bat, Config.sys, and Win.ini

The IBM/MS-DOS and Windows Operating Systems have a variety of tools for customising (they call it optimising) the operation of your PC. Thus, you can have a unique selection of tools available for your use.

Telling you how to do so, however, is not within the scope of this Primer. You will find a few notes below, but your best teacher is experience plus your computer manuals and books.

Autoexec.bat: The batch startup procedure that is executed every time your computer is started. Use this file to execute procedures at startup, designate screen prompts, etc.

Config.sys: The configuration file that is executed every time that your computer is started. Use this file to specify unusual devices, etc.

Win.ini: An initialisation file that is executed every time that Windows is started up. This file is used to optimise the operation of Windows.

DOS 6 permits you to start up the computer and bypass (not execute) these files.

Toolkits

Sooner or later computer users will need to do minor maintenance and repairs or install a new piece of hardware. Having the right tools makes the job go much better.

I can tell you from my own experience that pocket knives, for example, get rather battered when used as screwdrivers. I'm not suggesting that you need an expensive toolkit, but I would remind you that quality tools last longer than cheap specials.

- Buy tools as needed and learn how to use them. Take care of them, and they will last for years.
- Have a workbench or other location for your tools so that they will be available when needed.

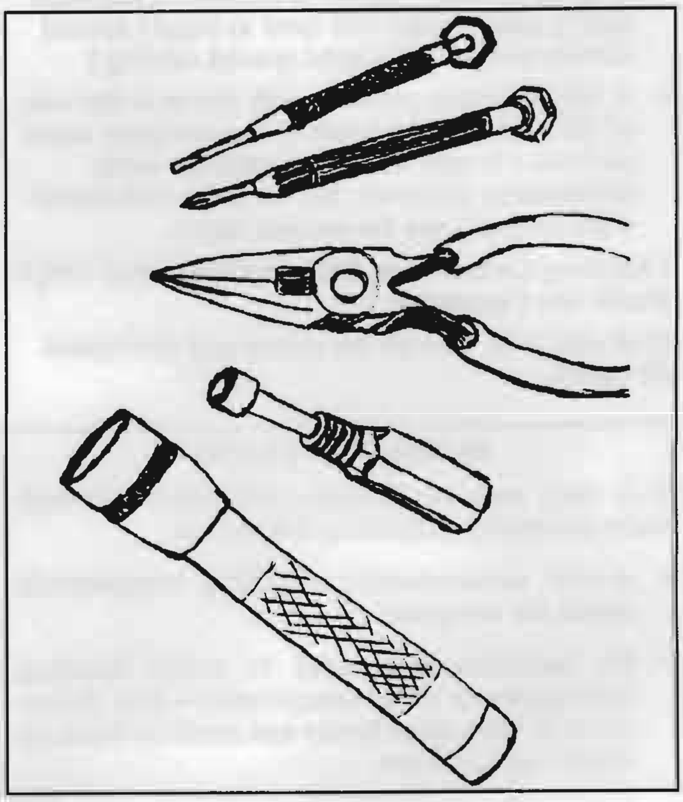
Several computer and electronic suppliers have a simple toolkit containing a set of screwdrivers, pliers and cutters. These will probably be adequate for most needs and should not cost more than $30, including the case.

In the last six months I have only used the following tools:

- regular screwdrivers—slot and Phillips (I use one that has several interchangeable tips in different sizes and types), for detaching cables, repairing broken cables, and assembling a desk
- jewellers screwdrivers, for adjusting small screws (including the ones on my glasses)
- needle-nosed pliers and tweezers, for holding and retrieving small parts (particularly screws dropped inside a computer or paper jammed inside a printer or photocopier)
- only one of a set of 'nut' drivers, for opening the computer (it is easier to remove the hexagon-headed screws with a nut driver than with a screwdriver)
- small flashlight and a magnifying glass, for locating lost parts, reading serial numbers, etc. inexpensive 'multimeter', to determine if a power supply was putting out the right voltage
- 'Q tips', lintless cloth, soft paint brush, and methyl hydrate, for cleaning

My tool collection is, I admit, actually much bigger than this, but these are the only tools I've used recently for maintaining the computer.

Other tools that I would use less frequently include wire cutters, razor blades (for trimming insulation, sharpening pencils, etc.), and yes, a soldering iron and an inexpensive multimeter, for those occasions when I am assembling kinds of cables or repairing a power supply.



References

Your hardware and software manuals are your best initial resource. Other information sources include articles in some of the electronics magazines and the 'repair' or 'troubleshooting' books available from many publishers. Look at such books carefully, they are often out-dated and seldom deliver what they promise.

The two books described below are both readable and accurate in their details. More recent editions may be available—these are simply the editions that I have on my bookshelf. Interestingly, I have been unable to find any resources for maintaining portable computers (laptops and notebooks). I suspect that their miniature components are simply too complex.

Aspinwall, Jim et al (1989). *The PC User's Survival Guide.* Redwood City, CA: M&T Books.
General purpose guide to everything—reformatting your drive, recovering a lost file, solving hardware problems.

Mueller, Scott (1988). *Upgrading and Repairing PCs.* Carmel, IN: Que Corporation.
A fat technical manual—useful tables and other data that you only need once to save the cost of the whole book. Not for novice computer users afraid of technical details.

M&C UCQ CQCUS

Australian Case Studies

The opinions contained in this case study are those of the authors and do not necessarily represent the opinions or policies of Greenslopes Repatriation Hospital, Brisbane, or of the Queensland Department of Health.

Patient Care System: Greenslopes Repatriation Hospital

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Greenslopes is a 400-bed hospital of the Dept of Veterans Affairs . The computerised system, also used in all other DVA hospitals throughout Australia, took approximately 3 years to implement to the stage described here.

The system is up and functioning (Mar 91) with some modules; ie., it is not a pilot as it is being used in the real world. Within the next few years the DVA hospitals will be integrated within the relevant state health systems. Greenslopes will thus become part of a state system which has a long history of hospital computerisation, and which has recently undertaken a $70 million program to install hospital-based information system in as many as 13 hospitals.

Greenslopes uses an Australianised variant of the IBM-based PCS (Patient Care System) originally developed in the United States and now used in 200 plus hospitals there. A simpler version of the PCS system may have been implemented by at least one more Australian hospital.

PCS runs on a mainframe located on site at Greenslopes, 150 micros (not all used as part of this system as some are used for word processing only), and about 250 VDUs and 60 printers throughout the hospital. The total DVS Australian project cost about $25 million, although there are hidden (planning, development and implementation labour) costs not included in this total.

DVA Hospitals are being required to 'pay back' costs from the supposed savings of the system; however, it is still too early to see any real savings. Greenslopes can demonstrate that there have been savings in food used (dietary module—see below) and that there are significant time savings processing information and orders. For example, an x-ray requisition and callback to the patient on the ward now takes 6 minutes instead of half a day.

There are 4 terminals in each 40 bed ward with a proposal to have 6 terminals by the time all modules are implemented. PCS modules currently implemented (Mar 91) are dietary, radiology, clinic scheduling, and nursing care. Payroll/ personnel, a non-PCS function, is also available.

As can be seen from this case study, successful computerisation is never easy and the pitfalls are many. We have tried to be as informative as possible about the problems encountered without losing our positive feelings about the results.

Good luck with your computer activities and remember:

- Manage change or it manages you.
- Be flexible.
- Plan for a long lead time on everything.
- Success is the result of 'internal marketing' as much as technology.
- Involve top and middle management as well as users.
- Don't wait for a perfect system.

Introduction of the Patient Care System (PCS)

The PCS information technology was introduced to the Greenslopes clinical area in July 1988 as the APMS (Australian Patient Management System, a predecessor to the current system). Nursing services were responsible for dietary function, condition update and bed swap data entry, and staff had access to the general enquiry function.

In May 1989, a Resource Scheduling module was introduced, replacing the manual clinics appointment system. Nursing staff do not make a patient's appointments, but can make a general enquiry for this function. The computer training room can be booked with this module but the system has not been expanded beyond this room.

An extensive review was given to the module to evaluate its suitability for use as an operating theatre booking system. The module, however, could not meet OT, needs mainly because of the difficulty of rearranging the order of patients on a particular resource.

An Orders Entry module was introduced into Greenslopes in June 1990. Before the implementation occurred a number of issues required resolution or implementation:

- Establishment of a comprehensive terminal and printer network;
- Train nursing staff in the use of Orders Entry;
- To modify the PCS-OE module to meet Greenslopes' needs (screen designs, etc.);
- Use of electronic signatures (security and legal considerations);
- Prioritisation of sequence of implementation of various functions;
- Comprehensive testing and evaluation of all functions, flows and prints of Orders Entry.

The APMS dietary function proved to have limited success and it was proposed to replace it with the Orders Entry—dietary function. Nursing and kitchen staff were both familiar with a computerised system and it was felt that the replacement by the Orders Entry—dietary would have minimal negative impact. This was proved correct when three trial wards (Wards 23, 43 and ITU) ran the two dietary functions for 48 hours, and on Sunday June 17, 1990 the hospital changed totally over to the new system.

Two weeks later, Orders Entry—Radiology was introduced. All radiology requests for inpatients are now ordered by medical staff via the mainframe computer. Radiology results are sent back on-line to the ward printer. This module has replaced the time required for delivery of the request and results from greater than 24 hours to less than six hours.

It is proposed to introduce the following additional functions of the Orders Entry module later this year (1990):

- Nursing orders;
- Orders for consultation of allied health professionals;
- Porterage requests;
- Orders for consultation of Clinical Nurse Specialists (early 1991);
- Implementation of Orders Entry into Outpatient area (via Case link module).

Typical issues that required attention during the implementation included:

- *Disposal of paper from the printer.*

  Resolution: Classified 'Wheelie Bins' have been located near each printer for disposal of waste paper. The paper is then recycled.
- *Removal of hard copies from the printer.*

  Resolution: Clerical staff will remove and file radiology reports. Nursing staff will remove and store onto clip-boards dietary requests.
- *Ordering of diets for patients not on APMS* but located within the ward before dietary orders cut-off time and special areas, GE Clinic, Day Hospital.

  Resolution: Use of dietary message system to order appropriate diet.
- *Linked log-on of two users.*

  Resolution: The PCS operations staff erased all linked log-ons using a 'Cold Start' technique.

  Extensive training and correction of this poor user technique. There has only been one case of this re-occurring.
- *Many minor problems* that exist within the system relate to the *user unfamiliarity* with the system.

  Resolution: The Education Centre is continuing to offer 'update' training sessions for all nurses.

  Continued meetings with the Orders Entry—Nursing Working Party.

The time logs (October 1990) show that, on average, the nursing time spent using the PCS system is 60-70 minutes in every 24 hours, with transactions averaging 20-40 seconds each.

Implementing the PCS Modules

Clinic Scheduling: quite elaborate as has to tie in with the existing Comcar system to provide transport for all patients.

Payroll/Personnel: really done centrally for government departments (a non-PCS mainframe module).

Dietary: nurses can order routine diets from the wards by use of light pen on screen. Physicians and dietitians can order specialised diets in same way (ie., all work from the same screen but the nurses' authorisation for orders is limited). The system can cope with orders like 'early breakfast, then nothing by mouth'.

When the lab module is implemented an order for specific lab tests which require a modified diet prior to the test will automatically generate such orders. Orders are printed out in diet area and put on trays to provide a confirming check as tray is delivered. The system is also able to cope with patient preferences (eg. no fish).

Radiology: orders must be made by authorised physician (ie., nurses do not have to write out orders and wave down a physician to sign them any more). Since most ordering can be done via light pen there has been little physician resistance (ie., not much typing involved). Reports are available to the ward as soon as they are entered in system. Most radiologists are typing in their own reports if they are brief, another big saving in time in the system.

Nursing Care: each nurse has an identifying number which must be used to access the system. This number will give the nurse access to any of the patient files for the unit on which they are working, but not others (access is terminal location dependent). Each access is logged by the system so that a complete record can be retrieved; each order which is entered or discontinued is recorded with time and name of person authorising for the permanent record, but the normal screen on the ward only shows current orders. Standard procedures have easily called up screens of usual orders (pre- and post-op prep for example) which can be printed off, checked as the procedures are completed and sent with the patient to indicate that all preparations are complete.

In addition to the screens used for patient information there are a number of help modules which are accessible at all times (calculator for drug dosages, education modules, patient discharge plans, 'fun' graphics) This has helped to make the system user friendly.

Hospital Computer Applications

Patient Database

Clinical: *Dietary, Nursing Care, Radiology Results,* Lab Results, Pharmacy

Financial: Revenue Management, *DRGs, General Ledger*

Administrative: Medical records, *Clinical Scheduling, Utilisation Review*

Non-Patient Database

Other: Materials Management, Budgetting, Payroll, Personnel, Statistics, Reporting

PCS Software is in *italics*; non-PCS software is both mainframe and micro-based.

Benefits and Challenges: There can be additional benefits to the system. When a patient on the unit is discharged, a summary record is prepared for archiving (Note that the record does not need to be signed as electronic 'signatures' are legally acceptable—Federal Attorney General).

Information available in this system should allow Greenslopes (the DoN, for example) to track the cost of different procedures (eg.: the cost of all tracheostomy care in the hospital over a year) and determine appropriate staffing patterns as well as lobby for more appropriate resources. Use of this system can also make it possible to log the use of expert nursing clinicians and to justify their use by on-line consultancy referrals.

In general, nurses like the system because it is very user friendly. '*It takes less time to place a dietary order through the computer than to try to ring the kitchen.*' Training of staff was basically done by training of trainers. There were approx. 600 nurses and other staff who had to be trained to use the system. Six terminals were used for training, but most was peer training on the ward.

Maintaining an adequate power supply has been a bit of a problem. The hospital's emergency supply cuts in after 3 seconds. This is quite adequate for ventilators but not computers. Greenslopes is developing swift back-up plans and have developed a contingency plan for 'large' down times so that power will not be seen as a major problem once these plans are in place.

Converting the system from US terminology, etc., has been a major chore. It is estimated that each change of one item on a screen costs about $200. Changing of dates, for example, from the US to Australian format took suppliers, Baxter-Travenol, about a month.

Future modules still to be implemented include lab, pharmacy, and DRGs. OR theatre scheduling, which will provide automatic lists of materials, etc., has also been discussed.

Lessons learned:

- there is a long lead time in introducing such a system; (There had been a previous very difficult system in place.)
- yes, there are a lot of printouts produced; need secure paper disposal;
- must have middle and top management support;
- must put effort into internal marketing;
- management of change is most important;
- better to start using than wait until the system is perfect
- flexibility is important.

Implementation of the Nursing Orders module was delayed until late 1990 due to poor mainframe response times which ranged from 15 seconds to 2 minutes, when 2 seconds was the maximum acceptable response time. The administration readily approved a CPU upgrade, costing 'tens of thousands of dollars'.

An Interview with Estelle Bartley, 7 September 1990

This edited interview, between Estelle Bartley and Lynn Zelmer, was conducted in Estelle's office at Greenslopes and indicates some of the challenges of implementing a computerised information system. Indicative of Estelle's working style, her office is festooned with cartoons and 'mood changing' posters.

LZ: How does a 'mood changer' get into computers and being the chief educator for the new computer system?

EB: By being in the right spot at the right time and being a risk taker. My previous computer background is zero. I couldn't even type.

The module, PCS, was chosen by the Department and was imposed upon us with very little consultation. The nursing people who were involved in it lived in Sydney and they tended to be Directors of Nursing. Ultimately we got the system and I was very fortunate that the person driving the system in Brisbane had been Nurse Educator here, a friend I had known for 20 years, and I got conned into it.

LZ: How do nurses get involved...?

EB: That all happened in Sydney, it had nothing to do with us. I think it evolved partly by someone who was fairly innovative and could see that handling information in health care was fairly important.

A very large amount of what nurses do is handle information and if they could expedite that they could spend more time doing hands-on patient care. So ultimately we could see that we could process more patients using the same human resources. Certainly the literature I've read supports that—but unfortunately all that has been done since I got the job.

LZ: So what has been the process here? You had it dumped on you—

EB: Yes, we were essentially given a password and logon and a terminal and that was it.

LZ: The computer system existed? So this was something that was added onto the administrative computer?

EB: No, we actually went through the National Computer Centre and used the mainframe test system that was given to Concord in Sydney; so all of the Veterans' Affairs Hospitals in Australia used Concord's system. We had a land line down there and that was initially a bit of a problem—a few times farmers plowed through it. So you learn lots of things...

In the beginning... it would take two or three minutes per command but gradually as time went on that became much faster. The real problem was we were not given any reference material. IBM local support was very basic at that time because they didn't know any more about it that we did. The only reference sites were in the United States and they sleep when we are awake, so your telephone communication was a real problem.

One of our main problems was that we didn't know what questions to ask. It is pretty difficult to know what to ask when you don't even know what you are looking at. So we essentially sat for six months doing nothing but looking at screens and deciding who was going to have access to what screen and what these functions were.

We had a working party that consisted of a representative from every department or service in the hospital, and just gradually we went through all the screens and decided who ultimately owned what. Now two things that were a spin-off from this; one, that we looked at procedures and found out who was doing procedures that they shouldn't be doing—like some nursing people were doing discharges when that was a clerical function—so when we designed menus, nurses do not have discharge functions and now it is totally a clerical system—so that solved some of those problems.

The other thing that happened here was the networking between departments because we got to know each other and grew this trusting bond within this network. We now ring each other for other problems, including having lunch of course.

LZ: Each hospital has set up their own way of working with the system?

EB: Yes.

LZ: So if I went to another of the repatriation hospitals I might find the nurses having access to quite different sorts of screens?

EB: Correct—even their screen designs might be different. We were given a framework for the screen design and we changed them to meet our needs.

LZ: Who changed them? ...programmers?

EB: The users chose the screen designs, the programmers did the actual task.

LZ: So you've obviously moved on then if originally what you had was just this land tie... now you've got in-house computing staff and at some point you had a computer brought in.

EB: Yes, there was a national PCS team who consisted of people who knew a lot more about the network than we did as far as how it operated and they consisted of programmers, but certainly at that time none of them were implementation officers.

So they understood the programming and how generally to find bugs and change scripts. We didn't have those skills although a lot of us do have those skills now—including myself. I can do elementary screen changes and process changes but I do it at a very low level.

LZ: And now the computer is in-house?

EB: Yes.

LZ: When did that come in this total process?

EB: It came in several months before we went live with our first module which was in 1988. It was a central processing unit located here within the hospital. Actually a new building was being built and we commandeered the basement.

LZ: This is late 1990, so for something over two years you have had your computer in-house and roughly two years you've had the first module up and running, right?

EB: Yes, over two years now…

LZ: And I have a list here that indicates which modules are up, then it says the Nursing Care module will come up in two months?

EB: Yes, we had a test region up for about two months and we're still playing with the test region. Where we differ a lot from some of the other Veterans' Affairs Hospitals at this hospital is partly a result of our thinking of the management of 'not power' I call it, not management of power.

We believe that the users on the system should be driving it. They're the ones who have to use it—they know more about their needs—sure we can tell them about the computers but what they need is the process of handling that information for patient management. So we actually let them drive the project to a large degree. Most other hospitals have several people devoted full time, particularly in nursing, to running and doing training.

My job is also Principal Nurse Educator. I have a teaching load outside of computers as well as within computers so up until two months ago I was the only nurse really managing it. I have a nursing working party, what I call my trainers, and I get them to do all the work. It's been extremely successful because when we implement those people will own it. Its not my system. Although I'm seen as the in-house expert, they essentially drive the program. I think that's why we've had less problems than other hospitals in Australia.

LZ: What about the management above you, how did they approach this whole thing?

EB: Initially we had a lot of problems with management because they haven't understood it. We didn't understand it either, therefore when they asked questions we couldn't answer them because we hadn't reviewed enough of the system, or become familiar enough or know what it could do or it couldn't.

For a long time I personally had a little bit of hassle with the Director of Nursing because she couldn't understand the amount of time I was spending 'playing with the computer' and not producing something. Essentially it was a 'discovery learning' exercise. I know the system well, but it took a long time to do, and how you cost-justify this I sometimes wonder.

Ultimately when we got the system up and running, and when we knew what it was about and I could answer their questions, from the Director of Nursing's point-of-view, we had a total swing around and she's been our greatest ally. Certainly if it wasn't for her support we wouldn't be as far down the track. I keep getting hassled now, 'When are we putting Nursing in?', 'Is it coming in soon?'. The coin's flipped over totally. Certainly she has been a great asset.

LZ: …in looking at [your] screen there were a lot of options on the screen that were, in essence, blocked out… A number of your screens do have options that not only don't exist from your point of view because you haven't bought them, but you don't know what they do. Have you had any feedback from people about the confusion that might be possible with having options up that they just don't get into.

EB: We often get questions about 'What's this mean?'. They know that it's 'blued out', the term used is a 'non-probable option', and we say that we haven't bought the option. That ends the question; they have enough trouble coping with what they've got. Most of my users, initially I would guess around 90% of them, have never touched a keyboard in their life before. Most of them are completely computer illiterate to the point of when I said 'Press Enter', they would look at me and say, 'What's an 'Enter'?', 'What does it mean?'.

They would type information in and sit there and wait; and of course, because they hadn't pressed 'enter' they would be sitting there five minutes later. But because the system is so user friendly I've managed to teach people all sorts of things that they would not have believed possible.

User feedback is important. I actually even get messages sent to me now over the message system, 'See how well I can use the system!'; so I usually send them back a gold star or something.

LZ: What about light pen versus keyboard? A lot of things you can choose with a light pen, including hitting the 'enter' key; other things you have to type in. Is there any confusion over one or the other?

EB: No! We don't seem to have a problem. Most things are not free text. I'd say 90% of the options you could choose using a light pen. That's one of the advantages with this system...

We've got everybody using it from people with extreme experience with computers, mainly microcomputers, doctors and that sort of people who have a great deal of education and exposure to mainframes at universities to people in the kitchen and our wardsmen who know nothing about them at all—with very little formal education, if any. Some of our people can hardly speak English and they don't seem to be doing too badly.

LZ: And you have gotten the doctors entering some of their own information... rather than ordering somebody else to put it in?

EB: Yes... It's interesting. I believe that this was a power thing: 'Only doctors can order 'x-rays'; so they made the decision that no nurses could order it. But yet, we surveyed the hospital—by a number of wards—and I think that I went to most wards and departments in the hospital and found that a very large percentage of pathology, and radiology, requests were manually written out by nurses, and signed by nurses, either by their signature or forging the doctor's signature...

The doctors knew that this was going on, and they were quite happy to accept that... but when it came to the computer it was a different thing all-together because people at the top were deciding, not doctors at the bottom.

Then the doctors made the decision that nurses no longer actually enter any requests for radiology. That's one job that I had been trying to get nurses to stop for many years and it stopped overnight.

The thing is that the orderer's name and the enterer's name appears on the request slip and the Radiology Department made the statement that 'Any requests placed by a nurse will not be processed'. Now, we tried to make a few exceptions to that; such as the operating theatre—no doctor was going to unscrub in the middle of an abdo aortic aneurism operation to go and order an emergency x-ray—so they are still using the telephone ordering system for those sorts of things. We tried to get it for Intensive Care, but they still said no, there were no exceptions at all.

LZ: You're in the process of doing some new materials, the Nursing Care one, for example, how do you decide what is going to be next?

EB: We do a prioritisation exercise. That's done by a committee that has representation from all parts of the hospital. We meet and we all put in cost-benefit analysis of the modules asking 'How can we save money?'. We do the timing on how we're not going to do 56 phone calls in a day, and that's three minutes and worked on average salaries... We're now getting much better at doing cost-benefit analysis...

We believe that the pathology module will be the greatest saving and certainly for budget prediction in the future, yet the group of users in that area are very unfriendly. I think that a lot of doctors think that its the long road to having some computer making the patient diagnosis, and that's not an unsubstantiated fear.

I did some research at Uni last year as part of my degree, I did an arts degree, and I did some research work on computerisation and health care. It talks about how doctors and nurses feel about the erosion of their roles. I think that it's partly change—and fear of the unknown as well.

I think what it will save time for nurses at least—instead of wasting time hanging on phones waiting for people to answer, or the number is engaged, they can now send it down the mainframe and get back to care for their patients. Initially people don't see the computer as a time saver because they aren't all that familiar with the system.

With the Nursing Care module we indicated that 'we would be very reluctant to implement it without the addition of another terminal per ward'. We have three terminals per ward, our goal is to have six and we hope to get another one this year.

LZ: How many wards total?

EB: About 15.

LZ: So 15, and what, about $3,000-$4,000 per terminal I suspect...

EB: Yes.

LZ: A not insignificant cost...

EB: Well, it's not a lot of money, Veterans Affairs spent over $25,000,000 over 5 years in 7 sites. Initially the costing came from a national fund and it didn't cost the individual hospitals any money. Veterans' Affairs Hospitals are at the moment being integrated into state systems. So within three to five years we will be part of the Queensland Health Department system...

The current position on management of computerisation is that we find our own money. The 1989/90 budget is $62,000,000 and out of that we lose 1.5 straight off for operating costs for our computerisation process. That includes both mainframe and microcomputers.

We pay licensing fees for our software so if PCS put out a new module 'Orders Entry' next year we get that. All we pay is the changes that we make to the software so that the new module fits into our current module. Considering the amount of software we have around the hospital I don't think that that is an exceptionally large amount of money but when you see it as all one figure people do freak.

We have over 150 microcomputers and each of them would have 2-3 different types of software. We pay licensing fees on them as well so we are paying quite a lot for licensing fees.

Part of the operating costs would include a call-out service by IBM so that if something breaks they just come and fix it, and that's included in the costs.

LZ: Can I divert us for a minute, what are the micros primarily doing?

EB: I would say that 90% of the work they do is word processing. They do some spreadsheet work; some dBase III, or IV, or SQL—its database work. I think they are trying to change over. We do some desktop publishing, not a lot though—and then there are a few in-house systems that do special patient things—things like working out cytotoxic drug regimes and management... some pathology type tasks.

We've got one system we use in nursing where it calculates the patient nurse dependency assessment function. The data is collected within the wards and then taken down to nursing admin. They feed it in and it helps them predict their nursing staff and work loads for the next shift. Unfortunately with that system you can fudge the figures—and people do.

LZ: I guess the point to make is that the micros are essentially separate from the mainframe and you don't have micros as terminals.

EB: Yes, but there are a couple. I think about three but it's not common. I think they tend to be in the Computer Centre. We are looking in the future—I was on a hospital strategic planning, information technology program where we developed a strategic plan for future information technology for the hospital—a number of us were off-line for a period of about six to eight weeks to do this—the main problem we had was none of us had any experience in this before. I think the hospital should have realised that and got an expert in to help us because it was a very slow process.

We found out that the main future of computers was that the mainframe would be used for disseminating information and collection of general hospital patient data but unique manipulation of data would occur on micros. The facilities do exist to download data off the mainframe, manipulate it in your Lotus/database and then produce a report and send it to the managers saying: 'This is what I predict is going to happen the next year. I need x amount of dollars'. I think that we'll see a lot more of that happening.

LZ: At the moment, who is using the micros? What level of staff?

EB: Everybody from the Director of Nursing, Medical Superintendent, at that level of management, but there are micros available for people below that. I have one next to my office that all the nurse educators use. I occasionally have nurses who come along and just want to learn how to do word processing and I'm quite happy to do that.

We've looked at a number of self-directed learning packages which are commercially available—one on cardiopulmonary resuscitation and the other on drug calculations. I was not very happy with the products so we didn't actually buy them. I found that they were very unfriendly to use and they didn't meet our needs.

One package that I have picked up, we got free, supplied by Amies, who supply a lot of urine testing and glucometer testing products. We have a very large amount of diabetics who use their products so they gave us the software free. It was produced by somebody in Melbourne who was a doctor. From an educational point-of-view I found it extremely valuable. The hospital has in fact bought a Toshiba laptop and the patients find that very acceptable because its like a toy.

Whereas we initially thought about sticking them in front of a PC in an office I think they would perceive that as threatening. They perceive it as a toy, non-threatening and its got very soft keys. I found it quite educationally acceptable, but its aimed at the level of patients. Its not particularly high level and its usually just multiple choice, yes/no and 'enter' I think.

We don't have the skills, or the time, to develop more...

We just had a major problem with the users almost rejecting the Nursing Care Planning process we are looking at. It wasn't so much that they didn't like the computer software, or the process that went on; it was more that they found the time it took to enter the data was so great that they were resistant to accepting it. We got them to identify what the problem really was, and in fact it was time management and confusion over the division of labour between various nursing groups.

These groups identified that there was not good communication between them. The team function was really the problem. Now they've taken this in hand and they are starting to do a little more open and honest communication. Since they have recognised that's the problem and it's not the computer—once again the process of implementing the technology has identified major problems in our current procedures and processes.

It's not the computer, it's what we currently do that's the problem...

Interestingly people are identifying these problems and they are wanting to own these problems. I think that it's partly the process of the way we have handled it. Certainly we [were] very fortunate in having one of the driving people here with a degree in the organisational psychology. A lot of us picked up those skills, but it's also very important that a lot of the people we've had in the actual program, and in the actual driving of the program, have been people with really positive attitudes and who've been what I call 'fun' people.

They've been approachable, realistic, practical, and certainly taking punitive action has never entered in their heads. Any mistakes people make, it's just a matter of making some sort of a remedial education program to solve it.

LZ: What's the future? the next two years, five years?

EB: For education I think there is a great deal of excitement going on. I see the computerisation impacting not only nursing care but certainly education. I would really like to get more involved in self-learning packages. I believe that is one of the few ways we can expand our opportunities here without expanding our resources as educators are too expensive.

Computerisation will give a far greater dissemination of information. Management of information will certainly have a dollar cost against it... having to be accountable and justify how you spend your money, we'll need computers to do that.

I think that in the long term, and certainly the literature supports it, that we can predict where we are going with greater expertise and we can manage more people with the same amount of resources. Any hospital that doesn't have an integrated, comprehensive computer system by the year 2000 is not going to survive without a lot of money down the drain...

We've opened up a box that reminds me of the Horn of Plenty, although some of my colleagues call it Pandora's Box. I think that we've got a lot to learn and a long way to go.

Sample PCS Screen Display

```
                                                  05/06/90     13:42

6      -02   TEST PATIENT
       FULL DIET WITH MODS, SM PORTION, NO EGGS, NO POULTRY
       EARLY BREAKFAST THEN NIL BY MOUTH, START 06/09/90
____________________________________________________________________

D I E T E T I C S   O R D E R   E N T R Y   I N D E X
KEY IN DIET NAME

                                                  -FULL
KILOJOULE MODS                                    -FULL & MODS
PROTEIN MODS         AAA    GGG    MMM    SSS     -SOFT
FAT MODS             BBB    HHH    NNN    TTT     -TRANSITION
MINERAL MODS         CCC    III    OOO    UUU     -MINCED
TEST DIETS           DDD    JJJ    PPP    VVV     -PUREE
ENTERALS 1           EEE    KKK    QQQ    WWW     -FREE FLUID
ENTERALS 2           FFF    LLL    RRR    XWZ     -CLEAR FLUID
MISCELLANEOUS                                     -NBM
DIETITIAN TO SEE                                  -ERLY BF/NBM
UNLISTED                                          SINGLE MEAL
____________________________________________________________________

DELETE     REVIEW     ADD TEXT     END ORDER      CONTINUE
                                                    BARTLEY, EJ
```

Diet/Menu Selection Using Light Pen

Note the use of the character-oriented interface in this typical screen design. The alphabetic letters in the centre of the screen are used for 'typing' with the light pen and allow the user to specify items not on the selection system. A more modern system with a graphical user interface (GUI) would probably provide scrolling 'pop up' or 'drop down' lists of items for selection.

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Australian Case Studies

ahia

The Challenge of Change: Computers in a Regional Hospital

Jill M Watts, Registered Nurse Education Co-ordinator

This case study looks at an accredited 158 bed private non-profit hospital in Northern Queensland. The hospital, one of four similar institutions, is owned and operated by a religious organisation, and employs approximately 300 people, over 60% of whom are nursing staff.

In January 1993, the group signed a contract to purchase computer hardware and software for implementation throughout all of their hospitals.

By September 1993, computer terminals will be located throughout this hospital. Apart from the administration, which has traditionally utilised a computerised information system, this is new venture for the hospital and will require some changes in the work practices of those staff who will have to use them.

The first part of the computerisation project will see an upgrading of the existing core computer system within the administration. Applications in the clinical areas will likely be limited initially to a patient nurse dependency system and stand-alone applications for speciality areas. An integrated clinical management system is still some way off.

Although the computer hardware will be present throughout the hospital, the initial changes in work practices will actually be fairly minimal and will probably consist of entering manually collected information directly into the computer.

A Study of Attitudes

This case study reports the findings of a series of focus interviews and a questionnaire designed:

- To determine the attitudes of staff towards the introduction of computers throughout the hospital.
- To identify any specific fears, threats and concerns that staff may have relating to the introduction of computers in their department.
- To establish the current levels of computer knowledge and skills that staff members possess.
- To recommend appropriate strategies and tactics which will assist with the forthcoming implementation.
- To identify staff members who may have special skills and knowledge relating to the use of computers, and who could be utilised as resource people.
- To determine specific training methods which may promote the future acceptance of the system.

Seventy-five questionnaires were distributed to all of the hospital departments, apart from the central administration areas who have traditionally used computers. A cross section of staff was targeted by giving questionnaires to each department manager for distribution. Participation was voluntary; individuals completing the questionnaire were given the option of not identifying themselves to encourage more honest responses.

Four small group and 5 individual interviews were conducted with a cross section of staff from various departments throughout the hospital. Attendance was voluntary, interview were kept short to avoid disrupting work flows.

The Findings

Overall, literature indicates that the keys to acceptance of computers is good communication and education. The quality of the training received by the personnel involved with the new system will provide the foundation for future user success.

The study concentrated on the departments outside of central administration (Table 1) as it is in these areas where the introduction of computers will result in a change in the current work practices. Of the seventy five questionnaires distributed, 52 were returned, giving a response rate of 69%.

Attitudes Towards Computerisation

Overall the attitudes of participants identified in the study were fairly positive, with staff looking forward to the challenge of computerisation. Most participants thought it is an excellent idea to keep up to date with technology and were excited about learning new skills. Over 50% of those surveyed believed that the introduction of computers would improve the service in their departments, while 40% were not sure if it would. One participant asked 'Is it warranted for a hospital of this size.'

TABLE 1: Distribution of respondents, by department, indicating the percentage of participants from the total sample.

Area employed	Number	% of total sample
CATERING	4	8%
MAINTENANCE	3	6%
MED/SURG WARD	17	33%
MATERNITY UNIT	7	13%
PAEDIATRICS	2	4%
NURSING ADMIN	4	8%
THEATRE	5	10%
PALLIATIVE CARE	3	2%
EDUCATION	1	2%
QUALITY ASS.	1	2%
MED. RECORDS	1	2%
DAY SURGERY	2	4%
INF. CONTROL	1	2%
NOT INDICATED	1	2%

Although all the staff knew about the impending computerisation many seemed unsure what to expect and were not really sure how their own role would be affected. Participants in the questionnaire were asked to rate their feelings on the forthcoming computerisation. The responses are indicated in Table 2.

TABLE 2: Feelings of the workforce about computerisation.

Feeling	Number	% of total sample
TERRIFIED	1	2%
FEARFUL	4	8%
UNSURE	12	23%
COMFORTABLE	18	35%
EXCITED	17	33%

During the study it became apparent that there were a number of misconceptions in the workforce regarding computers in general and their capabilities. These misconceptions will certainly affect the attitudes of participants towards the forthcoming computerisation. One nurse wrote:

> *Computers will do all the thinking and work and we will get a bit lazy and do what we used to do.*
>
> (Registered Nurse)

There were also some fairly high expectations relating to the introduction of computers. Some participants believed that as soon as there was a terminal in their department, everything would be automated overnight. A number of similar comments were expressed in the group interviews:

> *Once we get a computers in our department we will have a lot more time for our patients.*
>
> (Registered Nurse)

However apart from one person who could see no benefits at all, participants did identify a number of benefits that could be gained by the introduction of computers:

- Saving time x 19
- Easy access to information eg, results
- Patient nurse dependency x 10
- Less paperwork x 8
- Understand illegible medical orders
- Increased efficiency x 4
- Greater confidentiality
- Increase staffs skills x 3
- Keep up to date with technology
- Enviromentally friendly
- Save money
- Save space/easier storage of information

While these are all real benefits that computers can bring. In reality it will still be quite a while before the hospital introduces clinical systems and realises many of the advantages that have been suggested. Initially the actual changes in work practices will be minimal and involve the imputing of basic data about patients dependency levels into a computer.

Fears, Threats and Concerns

It was far more apparent in the focus groups and interviews than in the questionnaires that some staff felt threatened by change and fear of the unknown. Some participants appear to have an inaccurate perception of the hospital's future plans, and this is causing unnecessary fear among some.

While 19% of participants could see no disadvantages at all, the major concern of staff seems to be that adequate education be made available prior to implementation, and that adequate time will be allocated for this purpose. The main concerns identified during the study were:

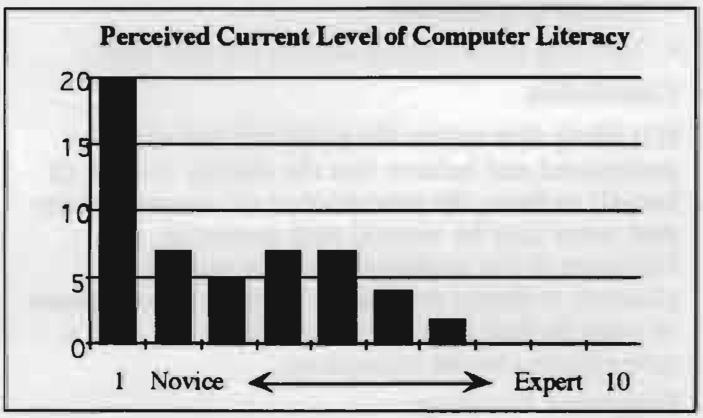
- Fear of the unknown. Many have had no previous contact with computers at all.

- Fear that they have no understanding of computers and that learning computer skills will be complex and difficult.
- Anxiety that adequate time would not be allowed for training, or that training sessions would not be separated from other responsibilities.
- Worry that given the limited space within the hospital already that the introduction of computers would only compound this problem.
- Fear that computers will take the individuality out of patient care.

Current Skill and Knowledge Levels

Because the study concentrated on those areas who are not regularly exposed to computers in the workplace, it was not surprising that the current level of computer literacy throughout the hospital is fairly low . 79% of participants indicated that they did not currently use computers as part of their daily routine at work. However these figures are clouded by some that included a computerised patient call system and others who did not.

17% of respondents indicated that they had never used a computer before, 19% sometimes used one, 30% occasionally used one and 17% frequently did. The participants rated their computer literacy (see graph) on a scale of one to ten (with one being a beginner and 10 being an expert). The average score was 2.8, the highest was 7.



These scores indicate that the level of computer literacy within the hospital is minimal and that time needs to be spent on basic education. The low level of knowledge is probably responsible for many of the unrealistic fears that are around.

People Resources

One of the objectives of the study was to identify staff who had an existing knowledge of computers and could be used as resource people for other staff. Even though the overall level of literacy was fairly low, there were staff the departments who had a range of skills, mainly word processing, and a knowledge of other software packages which had been mainly used at home.

However a knowledge of computers is only one of the skills required to be effective as a resource person. In the questionnaires only three participants indicated that they felt they had some skills that they would be willing to share with others. A few participants in the focus groups also indicated that they would like to be involved in the training.

Staff will need to be trained for the role of resource person, to make sure that they are given the skills to be able to impart knowledge. However it is likely that training computer resource people will be made easier if they already have a basic understanding of computers themself. Those persons that indicated they had skills they could share were identified to the hospitals Informatics Coordinator.

Implementation Strategies

The design and implementation of the computerisation program will demand adequate preparation and planning. Successful implementation is likely to require significant investment in both human and material resources. The prospects of acceptance and enthusiastic participation is likely to be widely enhanced by giving future plans wide publicity. As literature suggests good communication and adequate education are the keys to allay the majority of fears and clear up most misconceptions. Participants made the following suggestions to help with the introduction of computers:

- Provide adequate training for end users x 9
- Conduct workshops prior to installation
- Have training available at all hours
- Hasten slowly x 4
- Reassure staff who are terrified, be aware that some of us have no knowledge
- Provide adequate security eg. stringent controls, use of passwords.

Some of the senior staff that were involved in the study were unaware of the future hospital plans. It is important that the appropriate staff are involved from the beginning. Support of departmental managers and key staff should be sought early on. It is often during the early stages that projects will gain acceptance, commitment and ownership. Ideally a planning committee with representatives from a cross section of departments should be involved in the development of a strategic plan for implementation.

Training

Training was the area of most concern to participants in the study. However it was refreshing to learn that 96% of those surveyed were keen to learn more about computers. Respondents indicated that they would like a variety of training methods to be made available. Hands on practice within the department and small workshops were by far the most popular methods suggested.

19% of participants were concerned about the time it would take them to learn. Some also feared it would be stressful to learn new skills.

It is likely that the structure of the training program will provide the foundations of the systems future success or failure. Training large numbers of people from different departments will require excellent planning. It is important that a systematic approach be taken and realistic time frames set.

As suggested in literature and the findings of this study, training staff should be approached in a number of ways to allow for different learning styles. It is important to consider who will do the training and how the training experience should be designed. Trainers, liaison people and senior staff should be trained first. There should be consistency in training by the trainers for different places and areas. Resource persons and literature should be available for all shifts including night duty.

It is important that trainers have an understanding of adult learning principles and be able to deliver information in a non-threatening manner. Training should address all three domains of learning, cognitive, affective and psychomotor.

On the cognitive level, the learner needs to be provided with an overview of computers and their capabilities. This should include basic terminology and an overview of the hardware and software. All end users should have easy access to 'user friendly' reference manuals on the actual system to be used. There should be a basic understanding of the computerised system and its relationship to staff, patients, and the organisation.

On the affective side resistance to change and computer phobia may need to be overcome. Improving computer literacy can help promote favourable attitudes. Gaining the support of key personnel and group leaders throughout the institution may also help to persuade those with negative ideas to support the system.

In the psychomotor domain a basic understanding of keyboard/mouse skills may be all that is needed if the system is well designed and menu driven.

Ideally initial training should be provided away from the area of work. If training is provided at ward level, specific times should be allocated or training will compete with other responsibilities. Communication of computerisation plans should be ongoing, keeping people aware of plans will stop misconceptions. Sending out newsletters may be one way to address basic educational needs as well as keeping staff up to date.

> *Computers are excellent if they are regularly available, end users are correctly trained, and updates are communicated as and when acquired.*
>
> (Questionnaire Response)

Recommendations

- Set up a computer installation planning committee.
- Keep staff up to date with computerisation plans.
- Involve unit managers and senior staff as much as possible (their support is vital).
- Develop an action list with anticipated live date.
- Select trainers who are comfortable with the teaching process.
- Provide training to trainers in adult learning principles and instructional skills
- Develop a teaching program with individual lesson plans for each session.
- Limit the time of training sessions to prevent information overload and allow for easier release from working schedules.
- Provide initial training outside of the ward.
- Develop simple documentation and manuals, a self learning package could be utilised as pre-reading material.
- Develop a orientation session for new staff.

Conclusion

It is likely that unless the proposed end users understand and believe that the change may be of benefit to them, the introduction of computers into new areas may be viewed with suspicion, However, if the implementation is properly planned, it should eventually give the users a sense of pride in their ability to deal effectively with a new system and the technology.

Suggested Readings

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Australian Case Studies

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Barcode Technology in the Central Supply Department of a Large Provincial Hospital

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The introduction of new technology is often problematic, regardless of whether the technology is regarded as major, as with the introduction of a computerised management information system, or relatively minor, as with the introduction of barcode technology to assist with inventory control. In this case study, Helen Baker, describes the introduction of just such a barcode system.

She approaches the topic from the point of view of an experienced nurse—one who has been involved with both staff and materials management—and from the comfort of a successful implementation. Geelong's adoption of barcode technology has been successful enough that information system suppliers as well as individual institutions are copying their system.

Reading the case study, the reader might think that a project such as this is too difficult to be undertaken elsewhere. Such is not the case. Helen emphasises the difficulties because they established the timing and the limits for the project—they were challenges, not impassable roadblocks, and were mostly successfully overcome.

The case study concludes with guidelines for the successful implementation of any major project involving technological change plus a recent update with some of the practical problems encountered as the barcode usage matured.

Background

Geelong is situated about an hour's drive from Melbourne, the capital city of Victoria, and has a population of approximately 130,000. The Geelong Hospital, servicing Geelong and the sizeable surrounding area, operates at about 380 beds. As an indication of its size, approximately 12,000 surgical procedures are carried out in the hospital each year.

The hospital's Central Supply Department (CSD) operates 7 days a week, from 0700 hours to 2000 hours on weekdays and from 0830 hours to 1730 hours during the weekends. At the time of this study it was staffed by one registered nurse (the charge nurse) and 14 other staff—roughly a 50/50 mix of enrolled nurses, with one year's in-hospital training, and CSD attendants, with on-the-job training only.

CSD handles two categories of materials.

- The first category consists of hospital supplies processed and produced within the department. These include linen bundles for the operating theatre, procedure trays for the wards, packaged sterile bandages, dressings and other minor sterile supplies.
- The other category, that which is of most interest in this paper, comprises surgical supplies which are purchased already sterilised and packaged by the manufacturers and distributors.

Materials are ordered weekly by CSD from the general store of the hospital and received, in bulk, in 'outer' cardboard containers. CSD breaks up the contents of whole cartons and supplies in smaller quantities of 'individual packs' and 'items'.

The distribution system provides each patient care area, or other cost centre, with two trolleys. One trolley is in the ward and is slowly being emptied throughout the day. The other is situated in CSD being restocked to pre-negotiated levels. The trolleys are exchanged daily.

The wards and departments have individually negotiated stock levels and normally receive the same level of supplies every day.

The Problem

Until about 1985 the hospital considered the Central Supply Department to be the only cost centre as far as supplies were concerned. The hospital, and the accountants, considered stock to have been used once it was supplied to CSD from the hospital store. This resulted in several anomalies that had a major effect upon budgeting and costing within CSD and the hospital.

- Because stock was considered to have been used once it was *delivered* to CSD, there was never a stock-take of CSD.
- The materials held by CSD, no matter how large a volume or how valuable, were not regarded as part of the stock-in-hand of the hospital.
- The costs of stock supplied to CSD was considered to be a CSD expenditure, and the costs were never handed on to users.
- Annually, when the CSD budget was exceeded, the charge nurse was called to task and asked to explain the over expenditure.

As is obvious, CSD did not actually consume the materials, it simply operated a storage and delivery service for the actual consumers—the patient care areas and other cost centres—who were receiving their materials 'free'.

The charge nurse, when called to task over 'her' budget overrun, replied that she had no control over the budget, and that the items should be charged out to the patient care areas. Patient care personnel, mainly nurses, could then actually control what was used. Inherent in this idea was the responsibility of charge nurses for their own expenditures (budget).

The hospital's first response was that it couldn't be done. The next, almost immediate response, was that the CSD charge nurse was shifting her responsibility onto other people, expressing the anticipated resistance from patient care charge nurses to the notion that they should assume budgetary responsibility. The CSD charge nurse persisted and, eventually, a meeting was called between the Finance Department, Stores Department, the Director of Nursing and the CSD charge nurse.

After long discussion, the consensus was that the task was too hard.

- The Director of Nursing objected to the shift of responsibility to ward charge nurses.
- The Stores Department manager could see trouble ahead for the Stores.

Members of the Finance Department, however, saw opportunities to gain useful information, and were prepared to co-operate.

A Possible Solution

The CSD charge nurse, computer illiterate along with her entire staff, indicated that she had observed people in supermarkets, with handheld black boxes, apparently counting something.

Although she had no idea what they were actually doing, it was obvious that they were using an electronic tool of some kind. It seemed to her that if the supermarket staff had an electronic system for counting something, then the same method could potentially be used by Central Supply staff.

The Finance Department, in which the computer operators were located at that time, promised to look into it. At the meeting which followed a few weeks later, the possibilities for barcode use were presented and it was decided to pilot a trial using barcode technology to charge out stock from Central Supply.

- It had been discovered the hospital already possessed the capacity to print barcodes.
- As every stock item had already been assigned a catalogue number peculiar to this hospital, it was decided to express those stock catalogue numbers in barcodes for use with the system.
- Each cost centre already had an alpha-numeric code, consisting of one alpha and four numeric characters, which could also be expressed in barcodes.

Two barcode readers, borrowed for the trial, were literally left lying around in Central Supply for staff to 'play' with while the special barcode sheets were being prepared.

The readers produced some curiosity and everyone tried them out—mainly reading the codes on the back of their lunch time cheese and butter packets.

The reader rejected the codes—on the grounds that their symbols had too many characters—but at least they were read. The tiny red light on the wand was seen, the reader made some noises, and users got the idea that they were not difficult to operate.

Industrial Implications

In Victoria there is industrial legislation regarding the introduction of technological change — requiring staff to be fully informed about, and agree to, the proposed change.

A CSD staff meeting was called after the bar-code readers had been lying around the department for a while. By this time, the staff had had an opportunity to see how the readers operated, and what the system might mean to them in the workplace. This meeting included all department staff, a representative from human resources, an industrial officer of the hospital, a trade union representative, a representative from computing who could answer technical questions, and the charge nurse.

- By the time this meeting was held, the staff regarded the technology as quite boring. They had been associated with it for several weeks and questioned the necessity of the meeting. Although they hadn't used the technology for any practical purpose, they were very familiar with their role in its use. There was no perception of something rare and strange.
- They asked a few questions of the trade union representative and then quite happily signed a document to say that they had been informed of the purpose of the technology and that they agreed to use it.

In the light of the evasions and difficulties that were encountered later, it could be questioned whether the full import of using the technology had been brought home to the staff. However there was no question but that the requirements of the technological change legislation had been met.

Initial Implementation

The barcode labels arrived in a laminated form with adhesive backs. There was no attempt to put a code on every item of stock. Rather it was decided that the code should go onto the storage rack for the stock. The storage rack was labelled with the stock code in large letters, the name of the item in large letters and, close by on the shelf, the barcode symbol and stock code displayed in numeric form.

Cost Centre codes were placed on the trolleys belonging to each Cost Centre. This meant that they were easily accessible when staff went to stock a trolley.

- Turning the reader on produced prompt for the date and the invoice number. Once that was entered, a prompt appeared for a Cost Centre number. This was read with the wand from the trolley to be stocked. This produced a prompt for a stock code number, readily read from the storage rack for the stock required.
- Next, quantities were requested and keyed in. A prompt then appeared for the next stock code number, and so on.
- At the end of the day the data collected was downloaded via modem to the hospital's central computer.

The charge nurse explained to staff that they were actually filling in a form. By doing it in this way, not only is the task accomplished faster, but also more accurately.

The staff, however, took to this procedure cautiously, and the charge nurse had to resort to motivational strategies to get their cooperation. Whenever anyone actually used the readers to enter a stock code during the trial period, she would take the reader down to the finance department, have it down loaded and printed. She would then rush back up the stairs to show the staff the product of their efforts.

Barriers to Progress

After a few weeks of trial it was announced that in one week recording would be commenced for the purposes of accounting. It was at that time that the barriers became evident. They can be divided into three major categories.

The first barriers were generated by people.

- Everyone, including the charge nurse, was computer illiterate and needed enormous support from the computer department.
- Many of the staff were entrenched in their positions. They had been there for as long as fifteen years and were threatened by change.
- There were perceptions by some that they were doing more work and therefore should get more pay. This was never intended, particularly as the barcode system should save work.
- There was a push by a union representative who said that as they were dealing with computers they should be paid extra. [It was pointed out that every time they pushed the button lift they

were dealing with computers but were not paid extra for that either.]

- There were complaints that stocking the trolleys took longer. This was true, because instead of just bundling handfuls of stock onto the trolley as had occurred in the past, the items actually had to be counted. However the process of recording did not add appreciably to the time taken.

The means of evading the system were remarkable.

- About a month after the introduction of charging out by this means, it was discovered that one senior enrolled nurse had never used the barcode recorder—she decided that she would not participate. Fortunately, she was due for a promotion and, after it was explained to her that this would be difficult if she did not participate in the work of the department, she relented and started to record stock movement.
- Many people had the idea that if the reader wouldn't accept information, the solution was to push the 'enter' key harder. A succession of rejection beeps and cries of dismay would emanate from the storage area. Hearing these, the charge nurse would run in to the rescue, explain that pressing the button harder was not going to persuade the reader to accept the information, and help to diagnose the problem.

Equipment was sabotaged.

- Readers apparently malfunctioned and it was only months later that it was discovered that this had occurred as a result of it having been thrown on the floor.
- There was a suspicion at one stage that the readers had been tampered with. This was suggested by the computer department who could not find any other solution for the problem that was presented to them.

The people who did use the recorders also found methods of recording stock movement in ways that suited them.

- The first scheme was that one person would go into the stock area and call out the code, leaving another staff member in central position to key it in manually. This opened up the opportunities for error, although it was difficult to persuade the staff members of this.
- Some attempted to memorise codes. This was also discouraged.
- There was a request for all stock code symbols to be put on the wall in a central position. This would allow the codes to be read centrally, instead of in the storage area, despite the necessity for everyone to go into the storage area to pick up the stock. It was explained that it is quite possible, when confronted with an array of codes, to read the wrong one. On the stock shelves only one code was allocated to each storage area.
- If something went wrong with one barcode recorder nobody would record for the day. The reasoning put forward was that if some of the information wasn't being collected, there was no point putting in the rest.

The second category of barrier was technical.

- There was no way of limiting the information that went into a particular field in the initial readers. Staff were impatient with the readers, if they didn't get an instant response, indicating that a barcode had been accepted, they would read it again.

  This meant that sometimes a stock code would appear in the stock code field and again in the quantity field. It was possible, theoretically, for 73456 of something to be charged out. Of course this was the stock code and not the quantity. Once the sequence was out of order, it stayed out until corrected.

  As this occurred when no one was reading the display, a whole trolley could be stocked with the quantity being entered in the stock code field and the stock code in the quantity field. This was a huge problem which yielded useless information and for which no solution could be found with the existing readers. Fortunately when the readers were downloaded, the computer rejected that information.

The initial readers were unreliable. This may have been through sabotage but there was almost certainly an element of unreliability in the equipment itself as they were often out of action.

- The readers were programmed so that any one stock item could not be charged out more than once to the same department until the reader was downloaded. This proved difficult as patient care areas frequently needed more of something in unexpected circumstances. One way of getting around this was to use another reader, but it was very frustrating to find that when supplying something in an emergency, it could not be charged out with the reader in use.

The third category of barrier was logistical.

- The finance computer dealt with stock in bulk. Therefore it recorded, under the stock code number, 'outers', such as cartons of 100 packs or a packets of 1000 needles.

  In central supply it was necessary to deal in smaller numbers and a great deal of negotiation was required to agree on a common unit .

An example of a problem that arose concerned the supply of abdominal sponges to the operating theatre. The CSD staff member counted out the number of packets of five sponges to be sent and keyed in that quantity. The central computer was dealing with 'outers' of 100 packs, so every time the staff member charged out 1 pack of five sponges the computer charged theatre for 100 packs. This broke the theatre budget one month and the theatre supervisor had difficulty understanding what had gone wrong until Central Supply came up with the answer and issued a credit.

The incident initiated a much more formal negotiation about units of supply and it was eventually decided that the only logical common unit is the single item. Thus needles are counted by the single needle, gauze sponges by the pack of three, and abdominal sponges by the pack of five. The only item currently charged out in a larger quantity is a packet of alcohol swabs containing 100 swabs. It is supplied only in that form.

These negotiations and decisions led to major changes in the information in the finance computer and took some weeks to accomplish. It also required a new format for the supply department stock catalogue when it was reprinted.

New Equipment

Eventually new programmable readers (approx. $1,000 each) arrived to replace the borrowed readers. Now information entered into particular fields could be verified and limited.

This means that the reader will only accept a valid Cost Centre code when the user is prompted for the code—one alpha and four numeric characters. Similarly, for a stock catalogue code it will only accept 5 numeric, and will only accept quantities for a maximum of three numeric digits. The synchronisation problem has thus been eliminated.

The new readers also require user identification, helping to check that everyone is using the readers. It also allows identification of people making mistakes to assist in staff development—the policy of the department is to prevent further errors, not persecute people who make them.

They are programmed so that if a department requests more of a particular stock item, the quantity charged out can be amended—as many times as necessary. All CSD staff have to do is add the new amount to the amount already charged out on the trolley.

With the arrival of the new readers, the method of down-loading also changed. Where previously the readers had been transported to the finance department for down-loading, a modem is now available to down-loaded the readers directly to the mainframe computer. This takes only minutes and can be done at any time of day, even if no finance or computing staff are on duty at the time. This has been absolutely trouble-free and has saved many footsteps up and down flights of stairs.

Physically the new barcode readers are much better.

- They are smaller and lighter.
- They have a very sturdy wrist strap which makes them easy to handle and easy to keep safe while people are removing stock from shelves and putting it on trolleys.
- They have a heavy rubber case. This protects them from knocks or bashes if they are dropped or thrown.
- The case is very difficult to remove, discouraging tampering with the removable panels on the back of the barcode reader.

At the same time the number of readers in use has increased. More than two people can stock trolleys at any one time. With these changes the system at last seems to be working, allowing attention to be moved from getting the system to work, to how the information it generates should be reported.

Reporting

The original report from the finance department was a pile of paper two inches high and every operation which removed stock from central supply into a cost centre was reported chronologically.

- In order for the charge nurse to trace large movements of stock from supply to the wards, she had to find, count, and add up aggregations of stock.
- If she wanted to know how many bandaids had gone through the department she had to extract bandaid information from the daily stocking records for 25 trolleys, then add these together to determine the total for one month.

Negotiations took place with finance department about modification of the reporting system to provide two reports.

- First, a monthly report of the aggregation of each stock item that passed through CSD. Quantities, stock codes, and prices should be included but the items should be arranged in decreasing dollar value order.
- Second, an exception report flagging any item in which the monthly expenditure had changed by 5% in either direction.

This caused great consternation among the computer staff, who had their own ideas about the way they wanted to report the information. Eventually the system delivered two sets of reports—one formatted for the computer staff, the other formatted as CSD requested.

CSD believes that the first 'top of the pops' report, that is the report in dollar value order, provides the most useful information for all Cost Centres. Using the 20/80 rule, 80% of the expenditure of the cost centre can be checked by examining only the first fifth of the list. The remaining items are of little interest and need not be considered if time is short.

The really interesting items are those which suddenly appear near the top of the list for the first time. Their appearance may indicate a sudden price rise, a change in treatment regimens or inappropriate use. It could also indicate a half dozen boxes of an item being hoarded in a ward cupboard.

Subsequent Spread

The system developed in Central Supply was subsequently modified for use in Pharmacy, the Linen Store, and then the General Store. It was also modified for use in Medical Records to tag patient histories. It has now been sold to a major computing supplier and is marketed by them as part of the package that they supply to hospitals.

The staff in Central Supply regard the barcode reader as an essential piece of equipment to supply stock to anywhere in the hospital. After the staff became accustomed to the barcode readers they began to see ways in which they could be used for themselves, many of which are now in operation. These suggestions give great satisfaction to the charge nurse. She is delighted that the staff members are thinking for themselves how they might exploit the new technology, and that they have a sense of ownership of the work.

The system has produced an accurate means of charging out supplies to patient-care areas. It has provided a means of obtaining accurate information very quickly, because as the readers are downloaded, the information is assigned directly to cost centre budgets. It is a source of great pride to everyone in the department—representing as it does five years of continuous development and modification.

The hospital has had many visitors from Victoria and interstate who are interested in introducing barcode technology to their Central Supply and other departments. While demonstrations are available from the computer supplier, visitors still arrive regularly to see how it might be implemented in their particular practical setting.

The CSD staff are now the experts—and are happy to share their experience with colleagues.

Achieving Success in Technology Adoption

To be successful in adopting a new technological innovation, management of the people who will use the innovation is as important as managing the technology itself.

- Involve users so that they feel 'ownership' of the project.
- Plan the implementation well, explain the implementation and the role of every individual involved, prepare training materials and other aids to implementation, and schedule the implementation so that everything isn't happening at the same time.
- Provide opportunities, as appropriate, for both professional education and training on the specific system.
- Be aware of individual problems and 'fears', they are often very rationale impediments to change.
- Identify and resolve the real problems—use the implementation process to examine and resolve existing system problems.

Update 1993

This update is based on extensive use of the barcode system within the Central Supply Department for approximately one year and identifies several areas for improvement.

CSD has faced two major 'housekeeping' problems with the use of the barcode readers. These problems have been the cause of a certain level of aggravation among the staff and have sometimes resulted in data loss or a reader being out of service for several days.

- First, the labels being used are not durable enough for the service required and must be constantly replaced. Every time that an item is taken from that shelf, the barcode is read by physically passing the wand across the label. Obviously, the more frequently an item is used, the faster the label wears out, with the result that the labels for the most common items, labels that are scanned several dozen times per day, require frequent replacement.
- Second, the wands on the particular readers used in CSD are fastened to their reader with a connector that uses a sliding lock mechanism. Whenever the wand is removed, such as when attaching the modem to perform the daily data upload, the wand must be unlocked and removed. The modem cable is then attached and the lock refastened. The process is reversed at the conclusion of the data transfer. This connector is easily damaged with consequent data loss.

It seems to me that the connection was made by people who had no idea of how this would be used or the frequency with which it would have to be detached and reattached.

In the past, CSD relied entirely upon the hospital's Management Information System (MIS)for maintaining and programming the bar code readers. Now, however, the need for additional programming is occurring so frequently, and the readers are in use so continuously, that it may be necessary to train someone in CSD to program the readers.

MIS is not too keen [to train CSD staff to do the programming], but they are also not very keen about the time that it takes to make the additions and subtractions in programming that we have asked them to do on fairly frequent occasions over the last few months... So we are negotiating to have at least one person, and possibly two, trained to do quite specific tasks with regard to programming the readers.

Until recently, the only items charged out through the barcode system have been items 'bought' into the hospital—items purchased by the hospital and charged against the units using them. Recently CSD has been attempting to replace disposable items with non-disposable items which are being produced within CSD itself. This often results in a lower cost per use, and is intended to result in a more environmentally friendly operation.

While CSD has no need, and no desire, to charge these items out—to transfer the costs to other departments—CSD decided to have codes issued so that the items could be charged out through the barcode system. This should then result in a better picture of usage.

We got a wail of anguish from MIS recently. Because this stuff is produced within the Department [CSD], it never becomes part of the stock inventory... and if it isn't in the inventory there are no stock levels from which our out-going stock can be subtracted... and the computer won't let stock go into negative numbers. So every time that we tried to charge the stuff out, the computer knocked back the information.

The problem was solved by putting a nominal quantity, 10,000 units, into stock. This nominal quantity will be replenished when the stocking level gets too low.

Of course, 10,000 bears no relationship to reality—to how many are actually in stock. It has been put in purely to allow us to generate information about our stock—where it goes and who uses it.

It seems to me that if I was computer literate I would be able to work out a better way of doing this.

CQCUS

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Australian Computer Society

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CQCUS

The Central Queensland Computer Users Society is a Special Interest Group of the Australian Computer Society. CQCUS members range from novices to professionals, all Central Queenslanders with a genuine interest in sharing their computing knowledge and expertise.

CQCUS hosts a general interest presentation on computing on the second Tuesday of every month except January. Meetings and field trips are usually in Rockhampton with sessions once or twice a year in Gladstone. The presentation is followed by an informal discussion and refreshments. There is a small charge for non-members at all meetings to cover the cost of refreshments. Business affairs are kept to a minimum with an executive, chaired by John Smith of UCQ, meeting regularly to manage society affairs.

CQCUS also publishes a newsletter 11 times per year and regularly schedules half day, full day, and longer professional development seminars (PDS) for local ACS members and other professionals.

Bachelor of Information Technology

During 1992 and 1993 the UCQ Department of Mathematics and Computing radically revised its undergraduate applied computing degree program to bring it more into line with current student and employer expectations.

This new course is described as a professionally oriented applied computing course with a solid information technology base while providing an emphasis on teamwork, communications and professionalism. The new course has two streams, software engineering and systems services, the latter being oriented towards training professionals who are able to directly support end users.

The new course, which starts in 1994, includes subjects which emphasise professional, legal, and ethical issues, and is part of a coordinated series of courses with multiple entry and exit points leading to associate and graduate diplomas, bachelor, honours, and masters degrees. All awards will be available on campus or through distance education.

Additional information is available from Professor John Smith, at the address above or through AARNet: J.Smith@UCQ.Edu.AU

Post Graduate Diploma Health Science (Administration and Information)

The UCQ Faculties of Health Science and Business (Information Systems Section) jointly offer this post graduate award through distance education. It is a one year course, normally studied part time over two years, with about 50 students currently enrolled.

Entry requires a completed three year degree or equivalent with work experience in a health care area. For maximum benefit, students should be currently working in a health care area.

Subjects include basic research methodology, information systems, the Australian healthcare system, epidemiology and statistics, ethical issues, and a special project. A 'taught' program, it can be extended into a masters degree by research.

Further information can be obtained from:

Evelyn Hovenga, Senior Lecturer, Faculty of Health Science, UCQ, Rockhampton, 4200.
AARNet: E.Hovenga@UCQ.Edu.AU

Health Information Systems in a Regional Context

The Faculties of Health Science and Business recently completed their second annual seminar focussing on health informatics as it applies to regional Australia, and the event seems to have attracted sufficient interest from practitioners that it will truly become an annual one-day conference worth attending.

Rockhampton may seem far from the information systems centres of Newcastle, Sydney, Brisbane, Melbourne, Adelaide and Perth, but the new Faculty of Health Science has certainly been putting the University of Central Queensland 'on the map'. Cooperating across disciplines with the Faculty of Business and the Department of Mathematics and Computing, Health Science has been responsible for several innovative programs such as this conference.

Health Science also has a deep interest in computer assisted learning technologies and runs a computer managed learning program for nurses re-entering the workforce.

Further information can be obtained from the Faculty at the address above.

Australian Health Informatics Association (QLD) Inc
C/- Family Medicine Programme
PO Box 1144, Milton Centre Qld 4064
Phone (07) 369 6833 FAX (07) 368 2615

INFORMATICS IN HEALTHCARE—AUSTRALIA

Use of Computers and Information Technology

This new national magazine is now into its second year providing healthcare practitioners with timely and appropriate information. Issues contain current state news as well as national news and articles. Future theme issues include HCN—The Health Communications Network and Education for Health Informatics.

Informatics in Healthcare—Australia is a joint venture of five of the health informatics organisations within Australia and is supported fully by AHIA(QLD) Inc. To receive *Informatics in Healthcare—Australia* you need to be a member of an affiliated association such as AHIA(QLD).

Use the application form below—join now!

AHIA(QLD)

AHIA(QLD) Inc was formed to assist practice and promote responsible health informatics in Queensland. It conducts regular educational meetings in Brisbane, and is fully incorporated. Educational meeting nights for 1993 are on the last Thursday in Jan, Mar, May, Jul, Sep and Nov. Participants are asked to make a small contribution towards the cost of refreshments.

Two Special Interest Groups (SIGs) are now operational, one in Computer Assisted Learning (CAL), the other in Computer Systems for GPs.

New projects for 1993 include educational meetings in regional centres and a series of basic publications in health informatics. *Computer Basics for Health Practitioners 1993*, is the first of these publications.

AHIA(QLD) Inc Membership Application

Please post this application for membership and your cheque to:
The Treasurer, AHIA(QLD) Inc, PO Box 1144, Milton Q 4064

Ordinary $40 for 12 months [ ]

Associate $25 for 12 months [ ] (F/T students & pensioners)

Full time students, please specify course and institution:

My main areas of interest in Health Informatics are:

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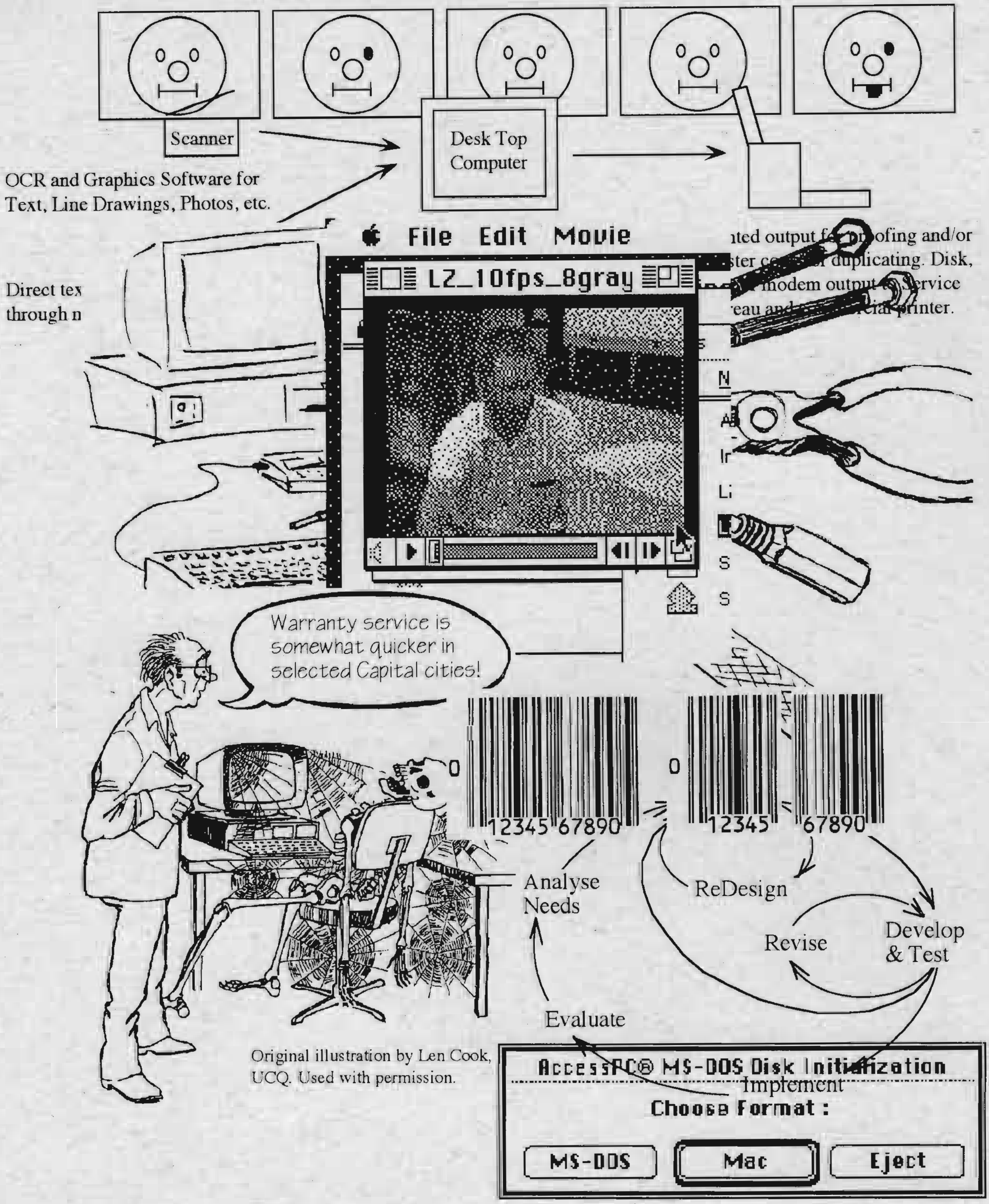

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ISBN 0 646 14657 2