Chapter 23

A Final Word

The contents of this book cover most of the components of an IBM-compatible personal computer system. In this book, you discover how all the components operate and interact and how these components should be set up and installed. You see the ways that components fail and learn the symptoms of these failures. You review the steps in diagnosing and troubleshooting the major components in a system so that you can locate and replace a failing component. You also learn about upgrades for components, including what upgrades are available, the benefits of an upgrade, and how to obtain and perform the actual upgrade. Because failing components so often are technically obsolete, it is often desirable to combine repair and upgrade procedures to replace a failing part with an upgraded or higher performance part.

The information I present in this book represents many years of practical experience with IBM and IBM-compatible systems. A great deal of research and investigation have gone into each section. This information has saved companies many thousands of dollars. By reading this book, you also take advantage of this wealth of information and may save you and your company time, energy, and, most importantly, money!

Bringing microcomputer service and support in-house is one of the best ways to save money. Eliminating service contracts for most systems and reducing down-time are just two of the benefits of applying the information presented in this book. As I indicate many times in this book, you can also save a lot of money on component purchases by eliminating the middleman and purchasing the components directly from distributors or manufacturers. The vendor list in Appendix B provides the best of these sources for you to contact. If you intend to build your own systems, the vendor list will be extremely useful as I list sources for all of the components needed to assemble a complete system from the screws and brackets all the way to the cases, power supplies and motherboards. I've found that this list is one of the most often used parts of the book. Many people have been unable to make direct purchases because doing so requires a new level of understanding of the components involved. Also, many of the vendors are unable to provide support for beginning users. I hope that this book gives you the deeper level of knowledge and understanding you need so that you can purchase the components you want directly from the vendors who manufacture and distribute them, saving a great deal of money in the long run.

I used many sources to gather the information in this book, starting with my own real world experiences. I also taught this information to thousands of people in seminars presented over the last 13 years by my company, Mueller Technical Research. During these seminars, I am often asked where more of this type of information can be obtained and whether I have any "secrets" for acquiring this knowledge. Well, I won't keep any secrets! I can freely share the following four key sources of information that can help you become a verifiable expert in PC upgrading and repairing:

- Manuals
- Machines
- Modems
- Magazines

Manuals

Manuals are the single most important source of computer information. Unfortunately, manuals also are one of the most frequently overlooked sources of information. Much of my knowledge has come from poring over technical-reference manuals and other original equipment manufacturer's (OEM) manuals. I would not even consider purchasing a system that does not have a detailed technical-reference manual available. This statement applies also to system components—whether it's a floppy drive, hard disk, power supply, motherboard, or memory card. I have to have a detailed reference manual to help me understand what future upgrades are possible and to provide valuable insight into the proper installation, use, and support of a product. Often times these manuals must be obtained from the OEM of the equipment you purchase, meaning the vendor or reseller will not supply them. Where possible, you should make an effort to discover who the real OEM of each component in your system is and try to obtain documentation from them on the product or component.

Large manufacturers such as IBM, Compaq, Hewlett Packard, and others both manufacture their own components as well as purchase components from other sources. Many of these manufacturers also make available complete libraries of technical documentation for their systems. I have included a list of IBM's technical documents in Appendix A, which are quite detailed, and unfortunately often fairly expensive. These are often excellent at detailing the operations of CPU, memory, bus, and other architectures in the system, and are even appropriate when discussing compatible systems because almost all systems must be compatible with IBM's in most elements. In other words, the IBM documentation would be interesting to those who do not even own a single piece of true IBM hardware. IBM also has extensive technical information available on-line in the form of a BBS, as well as a mainframe database and information retrieval system called IBMLINK. The number for the IBM National Support Center (NSC) BBS is listed in Appendix B. Contact your local IBM representative or dealer for information on how to get an account on IBMLINK.

Other companies, such as Compaq and HP, also have extensive documentation libraries. Compaq makes their complete technical library available in a CD-ROM version (called Quickfind), which is very convenient and easy to search. Quickfind contains detailed information about all of Compaq's models and is available from any Compaq dealer. Both Compaq and HP also have BBS services available for technical support, check the Vendor list for phone number information on these and other BBS systems.

A simple analogy explains the importance of manuals, as well as other issues concerning repair and maintenance of a system. Compare your business use of computers to a taxicab company. The company has to purchase automobiles to use as cabs. The owners purchase not one car but an entire fleet of cars. Do you think that they would purchase a fleet of automobiles based solely on reliability, performance, or even gas-mileage statistics? Would they neglect to consider on-going maintenance and service of these automobiles? Would they purchase a fleet of cars that could be serviced only by the original manufacturer and for which parts could not be obtained easily? Do you think that they would buy a car that did not have available a detailed service and repair manual? Would they buy an automobile for which parts were scarce and that was supported by a sparse dealer network with few service and parts outlets, making long waits for parts and service inevitable? The answer (of course) to all these questions is No, No, No!

You can see why most taxicab companies as well as police departments use "standard" automobiles such as the Chevrolet Caprice or Ford Crown Victoria. If ever there were "generic" cars, these models would qualify! Dealers, parts, and documentation for these particular models are everywhere, and they share parts with many other automobiles as well, making them easy to service and maintain.

Doesn't your business (especially if it is large) use what amounts to a "fleet" of computers? If so, why don't you think of this fleet as being similar to the cars of a cab company, which would go out of business quickly if these cars could not be kept running smoothly and inexpensively. Now you know why the Checker Marathon automobile used to be so popular with cab companies: its design barely changed from the time it was introduced in 1956 until it was discontinued in July 1982. (At last report, there were only eight still in service in New York City!) In many ways, the standard XT- and AT-compatible systems are like the venerable Checker Marathon. You can get technical information by the shelffull for these systems. You can get parts and upgrade material from so many sources that anything you need is always immediately available and at a discounted price. I'm not saying that you should standardize on using older XT or AT systems, just that there are good reasons for standardizing on systems that follow the "generic" physical design of the XT or AT but use newer internal components. This results in systems that are completely modern in performance and capabilities and which are easily supported, repaired, and upgraded.

Even the PS/2 systems now are capable of being considered in this light because their installed base exceeds 14 million units. Many third parties now offer replacement and upgraded motherboards, power supplies, and disk drives for these systems. You can purchase everything from upgraded motherboards to disk drives, memory, video adapters, power supplies, and just about any other component in the system. Because PS/2 systems

are easy to disassemble, the upgrade procedure also is usually very easy, even if you are replacing the motherboard.

It's amazing that people purchase computers that don't have technical documentation, use nonstandard form-factor components, or have parts available only through the dealers. The upgrade, repair, and maintenance of a company's computer systems always seem to take a back seat to performance and style.

In addition to the system OEM manuals, I like to collect documentation from the different Original Equipment Manufacturers that make the components used in various systems. For example, I recently worked with Gateway and Hewlett-Packard systems, both of which use Epson floppy drives. The OEM documentation for these systems did not include detailed information on the Epson floppy drives, so I called Epson and ordered the specification manual for these drives. I also ordered the specification manuals for several other drives used in these systems, including Western Digital and Quantum hard disks. I now have detailed information on these drives, which covers jumper settings, service and repair information, and other technical specifications not provided otherwise. I recommend that you inventory each major component of your system by manufacturer and model number. If you don't have the specification or technical reference manuals for these components, call the manufacturers (the vendor list in Appendix B will help) and ask for them. You'll be amazed at the wealth of information you can get.

If you're looking for more general purpose documentation, especially on operating systems or applications software, try Que Corporation, which specializes in this type of computer book. In particular, I recommend *Killer PC Utilities*, and *Que's Guide to Data Recovery*. These books combine basic hardware information with more extensive software and operating system coverage. Microsoft and IBM also publish books of interest to computer enthusiasts and technicians. For example, Microsoft sells the *DOS Resource Kit,* and IBM sells the *DOS Technical Reference Manual*. The Microsoft kit consists of a command reference book (Microsoft left the command reference out of the DOS 6 documentation), and a very useful disk of utilities that both Microsoft and IBM left out of DOS 6.22 and 6.3. Que also publishes the *IBM OS/2 Technical Reference* library (IBM calls them "Red Books" because the covers originally were red), which is recommended for anybody using OS/2. IBM has several other technical reference manuals for use with IBM Compatible systems. A detailed list of these manuals is included in Appendix A.

Machines

Machines refers to the systems themselves. Machines are one of my best sources of information. For example, suppose that I need to answer the question, "Will the XYZ SCSI host adapter work with the ABC tape drive?" The answer is as simple as plugging everything in and pressing the switch. (Simple to talk about, that is.) Seriously, experimenting with and observing running systems are some of the best learning tools at your disposal. I recommend that you try everything; rarely will anything you try harm the equipment. Harming valuable data is definitely possible, if not likely, however, so make regular backups as insurance. You should not use a system you depend on for day to day operations

as an experimental system, if possible use a secondary machine. People sometimes are reluctant to experiment with systems that cost a lot of money, but much can be learned through direct tests and studies of the system. I often find that vendor claims about a product are somewhat misleading when I actually install it and run some tests. If you are unsure that something will really work, make sure that the company has a return policy that allows you to return the item for a refund should it not meet your expectations.

Support people in larger companies have access to quantities of hardware and software I can only dream about. Some larger companies have "toy stores," where they regularly purchase equipment solely for evaluation and testing. Dealers and manufacturers also have access to an enormous variety of equipment. If you are in this position, take advantage of this access to equipment, and learn from this resource. When new systems are purchased, take notes on their construction and components.

Every time I encounter a system I have not previously worked with, I immediately open it up and start taking notes. I want to know the make and model of all the internal components, such as disk drives, power supplies, and motherboards. As far as motherboards, I like to record the numbers of the primary IC chips on the board, such as the processor (of course), integrated chip sets, floppy controller chips, keyboard controller chips, video chipsets, and any other major chips on the board. By knowing which chip set your system uses, you can often infer other capabilities of the system, such as enhanced setup or configuration capabilities. I like to know which BIOS version is in the system, and I even make a copy of the BIOS on-disk for backup and further study purposes. I want to know the hard drive tables from the BIOS and any other particulars involved in setting up and installing a system. Write down the type of battery a system uses so that you can obtain spares. Note any unique brackets or construction techniques such as specialized hardware (Torx screws, for example) so that you can be prepared for servicing the system later. Some programs have been designed to help you maintain an inventory of systems and components, but I find that these fall far short of the detail I am talking about here.

This discussion brings up a pet peeve of mine. Nothing burns me up as much as reading a "review" of computer systems in a major magazine, in which reviewers test systems and produce benchmark and performance results for, let's say, the hard disks or video displays in a system. Then they do not just open up the machines and tell me (and the world) exactly which components the manufacturer of the system is using! I want to know *exactly* which disk controller, hard drive, BIOS, motherboard, video adapter, and so on are found in each system. Without this information, their review and benchmark tests are useless to me. Then they run a test of disk performance between two systems with the same disk controller and drives and say (with a straight face) that the one that came out a few milliseconds ahead of the other wins the test. With the statistical variation that normally occurs in any manufactured components, these results are meaningless. The point is perhaps to be very careful of what you trust in a normal magazine review. If it tells me exactly which components were tested, I can draw my own conclusions and even make comparisons to other systems not included in that review. The (now defunct) *PC Tech Journal* magazine always did *excellent* reviews and told readers what components were in the systems it tested. The review test data then was much more accurate and informative because it could be properly interpreted.

Modems

Modems refers to the use of public- and private-information utilities, which are a modem and a phone call away. With a modem, you can tie into everything from local electronic bulletin board systems (BBSs), vendor boards, and major information networks such as CompuServe. Many hardware and software companies offer technical support and even software upgrades over their own semi-public bulletin boards. The public-access information networks such as CompuServe and other BBS systems include computer enthusiasts and technical-support people from various organizations, as well as experts in virtually all areas of computer hardware and software. Bulletin boards are a great way to have questions answered and to collect useful utility and help programs that can make your job much easier. The world of public-domain and user-supported software awaits, as well as more technical information and related experiences than you can imagine.

Appendix B includes not only the name, address, and voice phone number for the company but also the BBS numbers where available. If you need more information on a vendor's products or need technical support, try using the vendor's BBS. Many companies run a BBS to provide updated software or driver files so that you can download them quickly and easily. One of the best examples of a BBS is the IBM National Support Center (NSC). This BBS not only provides information on all of IBM's products, but also serves as the source for Corrective Service disk patches to DOS, OS/2, and other IBM software. Also provided are fully downloadable copies of the reference and setup disks needed to configure IBM hardware. This BBS is the ideal way to get the latest versions of these disks directly from IBM at no charge. When a vendor provides a BBS service, I consider that service a major advantage in comparison to other vendors who do not provide such a service. Using vendor BBSs has saved me money and countless hours of time.

Many companies that provide a BBS do so through a public access utility, such as CompuServe, rather than running their own BBS. The CompuServe Information Service (CIS) is a public information access utility with an extensive network of dial-in nodes that allows you to log on to its cluster of mainframe systems (based in Ohio) from virtually anywhere in the world through a local telephone call. Among CompuServe's resources are the Forums sponsored or attended by most of the major software and hardware companies, as well as enthusiasts of all types. Some interesting discussions take place in the Forums. CompuServe, combined with a local electronic bulletin board or two, can greatly supplement the information you gather from other sources. In fact, CompuServe electronic mail is probably the most efficient method of reaching me. My CompuServe ID is 73145,1566, and if you have questions or just a comment or useful information you think I might be interested in, please send me a message. Because of the extra steps in processing, my standard mail can get backed up and it can take me awhile to answer a regular postal letter; electronic mail, however, involves fewer steps for me to send and always seems to have a higher priority. If you do send a regular letter, be sure to include a SASE (self-addressed stamped envelope) so that I will be able to reply.

Magazines

The last source of information, *magazines,* is one of the best sources of up-to-date reviews and technical data. Featured are "bug fixes," problem alerts, and general industry news. Keeping a printed book up-to-date with the latest events in the computer industry is extremely difficult or impossible. Things move so fast that the magazines themselves barely keep pace. I subscribe to most of the major computer magazines and am hard-pressed to pick one as the best. They all are important to me, and each one provides different information or the same information with a different angle or twist. Although the reviews usually leave me wanting, the magazines still are a valuable way to at least hear about products, most of which I never would have known about without the magazines' reports and advertisements. Most computer magazines are also available on CD-ROM, which can ease the frantic search for a specific piece of information you remember reading about. If CD-ROM versions are too much for your needs, be aware that you can access and search most major magazines on CompuServe. This capability is valuable when you want to research everything you can about a specific subject.

One of the best kept secrets in the computer industry is the excellent trade magazines that offer free subscriptions. Although many of these magazines are directed toward the wholesale or technical end of the industry, I like to subscribe to them. Some of my favorite magazines include the following:

- *The Processor*
- *Computer Hotline*
- *Computer Reseller News*
- *Electronic Buyer's News*
- *Electronic Engineering Times*
- *Computer Design*
- *Electronic Products*
- *Test and Measurement World*
- *Service News*

These magazines offer free subscriptions to anyone who qualifies. Aimed at people in the computer and electronics industries, these magazines offer a much greater depth and breadth of technical and industry information compared to the more "public" magazines that most people are familiar with. You'll find these and other recommended magazines in the "Vendor List" in Appendix B.

The Appendixes

Appendix A provides a collection of technical information, tables, charts, and lists especially useful to people in a computer support, troubleshooting, service, or upgrading role. Whether you're seeking the address and phone number of a company or vendor in the "Vendor List," or searching for something as technical as determining the pinout of the ISA bus connector, you'll most likely find the information in the appendixes.

The appendixes started out as a brief collection of essential information but has grown into a complete reference resource of its own. No other book currently on the market contains such a complete and informative technical reference, which is one reason why so many large companies and educational institutions have standardized on this book for their technicians and students. This book is currently being used as an official textbook for many corporate and college-level computer training courses, as well as my own PC training seminars, for which the book was originally designed.

I have recently released a new book which is actually an extension of the appendixes in this book. It is called *Upgrading and Repairing PCs, Quick Reference* and could be considered a sort of condensed version of this book. It contains all of the reference tables and charts found in the appendixes, as well as throughout the book, and even some new information. If you need a reference guide that is easier to carry, I highly recommend *Upgrading and Repairing PCs, Quick Reference*.

In Conclusion

I hope that *Upgrading and Repairing PCs*, 4th Edition, is beneficial to you, and I hope that you have enjoyed reading it as much as I have enjoyed writing it. If you have questions about this book, or if you have ideas for future versions, I can be reached at the following address:

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I am especially interested in any ideas you have for new topics and information to be included in future releases of this book. If you want a response through the mail, please include a self-addressed stamped envelope so that I can reply to you. If you are interested in one of our many intensive PC training seminars, just drop us a line.

Thank you again for reading this book, and a special thanks to those people who have been loyal readers since the first edition came out in January 1989.

Sincerely,

Scott Mueller