MICROCOMPUTERS IN EDUCATIONAL AND RESEARCH ENVIRONMENTS: THEIR MANAGEMENT, ACQUISITION, UPGRADE, AND MAINTENANCE

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ABSTRACT

This paper presents the management aspects of microcomputer hardware and software support for academic administrators, instructors, technical support staff and end users. The topics discussed include management of microcomputer hardware encompassing analysis, acquisition, support, troubleshooting, repair, upgrading and preventative maintenance. Another issue examined is hardware and software standards encompassing how to decide what to standardize on and instituting and maintaining standards throughout the organization. Moreover, we review the issue of compatibles versus brand names, including their evaluation, purchasing, support and upgrading in research and educational environments. In addition, points are made concerning communication with vendors and manufacturers involving pre/post sales support, procedures and requirements for procuring replacement parts, specifying product details on purchase orders, delivery specifications, type and period of warranty. Repair costs, maintenance contracts and in-house repair strategies are discussed. Finally, network management is touched upon with issues of approach, budget impact, standards and interoperability.

INTRODUCTION

The purpose of this paper is to educate administrators, managers and support personnel of educational and research environments about microcomputer management. Specifically, it will help decision makers in system purchase, component upgrade, maintenance contract procurement, and microcomputer and peripheral repair for laboratories, classrooms, and faculty/staff offices. Moreover, it will help individuals who determine whether an inoperative microcomputer or peripheral should be replaced or serviced, and who develop long range plans of scheduled replacements for obsolete hardware.

Although overall computing budgets are shrinking, the number of computers and users continues to grow. Computers are acquired through grants, donations, and built-in budget allocations. All disciplines now use computers and many departments have downsized from mainframes. Consequently, providing adequate service becomes increasingly more difficult. Budget limitations, inadequate planning and poor management can lead to expensive computing systems which do not meet the increasingly complex needs of faculty and students. Moreover, much of the useful information about microcomputer planning and management is scattered throughout the university computing community. Therefore, in an attempt to organize and codify the microcomputer management experience of the past we present what we consider to be the important issues to be faced by in the future.

In the first section, we will discuss acquisitions, standard selection, troubleshooting, repair, upgrades, preventative maintenance, and capital acquisitions. In the next section, we address instituting and maintaining hardware and software standards. The following section we review purchase criteria for compatibles. Next, we examine the advantages and disadvantages of building and customizing workstations. In the fifth section, we cover what to consider when dealing with and choosing vendors and manufacturers. Lastly, the strategies of maintenance, repair and network management are considered.

I. MANAGEMENT OF MICROCOMPUTER HARDWARE

A. Acquisitions

One of the first aspects of microcomputer management is control of what enters the institution. Many problems would not exist if poor quality or

non-standard hardware components and systems were not originally purchased or donated. Many issues should be considered before the computer procurement, including current microcomputer inventory and vendor support. Universities should ensure that microcomputer equipment can be purchased from more than one vendor because experience has shown that component availability, quantity in stock, ultimate purchase, and delivery can vary significantly by vendor and calendar date. Hence, strategic and tactical procurement will necessitate development of good working relationships with manufactures and suppliers. Also, vendor selection begins with determining equipment standards. For example, if most equipment is ISA (Industry Bus Architecture), and if there is no major reason to switch architectures then machines of the same architecture should be purchased for adaptor compatibility and quick on-the-spot troubleshooting.

A common question always arises, should one purchase IBM or compatible computers? Again, the pre-existing situation must be considered. The propensity of IBM machine with MCA or ISA buses and the future need for MCA architecture computer specifies four possible purchases scenarios: All IBM MCA machines, all IBM ISA machines, IBM and clone ISA machines, or all clones. Other features that should be considered when choosing computer criteria are: standardized parts, part availability, part quality, warranty, and out of warranty servicing. Doing your homework ahead of time will prevent future headaches! After bus architecture, processor types and other essential features have been evaluated the brand and types of computer equipment must be decided upon. It is important to purchase equipment from a manufacturer that is expected to remain in business for at least the next few years. Clearly, because the computer industry is so volatile even large companies might not exist five years hence. It is a good bet that IBM and Apple will be in business in the future. As the saying goes, "no one ever got fired for buying IBM". Finally, since there are numerous IBM compatible systems on the market, and since most vendor's sales and technical representatives are not always well informed about every hardware component constituting each computer model manufactured by their own company, we must research each company and it's computer's characteristics ourselves. Additionally, this seemingly daunting task can be mitigated by the acquisition of evaluation systems, usually on a 30 day trial, customized to your needs, for a trial period with no cost (except for shipping back to them) or obligation. Therefore, you get to see first hand the aesthetics of the machine, touch, feel, and most importantly, the interior components

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Standardized parts are one of the first characteristics you should look for when a evaluating computer. Pop open the computer case and look around inside! Take written notes on the different components. For example, the mechanical components, such as the floppy drives and power supply, should be examined first since the failure rate on these is the highest. The floppy drives should be able to be purchased at any local computer dealer that sells spare parts. The most popular brands are TEAC, Toshiba, Sony, and Chinon. These are usually half height, non-integrated (meaning the 5 1/4" and 3 1/2" drive and physically made together), have standard power connectors and controller cable connectors. Likewise, the power supply should have standard power connectors to the motherboard, as well as to the other components. Moreover, the size and shape of it should be one of about four different types (full-size AT, baby AT, PC/XT, and tower) readily available on the market. The power supply is usually the component where quality is curtailed in order for the manufacturer to cut costs.

Other modules in the system which should be carefully examined are the memory chips, chips on the motherboard, and hard drive. Some systems have proprietary SIMMs and can not be readily purchased. As a matter of fact, some times the SIMMs can only be purchased from the company itself. The best serviceable memory are DRAMS, but are almost impossible to find on current motherboards. There are many brands where a large percentage or all of its chips on the motherboard are soldered down. Most organizations do not have the experience or tools necessary to desolder a chip on a six layer board. On the other hand, many new models have an upgradeable motherboard, where the processor (usually an SLC) can be replaced by a newer, faster processor. Therefore, the computer has a longer useful lifespan. The hard drive is an extremely important part of the system. The higher capacity and quality ones come with a five year warranty. Some of the more reliable brands are Hewlett Packard, Maxtor, Conner, Micropolis, and Fujitsu.

The overall design of the computer should be analyzed. For example, are there additional bays for additional floppy, hard, tape, or CD-ROM drives. Also, does the power supply have enough wattage for additional components and are there extra power connectors for them? The physical layout of the motherboard should be checked. Sometimes the location of certain segments are in less than desirable locations. For example, at times SIMMs are placed directly under the hard drive, so close that possibly due to environmental vibrations etc., it occasionally shorts out the system. In other instances, a non-optimal design would include the processor and math coprocessor, two chips which disperse a large amount of heat, under the hard drive, which also throws a immense measure of heat.

Before purchasing a system, or especially a large number of systems, it is a wise idea to check with the manufacturer directly if replacement parts are available. Detailed questions should be asked regarding where, from whom, and how parts can be obtained. Moreover, after the information is gathered about purchasing parts, a test call should be

done to followup to assure the given procedure is the actual procedure. Too many times the representatives given out by the manufacturer will only sell to authorized dealers, will not accept purchase orders, or will not carry the particular items of interest but was in the manufacturers database because they presently carry other product lines of that manufacturer. In other instances, parts can be acquired directly from the manufacturer, but are usually very expensive and sometimes has to be purchased in large quantities. Furthermore, it is a good idea to check how long a machine is supported after it is discontinued. Many companies have a five to seven year support policy.

The quality of parts is an important issue when evaluating systems. Some dealers when they assemble systems, use cheaply made no-name parts from Taiwan. These type of parts tend to burn out quickly and because they are non-standard (ie. chip sets, etc.) there are many compatibility problems with software and other hardware. Moveover, these no frills boards tend to have and few jumpers in order to change interrupts, DMA settings, addresses and poorly written manuals. Furthermore, if it is a one-of-a-kind board and the manual gets lost or if there is a problem not discussed in the manual you can not find call Taiwan for tech support.

Compatibility with existing bus architecture is more important than one might think. For example, if there are ISA and MCA architectures mixed together in the same department and people at a higher level position might tend to get the newer machine and pass down the older machine to a secretary or graduate assistant. If the adaptor cards are not the same bus architecture than new cards have to be purchased for the original owners to have their previous capabilities.

A somewhat important issue for systems and peripherals is warranty. Warranties are usually standard at one year. Many vendors now give one year on-site for computer systems. Vendors mainly contract out the service to a third party repair company that is nationwide. Contracting out the service provides more security for the user because if the company goes out of business your one year contract is paid up and honored by the third party company. If the third party company goes out of business the original company still has to some how honor the one year warranty. On the other hand, some peripherals such as printers come with a two or three year warranty. In some instances, at the time of purchase, the user has a coverage option of either a three depot repair or a one year on-site. It is a good idea to pay a little more to obtain a printer with a longer warranty, than get stuck with a big parts and labor bill. Printers tend to have a high failure rate because they have a large number of mechanical parts and get the most abuse. It extremely beneficial to purchase hard drives with a five yearwarranty. Hard drives are somewhat fragile and costly, so a good warranty provides comfortable security. However, do not always feel secure about a company that offers a lifetime warranty - one has to wonder whether they mean the parts lifetime or theirs!

B. Troubleshooting

Proper troubleshooting requires good technicians, and appropriate tools. For basic in-house repair simple tools kits should include: two size socket drivers, two size phillips and flat screwdrivers, tweezers, 3-prong part pickers, wrist strap, chip extractor, needle nose pliers, and a metric driver. More advanced repair requires chip inserter, soldering iron, allen wrenches, oscilloscope, floppy driver exerciser, RAM and SIMM checkers - and of course a large hammer for the trickier problems.

Likewise, precise troubleshooting demands good diagnostic software. A complementary set of dependable diagnostic packages are recommended. Packages just like its designers, excel in some tests and are average or below average for others. Therefore, a few good software tools or hardware diagnostics boards usually enhances quick, accurate problem solving.

Some of the more well known diagnostic and troubleshooting products available are for both PC/AT and PS/2 machines. These products include PC Technician, PC Probe, POST Probe, Microscope 2000, IBM Advanced Diagnostics, RAMCHECKER, and SIMM TESTER and AlignIt. Other packages that only work on IBM PC/AT and compatibles, consist of Kickstart 2, and Verbatim Disk Drive Analyzer.

C. Repair

At what point should damaged or defective equipment be repaired outside instead of in-house? A rule of thumb to follow, is, if it takes more than an hour of benchwork beyond determining the faulty component, then the equipment should be sent out for repair. However, there are always exceptions to the rule. Many times depot repair centers repair at the same cost or less than to purchase the part retail. This is true primarily for monitor repairs. Moreover, board work is usually very difficult. For example, without expensive soldering equipment and extensive experience, severe damage could be inflicted upon delicate seven layer motherboards, resulting in higher repair costs or total board replacement.

More microcomputer support centers are setting up Help Desks. Many service calls can be completed over the phone by an experienced technician. Many repair calls are simple problems, such as software thought to be a hardware problem. A skilled technician could check for obvious maladies employing the user as his/her eyes. For example, many repair calls are nothing more than the brightness having been turned down on the monitor, an unplugged cable, a tripped circuit breaker on a surge protector, or even the wrong print driver

selected in a software application.

A more experienced technician can set up remote troubleshooting procedures. For example, packages such at Carbon Copy, Remote2, and Closeup are very beneficial in doing remote troubleshooting. The technician can see exactly what the user is seeing and do the corrections online at their end. In most instances, this saves an enormous amount of travel time, and is particularly useful in large or multi-campus environments with a single service center.

There are many advantages and disadvantages to evaluate when deciding to do in-house service or secure an outside maintenance contract. However, more and more institutions are switching to in-house service.

When considering in-house service attention should be given to technician costs, quality of replacement components, disposal of bad parts, and higher caliber service for the user. Technician costs are high, averaging between $90 to $120 an hour, sometimes even as high as $300-400 an hour during off peak periods. Furthermore, there is more control over the quality of parts replaced. Damaged parts can be used for future inventory, by sending them out to depot repair while a new part or known good part is installed. Response time can be much better for in-house service. Likewise, more quality time can be relegated to the user for easier or perhaps embarrassing questions that may not be asked of external support. Alternately, few adequately trained personnel result in long response time or further equipment damage.

Outside service contracts should be carefully reviewed for guaranteed response time, repair time, loaner availability, travel, labor and parts costs. A company may say it has a four hour response time, but it may only be from an non-technical coordinator. The actual repair person may not come until 24 to 48 hours. Moreover, sometimes repair people do not bring parts on the first site visit. Another item to consider, is the type of parts inventory the repair company keeps in stock and ordering time for non-stocked items. It is easier to get an outside service with a vendor that handles all makes and models of computers and peripherals, in case the institution decides to procure from different computer manufacturers. If the service company does not normally handle a particular type, it may take a long time to acquire the necessary part for repair. Some service companies have loaner equipment available, if the broken item has to be taken off site for repair. Note, some companies charge for the loaner equipment while others do not. Sometimes the charge for loaner equipment plus repair costs totals more than a new piece of equipment including the latest features and fresh warranty. Furthermore, some service companies charge for travel time, in addition to labor and parts. Many repair companies charge list price for parts or sometimes substitute a lower quality part with built-in obsolescence. A careful eye and a little knowledge could be helpful in avoiding unnecessary costs.

Other areas to weigh in deciding between in-house or outside service contract are personnel training, parts inventory, and service records. Training of personnel is sometimes an oversight that is very costly. It must be justified and chosen carefully. Room and budget for a parts inventory are necessities easily overlooked. Purchasing parts on a needs only basis leads to user frustration because of downtime and is not cost effective. Quantity pricing of parts is substantial and time lost by a down computer is sometimes never recouped. Additionally, some type of records for logging service calls should be kept in order to justify more personnel, budget and provide experience for future service calls.

D. Upgrading

Another important management decision concerns upgrading old equipment. Maintaining compatibility between new machines and old machines through floppy disk size and density enhances productivity. Likewise, consistent hardware configurations including memory, video display, and hard disk space, ensures software execution across platforms. However, there are times where the cost of upgrading an old machine is less cost effective than purchasing a new computer. For example, upgrading to a hard drive may mean replacing BIOS chips which could cost as much as a replacement motherboard.

E. Preventative Maintenance

Good microcomputer management includes encouraging preventative maintenance. Here, "don't fix what ain't broken" does not apply. Machines should be on a regular maintenance schedule. For example, CPU's, printers, and keyboards should be aired out with compressed gas to prevent dust, build-up that could produce shorts or overheating. In addition, printers should be vacuumed and printheads cleaned. Also, floppy drives should be cleaned regularly, according to usage.

Other preventative measures include watching out for static electricity, viruses, room temperature, electrical precautions, and updating hard drive error maps. Extreme caution should be taken concerning static electricity in certain environments. Many labs use anti-static mats or spray underneath the keyboard and around the computer. Similarly, wrist straps should always be used when handling sensitive chips (e.g., math coprocessor) in the service area. It is strongly suggested that an up-to-date and reliable virus scan program be loaded at the beginning of each sitting, to insure virus free disks after each computer session. Computers should be plugged into surge protectors with good clamping response, a protection indicator and protective filter for hot, neutral and ground. In addition, hard drives should occasionally be low level formatted, to include

new bad tracks in the bad track map. Also, it is suggested that hard drives be optimized and, if needed, 'parked' before shutting off the computer.

F. Capital Replacements

Directors should include in their long range plans replacement of old obsolete machinery. They should replace approximately 20% of their equipment each year. It would be extremely difficult for almost any institution to replace a enormously large number of machines at one shot. Computers, in general, have depreciated at the end of five years.

II. HARDWARE AND SOFTWARE STANDARDS

A. Instituting Standards

It is easier to institute standards when one individual oversees all computer orders. This person can work with the purchasing department and approve computer equipment, as ordered. This is difficult, but in theory, should hold true for computer equipment purchased on grant money as well as institutional funds. All specifications should be listed on the purchase order. Remember it is better to list all the details no matter how cumbersome, than to be sorry afterwards! Some vendors may not take back incorrect merchandise without a fight or restocking fee. If the institution is excessively large, a pre-approved list of computer equipment could be kept on file at the purchasing department.

Donation of computer equipment should be treated in similar fashion. Any potentially donated equipment should be inspected before donation. This equipment is usually well on its way to obsolescence. As a result, it becomes more difficult to find parts and costlier to maintain. Caveat emptor clearly applies to donations of pre-owned equipment.

There should be software standards, with a minimum specification of data exchange and ideally complete functionality. All software packages including languages and application software, such as word processors, spreadsheets and databases.

III. COMPATIBLES

A. Purchasing

Too often compatible purchase is dictated by lowest advertised price. Although a machine's stated speed, hard disk capacity, number of floppy drives, and display resolution, may clearly be stated in advertisements, direct price comparison is not possible because component quality varies drastically by manufacturer. Specifically, part quality, brand name, warranty, service, part availability, tech support, and company stability all add cost but value to the hardware.

Before computer purchase, information about the manufacturer should be obtained. The company should have a good track record, many years business experience, extensive experience in the computer field, and a reputation for high quality technical and customer support. And finally, they should be known for standing behind their product.

B. Upgrading

Compatibles are generally easy to upgrade if they include generic parts and a large system enclosure. As a result, a manager can ensure that future upgrades will be inexpensive because generic parts are more available and the system enclose provides for significant expansion. For example, generic parts ensure that many manufacturers can provide compatible replacements for obsolete or failed components. Furthermore, large system enclosures allow for larger motherboards with extended slots, or additional hard disks or tape drives.

IV. PC WORK STATIONS

If time and staffing are available, custom design and building of workstations may be desirable. This ensures quality control and compatibility. However, because of the concerted effort to build, it may not be cost effective. Additionally, it may not even save money, but might ensure high quality parts and customization of user needs.

V. COMMUNICATIONS WITH VENDORS AND MANUFACTURERS

Communication with vendors and manufacturers is an important part of procuring computers. The vendors should meet specifications, timely delivery of goods, honor warranties without a hassle, authorize sales of replacement parts, and have sufficient pre-sales and post-sales support.

VI. MAINTENANCE AND REPAIR COSTS

The primary component of repair costs is labor. The secondary component of repair costs is replacement parts. Price comparisons should be made for new and refurbished replacement parts.

Maintenance contracts are usually costly. Moreover, the maintenance company reviews the past year when the contract expires and raises its price accordingly to maintain next year's profit. For example, if there was an increase in service calls the prior year, the contract will reflect a significant cost increment. However, it is possible to acquire a contract on a call, parts and material basis. This way is usually more cost effective and should be seriously considered. Note, calls are customarily billed per hour. If the call took 5 minutes of the next hour, the customer will be billed for an additional hour.

When dictating hardware standards it must be remembered that a parts inventory has to reflect current equipment owned. If there are too many manufacturers and models, it may be difficult to store and finance an adequate supply of parts.

VII. NETWORK MANAGEMENT

Networks may solve some problems, but cause others. Managers must consider different network strategies, budget impact, reliability, services, standards, and future growth. Software must be network compatible. Networked software costs more. So, costs for both new software designed to run on a network and signal user software upgraded for networks are higher and these costs must be reflected in the budget.

The LAN must be reliable. Here, if server is down, it effects more users than a single microcomputer. Regularly scheduled system backups is a necessity. And a disaster recovery plan must be instituted. Furthermore, it is beneficial to develop standards for different LANs throughout the university. Finally, LANs should be designed for future growth, thus providing cost effective and facile expansion capability.

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