MULTI-USER MICRO SYSTEMS

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MULTI-USER MICRO SYSTEMS

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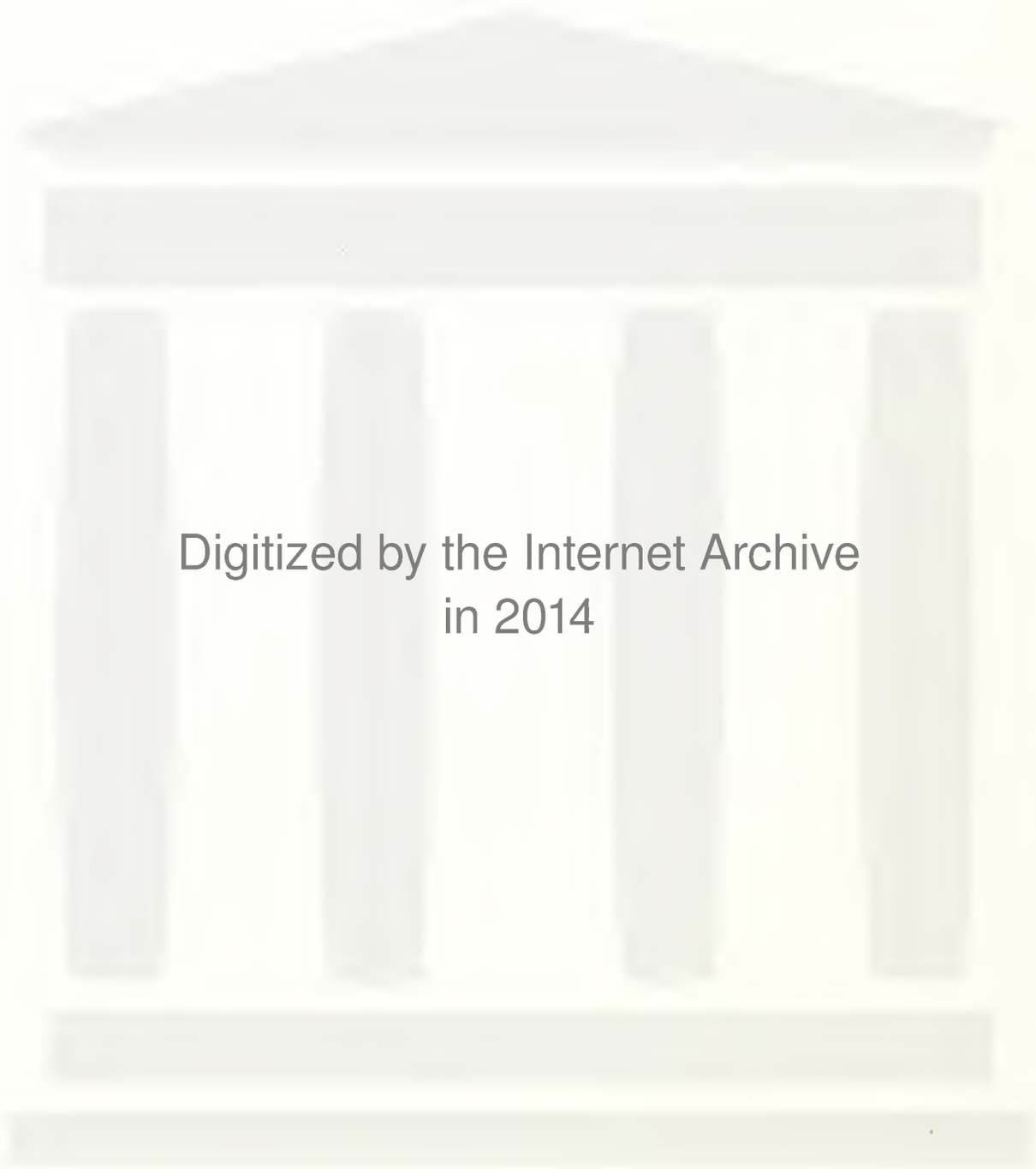
ABSTRACT

To many, the IBM-AT legitimizes the concept of microprocessor-based multi-user systems (MUS), much as the IBM-PC put a stamp of approval on corporate micros. Lacking mainframes, AT&T focuses on UNIX-based MUSs. Minicomputer vendors now offer scaled-down versions of their machines, microcomputer vendors are upgrading their machines, and component manufacturers are configuring MUSs based on standard, off-the-shelf subsystems. Independent MUS vendors face heavy competition from these sources.

There are a number of issues to be considered by users and vendors: what settings are most appropriate for MUSs, how they compare to other solutions, software availability, standardization, compatibility, connectivity, reliability, and cost benefits. This report addresses these and other questions and provides user implementation recommendations, market and technological trend analyses, and options for vendors. Twenty-four vendors are profiled and 26 products are described.

The report contains 197 pages, including 33 exhibits.



MULTI-USER MICRO SYSTEMS

CONTENTS

EXHIBITS

1 INTRODUCTION

I INTRODUCTION

A. BACKGROUND

- Microprocessor-based multi-user systems (MUS) fill the gap between microcomputers and minicomputers as systems designed for group, rather than individual, productivity.

- Microprocessor-based multi-user systems became available around 1980 due to increasing memory and higher processor speeds. MUSs fit the current trend away from standalone micros and toward integrated office systems.

- There is some user confusion about what settings are most appropriate for MUS solutions and why these systems are more desirable than Local Area Network (LAN) linked microcomputers or a minicomputer supporting multiple terminals.

- To many, the introduction of the IBM AT legitimized the concept of MUS, much as the IBM PC put a stamp of approval on corporate microcomputers. The AT will probably take a strategic role as a standard multi-user micro. At the very least, the product will bring more attention to MUS.

- In some respects, however, the AT is a latecomer in MUS, with other vendors' products having been on the market for approximately five years.

- Upon introduction, the AT only supported a single user.

- To date, the AT is primarily used as a powerful, standalone micro, with multi-user software coming months after hardware availability.

  - Its introduction is in keeping with IBM's observed strategy of entering no market before its time.

  - AT clones were quickly introduced to take advantage of limited AT inventories.

  - Entrepreneurs are offering enhancements, bringing multi-user capabilities to the AT before IBM fully develops the product.

  - IBM's desktop version of the System/36 small business computer more directly targets multi-user applications.

  - Other systems' AT compatibility will become as important as PC compatibility.

- Lacking mainframes, AT&T has focused its computer strategy on UNIX-based multi-user systems. Minicomputer vendors are introducing scaled-down versions of their machines for multi-user applications. Microcomputer vendors are upgrading their machines.

- The availability of standard components and third-party software means market entry barriers are low, encouraging several hundred vendors to participate.

- There are a number of issues to be considered by users and vendors in approaching multi-user systems: the availability of software, industry operating system and architecture standards, compatibility, connectivity, reliability, and cost benefits.

- Users are recognizing that sharing MUS computing power can be more cost effective than standalone micros and that sharing data and applications offers attractive efficiencies for the work group.

  - Price per user of multi-user systems is generally lower than the alternatives.

  - However, there are tradeoff issues, such as data security, system response time, user "independence," and the effects of a system failure on the entire work group.

- In addition to determining the proper use and placement of MUS are timing considerations. With the increasing power of micros and the sharing capabilities of LANs, what are the present advantages of multi-user systems for corporate information management?

- This report addresses this question as well as providing implementation recommendations, market and technological trend analyses, and strategic options for MUS vendors.

B. METHODOLOGY

- The research consisted of:

  - Client interviews.

    . INPUT clients were sampled to determine areas of special interest and to learn of their experiences, problems, and needs.

- Vendor interviews.

  . Structured interviews were conducted with vendor personnel from ten companies. The questionnaire used is in Appendix B.

- Corporate interviews.

  . Approximately 25 structured interviews were conducted with IS and Office System managers in June and July 1985. The questionnaire used is in Appendix C.

  . In addition, INPUT made several site visits to develop the case studies included in this report. The findings, with other information obtained from multi-user systems users, were used in the analysis.

- Product and service analysis.

  . INPUT collected and analyzed information on over 50 products, attended product demonstrations, and reviewed secondary research sources. Typical and unique multi-user systems are described in Appendix D.

- Proprietary studies.

  . INPUT has conducted a number of relevant custom studies. While no confidential information is revealed in this report, the experience obtained from these studies has been applied to the analysis and recommendations contained herein.

- Other studies.

  . Research conducted for other INPUT published studies has been used when appropriate to further understanding of the issues and markets discussed.

C. SCOPE

- This report, produced jointly by INPUT's End User and Market Analysis Planning Programs, is designed to help understanding of the technological, user, and market issues associated with multi-user systems.

- The study focus is general purpose, micro-based, multi-user systems and tends to exclude special purpose systems.

- It addresses the following topics:

  - Definitions of multi-user systems, comparisions to other systems, MUS office and market fit, communications analysis, and an operating systems review (Chapter III).

  - User experiences and issues, including case studies, economic analysis, software availability, performance factors, security issues, standards, features desired, and recommendations for implementation (Chapter IV).

  - Market forecasts, market trend analysis, distribution channel options, technological developments, competitive vendor analysis, vendor recommendations, and pricing trends (Chapter V).

  - Conclusions and summary observations (Chapter VI).

- Product profiles and a glossary of relevant MUS terms are in Appendices D and A, respectively.

D. RELATED INPUT REPORTS

- Interested readers are referred to the following INPUT reports:

  - Organizing End User Departments for Information Systems (1984) reviews the critical issues surrounding the surge of interest in end-user computing and examines the emerging role of IS as the director of this revolution.

  - Micro-Mainframe: End User Experiences (1985) describes various M-M methods, discusses their advantages and limitations, suggests implementation strategies, and projects changes in the technology and marketplace.

  - Micro-Mainframe: Corporate Impact (1985) describes the organizational and technological effects of M-M in the corporation in light of the growing demand of end user access to corporate data bases. The impact of M-M products on the current inventory of standalone micro and mainframe software is also analyzed.

  - Micro-Mainframe: Software Planning (1985) categorizes the M-M software products necessary to accomodate M-M access, with special attention on security and data integrity requirements. The report recommends a software development/acquisition strategy.

  - Micro-Mainframe: Market Analysis (1985) segments the market and provides projections for terminal emulation and intelligent packages. It also analyzes issues, events, and trends in the marketplace.

- Intelligent Workstations: Connecting the End User (1985) defines the tools, compares intelligent workstations with terminals and microcomputers, describes their benefits and limits, recommends implementation strategies, and identifies future usage, market, and technological trends.

- LAN/CBX: Planning for Change (1985) reports current experiences with these data and data/voice communications technologies and looks at the future of office-oriented communications devices.

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

- This Executive Summary is designed in a presentation format in order to:
  - Help the busy reader quickly review key research findings.
  - Provide a ready-to-go executive presentation, complete with a script to facilitate group communication.
- Key points of the report are summarized in Exhibits II-1 through II-6. On the left-hand page facing each exhibit is a script explaining the contents of the exhibit.

A. MICRO MULTI-USER SYSTEMS EVOLVED TO MEET NEEDS

- The first multi-user computers were mainframes operating under Time Sharing Option (TSO), introduced in the 1960s.

- The first dedicated multi-user systems priced within reach of small- and medium-sized businesses were minicomputers. These powerful and relatively expensive systems (costing over $50,000) allow computer resource sharing among numerous users.

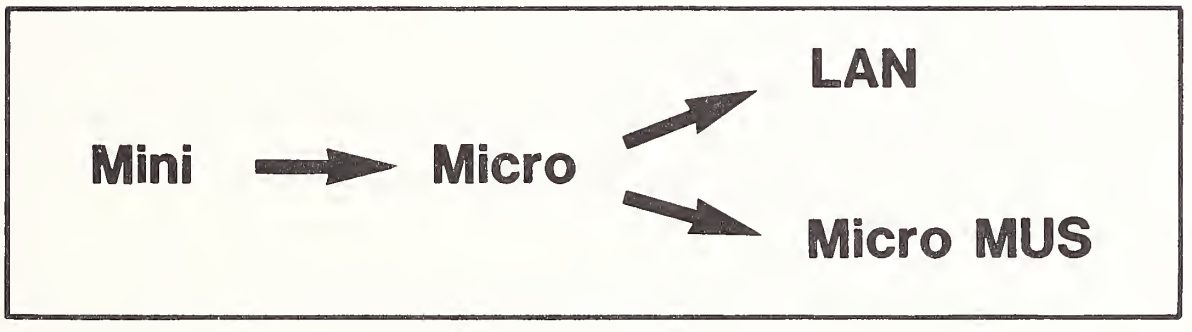
- Minis became less important to new users with the advent of microcomputers offering flexibility, personal productivity, and ease of use at an economical price.

- Multi-user systems based on microcomputers (MUS) now provide much (if not all) of a minicomputer's power in microcomputer architectures. Costing upward of $6,000, MUSs are less expensive than minis and allow better resource sharing than standalone micros.

- MUSs are most suitable for small work groups where a minicomputer is too expensive and too complex a solution.

- Local Area Networks (LANs) also provide resource sharing while allowing independent processing. LANs compete technologically with microprocessor-based multi-user micros, but are currently more costly on a per user basis than a MUS; they are also slower and harder to configure, install, and manage.

MICRO MUSs EVOLVED TO MEET NEEDS



B. KEY MUS BENEFITS ARE SIGNIFICANT

- The primary MUS value is economy; per user costs are lower than for comparable standalone micros, LAN-linked micros, or minicomputer-based systems.

- Secondly, MUSs economically share computer resources in the form of peripherals and data among work group members.

- However, MUS users must give up system independence; they generally share a central processor, and in multiprocessor systems they share a common bus. This sometimes leads to system response time degradation and means that system failure affects all users.

- A third value is the packaging of MUS hardware with industry-specific software for specialized problem solving. Vendors are paying more attention to value-added sales channels and niche strategies, selling systems for targeted applications not well served by general software packages.

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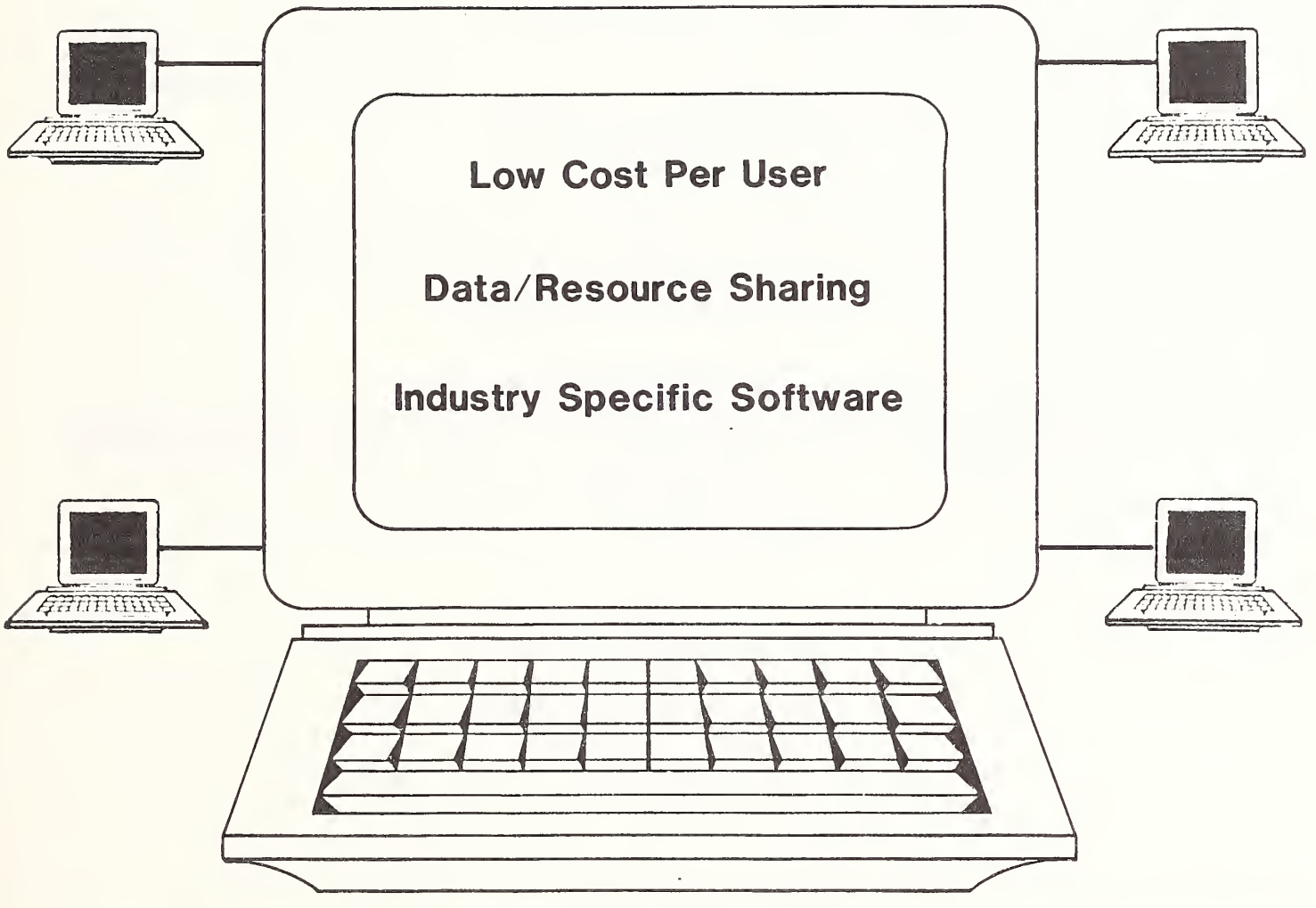
KEY MUS BENEFITS ARE SIGNIFICANT



C. MULTI-USER PRODUCTS COME FROM FOUR COMPETING SOURCES

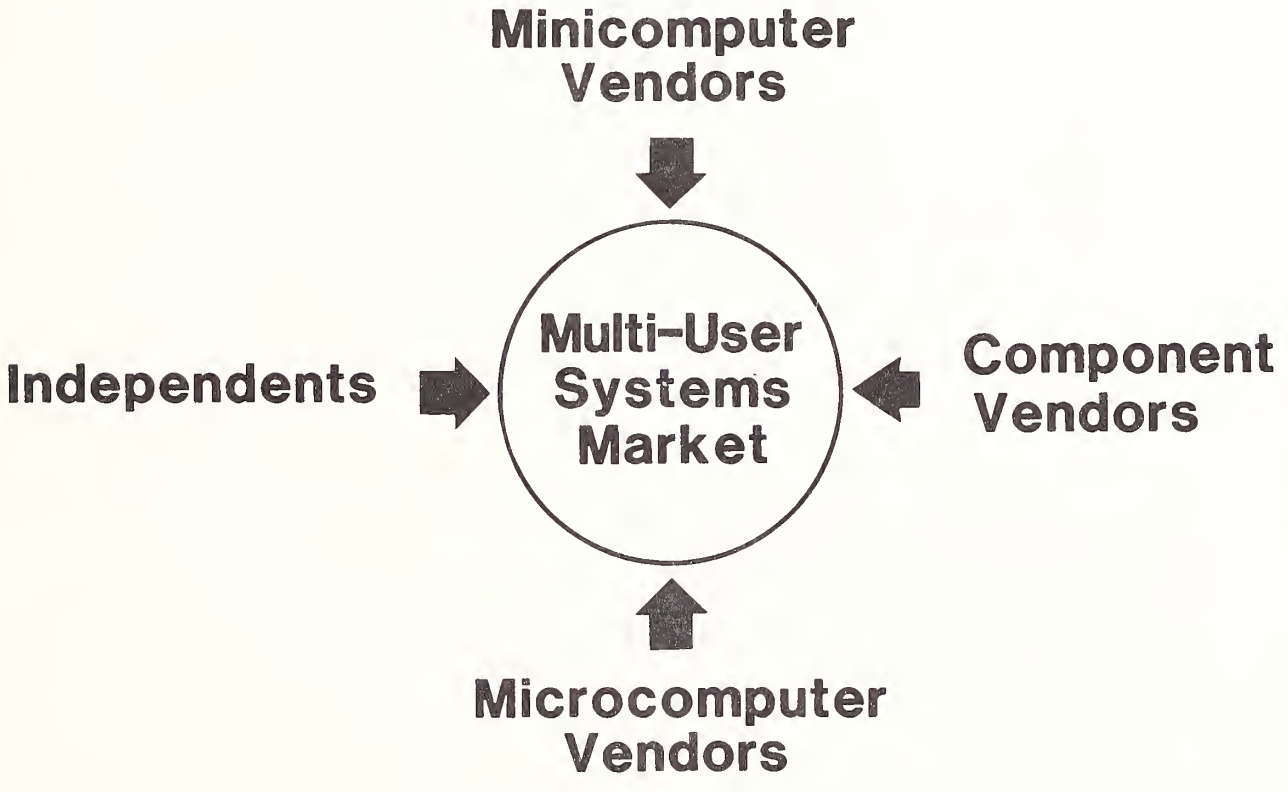
- Independent MUS vendors, such as Altos and Fortune, recognized the opportunity for low-cost, work group oriented systems. They entered the market in the late 1970s and early 1980s.

- Minicomputer vendors such as DEC have more recently recognized the MUS threat to their primary products and are now offering downsized, less expensive versions of their systems.

- Microcomputer vendors are upgrading their hardware with multi-user capabilities, offering both a full family of compatible computer solutions and an upward migration path for captive user installations.

- The fourth source, component manufacturers, are building their own systems based on standard, off-the-shelf subsystems. The low barriers to entry means heavy competition, especially in the under-four user segment.

MULTI-USER PRODUCTS COME FROM FOUR COMPETING SOURCES



D. THE MUS SEGMENT OF THE MICROCOMPUTER MARKET IS GROWING

- Currently, a few vendors share most of the market for microprocessor-based multi-user systems: Convergent Technologies, IBM, AT&T, Altos, Fortune, NCR, Onyx, and Tandy.

- While no market leader has yet emerged, MUS technical standards are centering on the UNIX operating system, the Motorola 68000, and the Intel 80286 series of microprocessors.

  - The IBM AT, designed to support up to three users, will become the most prevalent MUS. However, a majority of installations will be using the AT as a powerful, single-user system.

  - The IBM PC-2 will probably be a single-user version of the AT.

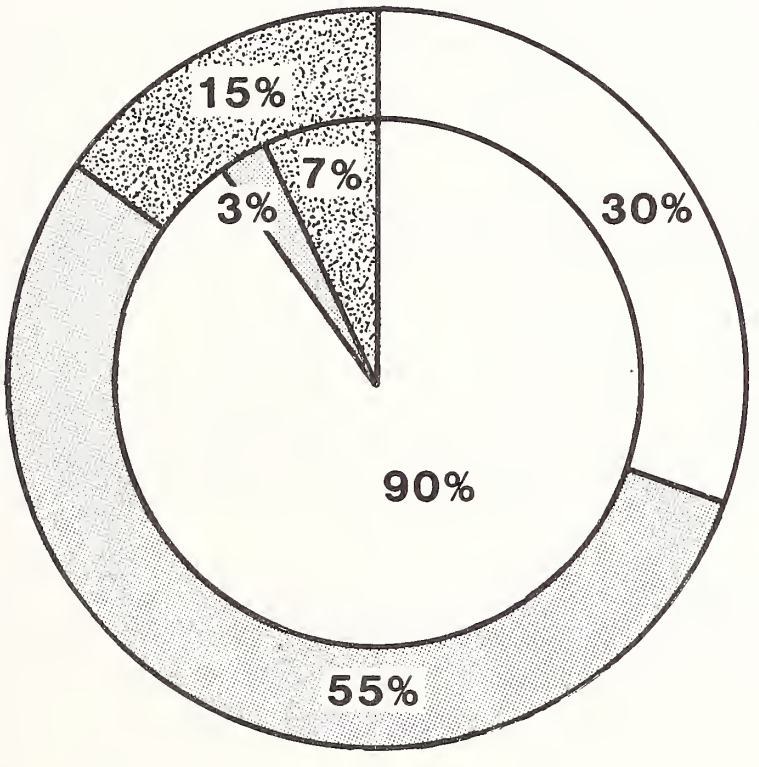
  - Other microcomputer compatibility with the AT will become as important as PC compatibility.

- By 1990, market shares will change due to new market entries and the results of smaller companies merging.

- The MUS segment of the microcomputer market is now estimated at 7%, or an estimated 400,000 installed units (1984). This segment will become 15% of the microcomputer market by 1990, representing an installed base of three million units.

- MUS segment revenue will grow at a 17% compound annual growth rate, becoming a $2.9 billion industry by 1990.

THE MUS SEGMENT IS GROWING



MUS
LAN
Standalone

Inside - 1984, 5.7 Million Units

Outside - 1990, 19.9 Million Units

E. THE MUS VENDOR's WINDOW OF OPPORTUNITY MAY BE CLOSING

- MUS vendors have an opportunity to capitalize on economical solutions to office system problems, especially in smaller, previously uncomputerized businesses and corporate departments.

- However, the window of opportunity may be closing.

  - Sharing information and peripherals can be accomplished through other means: LANs, physically moving floppy disks, and using switch boxes.

    . LANs will eventually emerge as a better solution due to lowering costs, standardized technologies, and easier usage and installation.

    . Fiber optics will make cabling costs inconsequential as services are integrated on high capacity, high speed links.

  - MUS vendors need to combat the psychological dynamic of users wanting individual processors. More powerful micros are now available at lower costs, and they can be linked on LANs.

  - Vendors must also counteract the fact that a MUS central processing unit or bus failure affects all users, rather than an individual user as with a microcomputer failure.

- Finally, independent vendors need to contend with the intention and ability of IBM (and in the longer run, AT&T) to dominate the MUS market.

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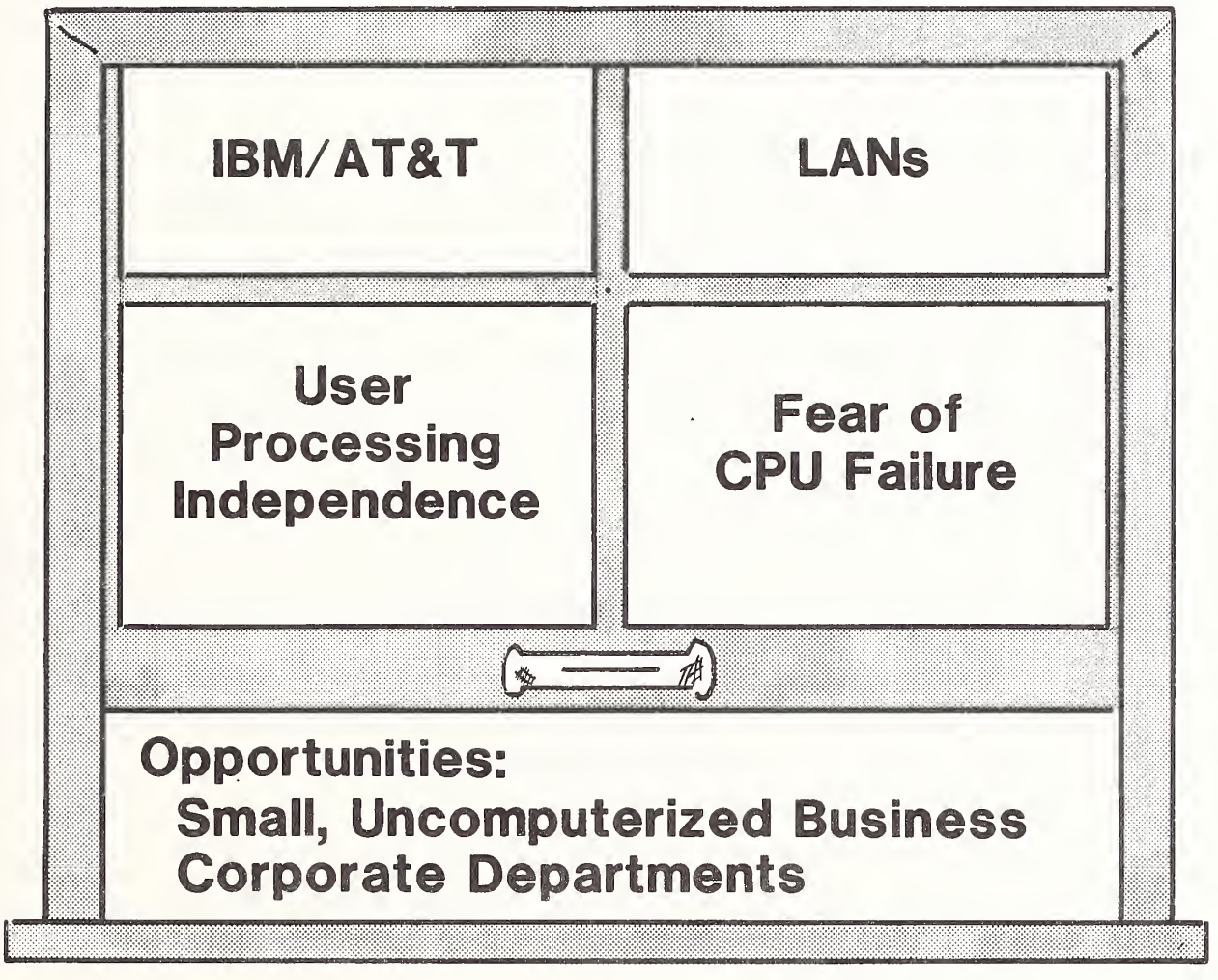
THE MUS VENDOR'S WINDOW OF OPPORTUNITY MAY BE CLOSING



F. MUS VENDORS: LEVERAGE STRENGTHS AND FORM ALLIANCES

- Smaller vendors need to leverage distribution through Value Added Resellers and OEM customers to develop targeted markets overlooked by major vendors, who often lack the flexibility to capitalize quickly on emerging opportunities.

- Smaller vendors also need to consider strategic alliances, acquisitions, and mergers to broaden product lines and build synergistic strengths.

- Larger vendors need to work to improve retailers' abilities to configure complex MUS systems and provide after-sale support. Retailers are vitally important in small business sales.

- Minicomputer vendors need to position their MUS offerings to replace obsolete minicomputers while evaluating the impact of this migration path on their principle products.

- All vendors need to differentiate their products and develop unique corporate identities to stand out in a competitive arena.

- Creative marketing is needed using cable television, industry publications, business broadcasts, videotex, and telemarketing.

- Vendors need to determine their IBM strategy: should they co-exist by supporting IBM micros and mainframe connections or compete on price and with value-added features?

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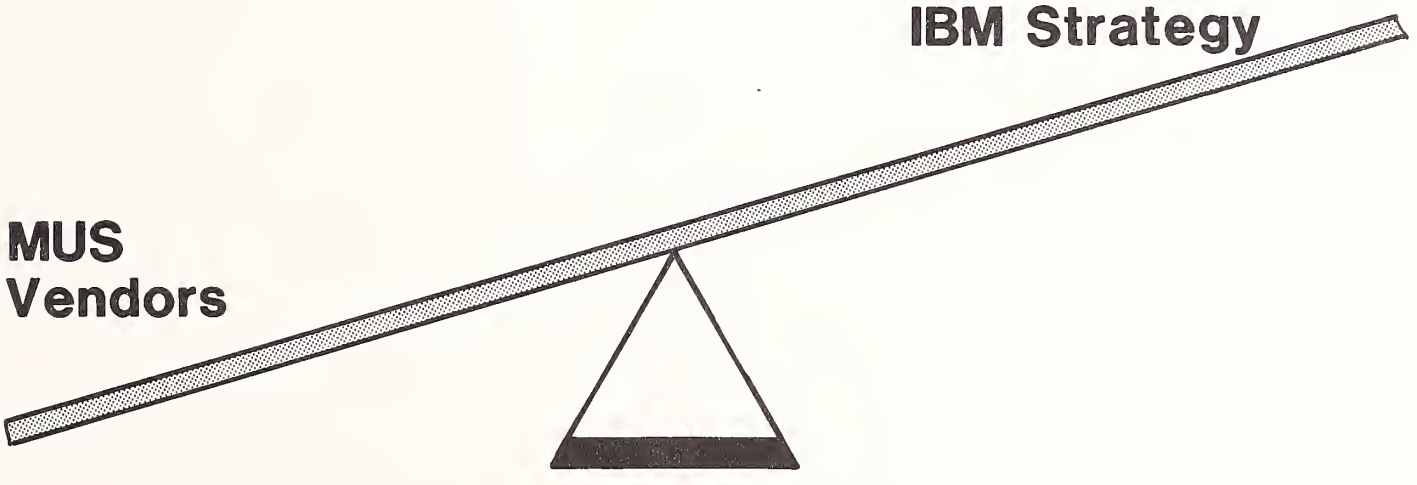
MUS VENDORS: LEVERAGE STRENGTHS AND FORM ALLIANCES

VARS, OEM, Retail

Strategic Alliances

Differentiation

IBM Strategy



III DEFINITIONS, APPLICATIONS, AND OVERVIEW

III DEFINITIONS, APPLICATIONS, AND OVERVIEW

- Until approximately 1980, minicomputer-based multi-user systems, costing between $50,000 and $100,000, were available to small- and medium-sized businesses. With the introduction of less expensive microcomputers, the importance of minis to new users subsequently declined.

- Microcomputer multi-user systems, priced starting at approximately $6,000, are being targetted to corporate work groups and smaller businesses.

- Understanding how MUSs fit specific information management needs requires a comparison to related technologies and an analysis of their relative benefits and limitations.

A. MULTI-USER SYSTEMS DEFINED

1. DEFINITION

- INPUT defines multi-user systems (MUS) as microcomputers which have added processing capacity and storage, operating system, and other capability enhancements intended to support a small number (2-32) of uses concurrently, for group, rather than individual, productivity.

- MUSs support multitasking with different programs running at the same time.

- MUSs are based on microprocessors, while minis are based on discrete board-level logic. Other differences are discussed below in Section B-3.

2. SINGLE SHARED PROCESSING UNITS

- MUSs use time-slicing control techniques with processing and memory divided between users. Single central processing units are often shared, lowering per user costs.

  - These shared logic systems work best when all users work with the same application.

  - Response time degrades as the number of users increases or if an application requires a large amount of memory, as in spreadsheets.

  - Failure of the MUS CPU affects all users.

  - Because of limited processing capability, shared single CPU MUS systems cannot be expanded beyond four to eight users.

3. MULTIPROCESSOR UNITS

- Alternatively, each user may be assigned an individual processor, one of several available processors housed in the same unit, or a processor integrated in an associated intelligent workstation with the main CPU handling disk and memory management functions. This type of system is called a multi-user, multiprocessor system (MUMPS).

- MUMPS have better response time and can support more users than shared logic systems.

- The failure of one processor will not usually affect the entire system.

- Expansion is easier.

- Exhibit III-1 is a schematic illustrating the differences in MUS architectures.

4. COMMON CHARACTERISTICS

- Standard components are often used to build MUSs, including a standard bus which carriers data internally among the components.

- Processing cycle times are generally between 6 MHz and 12.5 MHz.

- Peripherals such as disk drives, printers, and modems are shared, but each user is assigned an individual terminal.

- Although 8-bit processors can be used, 16- and 32-bit processors are now more common and are required to address larger memories and faster operations. Some MUSs have dual or multiple central coprocessors to accomodate a variety of available software, including that written for micros or minicomputers.

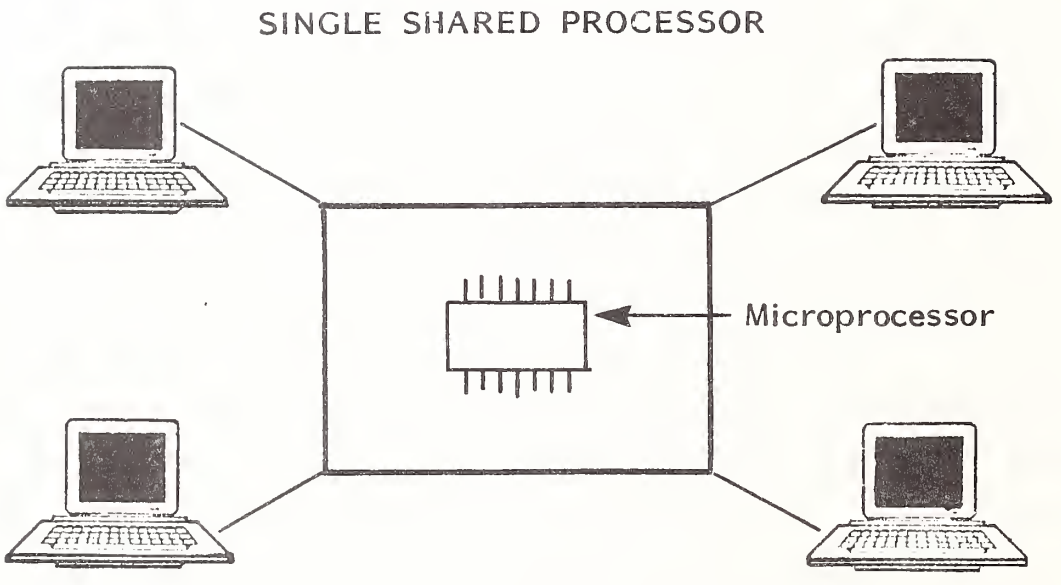
- Terminals are linked to the CPU with twisted-pair wire and standard RS-232 interfaces.

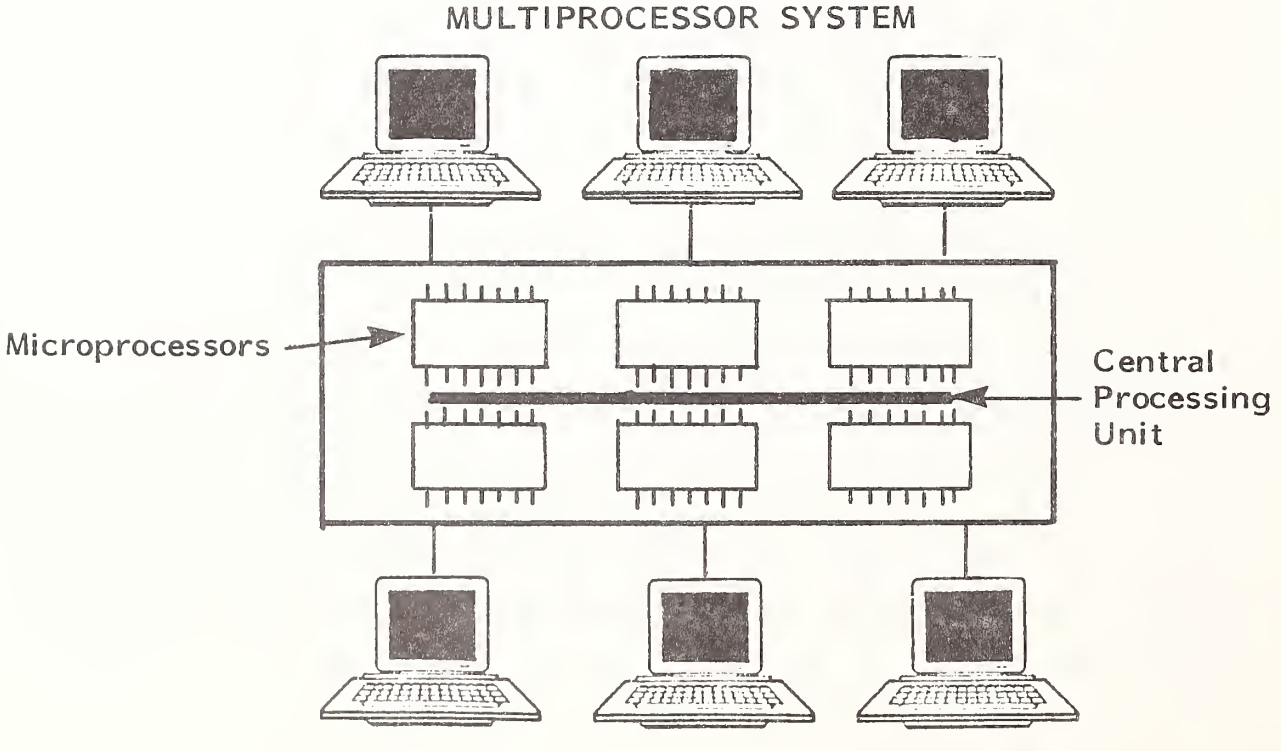
- MUSs can be upgraded with the addition of memory boards for additional terminals at about half a microcomputer's cost.

- Many MUSs provide access to standard operating systems, such as MS-DOS, through their own proprietary operating systems, expanding software availability.

EXHIBIT III-1

SINGLE VERSUS MULTIPROCESSOR
MUS ARCHITECTURES





- Other terms used to describe MUSs are "supermicros" (applied to 32-bit machines) and "micro-minicomputers," although these systems may use board-level logic rather than individual microprocessors. Both terms also describe powerful single-user systems and those intended for special applications. Nevertheless, these descriptions support MUS positioning between micros and minicomputers.

- Micro multi-user systems are defined in Exhibit III-2.

B. MUS COMPARED TO ALTERNATIVES

1. MUS COMPARED TO STANDALONE MICROCOMPUTERS

- The most significant differences between MUS and standalone micros are:

  - A micro does its own processing whereas a terminal associated with a MUS either does not or has limited processing capabilities, depending on its intelligence.

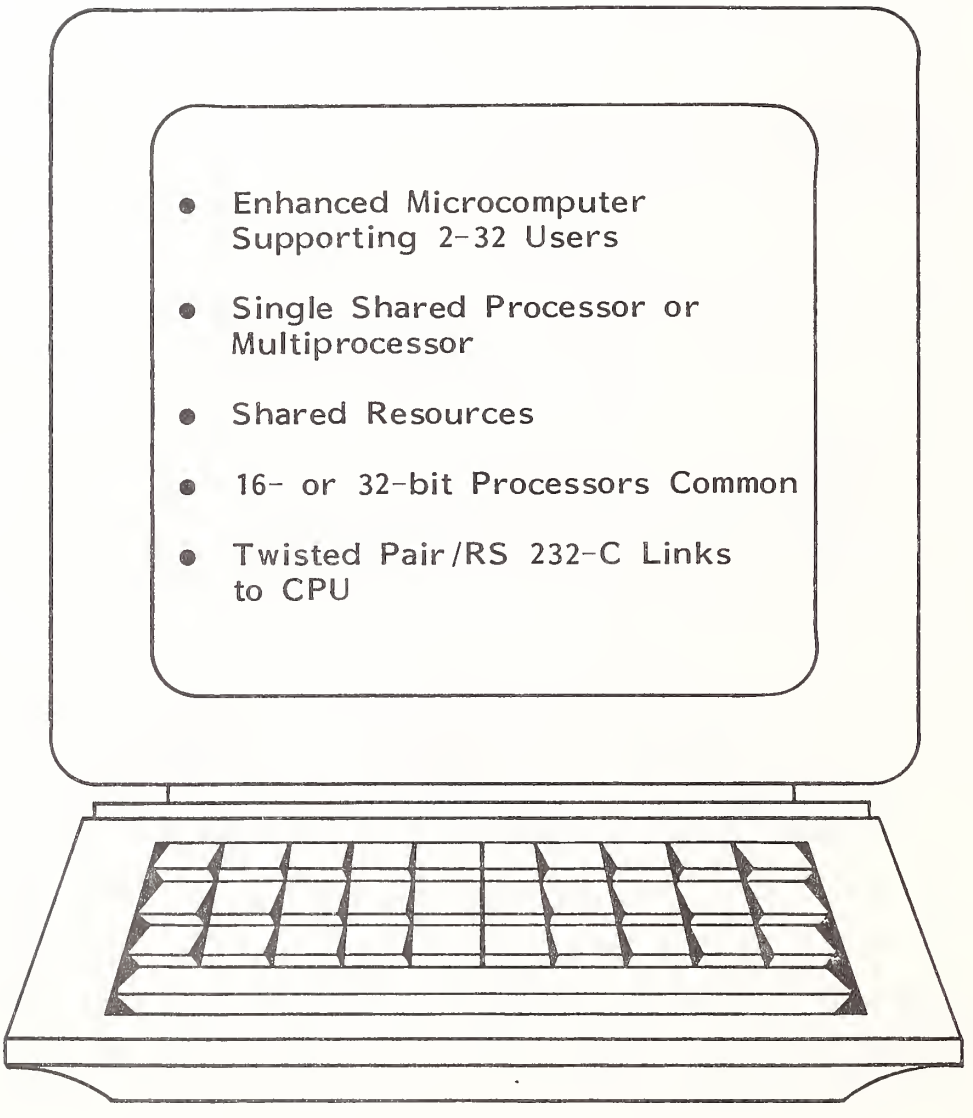
  - Standalones do not share data (except by physically moving a floppy disk from one computer to another) or peripherals (except by physically changing cable connections).

  - Standalones dedicate processing to one user and are more expensive on a per user basis than a MUS.

  - If a microcomputer fails to operate, only the single user, who can move to another unit, is affected. With a single processor MUS failure, all system users are affected and there may not be an available backup. Even multiprocessor systems are susceptible to a bus failure affecting all users.

EXHIBIT III-2

MICRO MUS DEFINED



- Standalones are flexible, with abundant available software. They can be configured for a specific job. MUS software is relatively limited at present and special needs may require customized solutions.

- Micro-mainframe or external links require individual cables, whereas a MUS needs only one connection for all system users.

- In the past, microcomputer acquisition was categorized by uncoordinated purchasing leading to system incompatibility, adversely affecting work group productivity and effectiveness. IS is now in a position to correct this problem, with better control of future acquisitions.

- Individual micros can be detrimental to work group productivity since multiple personal files do not feed into group results. Micros are "personal" computers, improving individual performance, rather than "business" computers optimized for work group or corporate productivity enhancements.

2. MUS COMPARED TO LAN-LINKED SYSTEMS

- Conceptually, a LAN is a multi-user system except that processing is distributed to individual, full-function, networked micros.

  - Data and peripherals are shared among network users. One networked micro or a communications server can serve as a gateway for outside links.

  - Per user LAN implementation currently costs more than an equivalent MUS due to individual micro costs, the need for LAN cabling, network controller cards, and system management software. This will change in the future.

- However, existing hardware and software can be used and incompatible machines can often be linked, thus protecting previous investments.

- LANs use sophisticated circuitry and software to share resources. LAN configuration can be difficult, especially as the number of users grows.

- Since independent processing is taking place, there is no response time deterioration affecting other users; however, data transfers through the LAN are slower than through a MUS.

- Locking, which prevents file revison by simultaneous users (and thus multiple, erronous copies), is often missing on LANs. This means LANs are generally unsuitable to high volume transaction applications.

- The LAN pieces may be available only from multiple vendors. MUS components can be purchased from a single source, providing service and support advantages.

- Sophisticated LANs can handle many more (100+) users than MUSs. This may be a deciding factor in selecting a multi-user approach.

3. MUS COMPARED TO MINICOMPUTERS

- Minicomputers can be technically classified as large multi-user systems and the line separating the two is unclear. MUSs combine the power of minis with micro ease of use. Minis are based on board-level logic while MUSs depend on microprocessors.

  - Minicomputers were originally designed for scientific and engineering applications and later added office system features. Due in part to this evolution, minis often require system specialists for management and support. Vendors supply more support for minis than is generally provided for micros or MUSs.

- Minicomputers usually use proprietary hardware and software while MUSs tend to rely on standard processors such as the Motorola 68000 and operating systems such as UNIX.

- Minicomputers are suitable for small to medium companies or for use as departmental processors in a distributed data processing environment (DDP).

- While similar to MUSs, minicomputers generally support more users (32-100+) and may be too large, too expensive, and too complex for a particular need.

- Minis are generally priced between $50,000 and $200,000, while MUSs are generally priced between $6,000 and $50,000.

- MUSs are compared to standalone micros, LAN-linked systems, and minicomputers in Exhibit III-3.

4. THE ROLE OF MUS IN DISTRIBUTED DATA PROCESSING (DDP)

- MUSs have a place in the DDP world, filling the middle ground between minicomputers and standalone or LAN-linked microcomputer configurations and fitting small work unit needs cost-effectively. However, most MUSs support office functions such as word processing and data base management. They are not used for extensive data processing.

- MUSs are intended for work groups. The ability of the system to interact with larger company computers, while often supported, is not currently central to their design.

  - Data may not be in suitable formats for easy integration with other systems or applications without conversion.

EXHIBIT III-3

SYSTEM COMPARISONS

	MUS	STANDALONE MICROS	LANS	MINI
Basic System Costs	$6,000-50,000	$3,500-5,000	$4,000+ per User	$50,000-200,000
CPU Failure Effect	All Users Affected	One User Affected	Other Users Unaffected	All Users Affected
User Orientation	Work Group	Personal Use	Work Group	Work Group
Effects of Increasing Users on Response	a. Shared Processor: Response Time Increases b. Multiprocessor: No Effect	N/A	None or Limited Effect	Limited Effect
Components	Usually Standard Microprocessors and Software	Same	LAN Elements are Proprietary	Proprietary
Operating Systems	UNIX and UNIX Clones, M/PM, Oasis, PICK, or Proprietary	MS-DOS, CP/M	Same as Stand Alone Plus Proprietary LAN Operating System	Proprietary
Number of Users Supported	2-32	One	Unlimited	32+

- Communications speed may be limited to, for example, 9,600 bps, slowing large file transfers (similar to the limits of micros).

- MUSs are also unsuitable when large amounts of processing and storage are needed. In these cases, a larger mini or mainframe computer should be used.

5. POSITIONING MUS IN THE CORPORATION

- MUSs offer a cost effective way to share data files and applications with a limited number of end users in departments or field offices.

- The concept of the work group, where individuals share the results of their efforts with limited external interaction, is important in understanding how MUSs fit specific needs.

  - A work group is a team charged with specific departmental responsibilities. It usually consists of:

    . Executives, ranging upward from vice presidents, who receive summary information and communicate verbally, in person or by telephone. They need to access corporate data and distribute information quickly, and maintain close working relationships with support staff.

    . Managers spend over half their time communicating with subordinates, peers, and superiors. They need access to policy and procedures, personnel files, and productivity tools such as project management schedules.

    . Professionals are first-line supervisors, sales/marketing personnel, project managers, analysts, and financial and legal staff. They need to access personal and corresponding files and

external information. They also edit, store, retrieve, and manipulate new information that they and other work group members create.

. Support staff includes secretaries who focus on form and processing rather than content. They need efficiency tools to speed turnaround time on revised documents.

- The work group benefits most from the features offered by multi-user systems because of the ability to share information and peripherals.

- Exhibit III-4 illustrates work group functions and relationships.

6. POSITIONING MUS IN THE MARKET

- MUSs were originally introduced by independent manufacturers to meet small- to medium-sized company needs for shared processing and data and to fill a perceived hole between micros and minicomputers. MUSs are now being sold to meet departmental needs within larger corporations.

  - Microcomputer vendors are offering upgraded versions of their stand-alone systems as MUSs. Examples include the IBM AT and the Tele-Video Personal Mini.

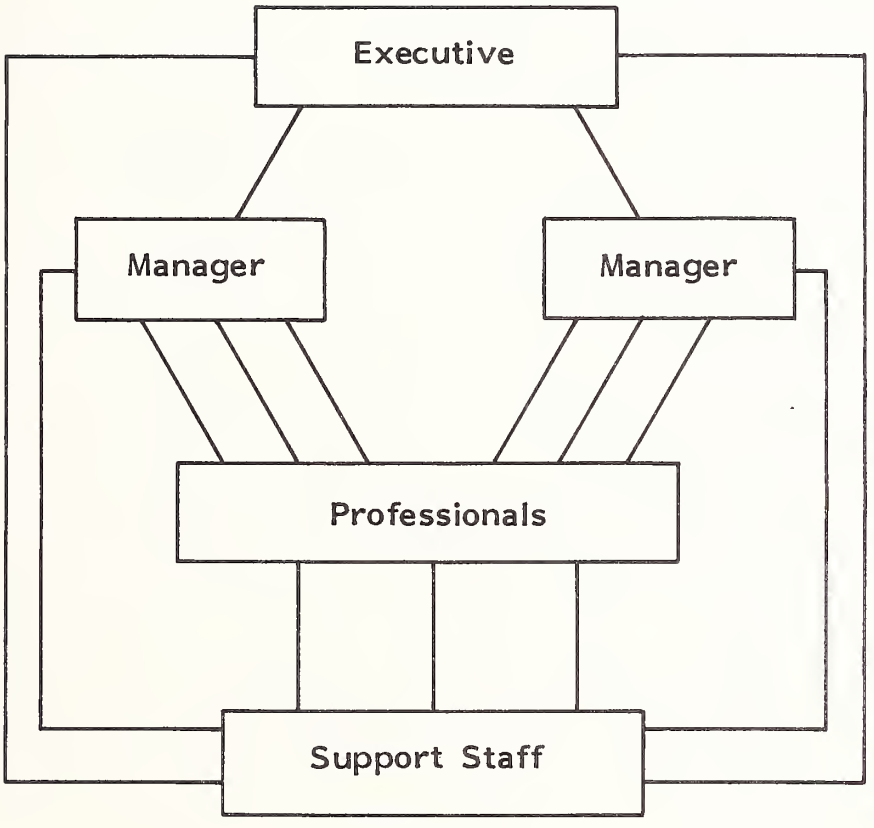
  - Minicomputer vendors have introduced downsized versions of their products to meet the competitive threat from independent vendors building products from standard components and third party software. An example is the DEC MicroVAX 2.

- Micro and mini vendors now participating with MUSs are responding to market pressures and attempting to maintain overall market share.

- Exhibit III-5 shows MUS positioning compared to competitive technologies.

EXHIBIT III-4

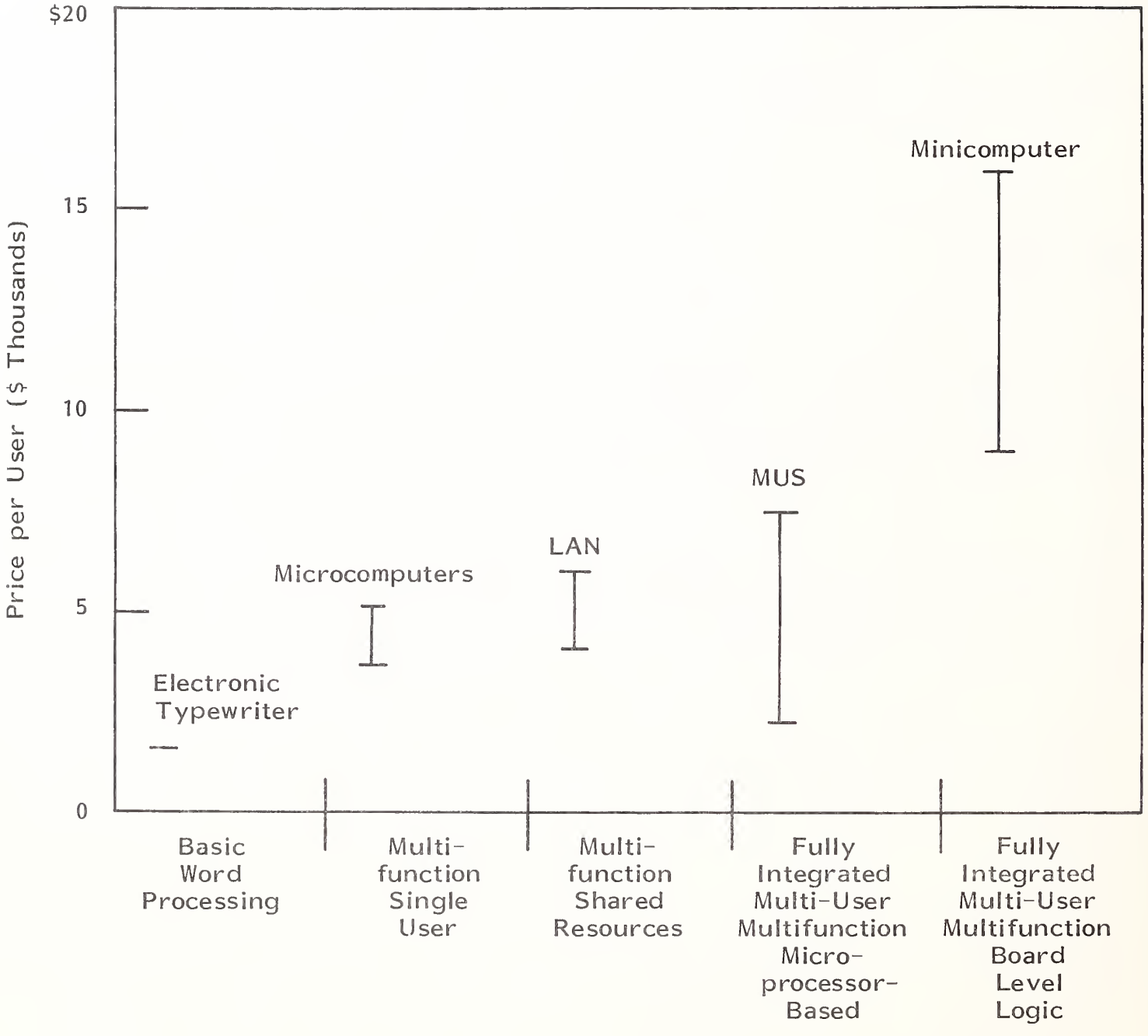
WORK GROUP FUNCTIONS



- Verbal Communications
- Summary Information
- File Access
- Productivty Tools
- Internal/External Information Access
- Create/Manipulate New Information
- Form Over Content
- Efficiency Tools Needed

EXHIBIT III-5

MULTI-USER SYSTEMS POSITIONING



C. COMMUNICATIONS AND CONNECTIVITY

- Full function microcomputers (as opposed to terminals) can often be connected to MUSs, making use of system storage and peripherals while also serving as standalone intelligent workstations.

- MUSs can be linked together through proprietary or other vendors' local area networks, making files and applications located anywhere on the network available to the individual user.

- Many MUSs support common communications protocols (3270 Bisynch terminal emulation, SNA, X.25, 3780) to submit batch files for remote mainframe execution and for network connections.

- Connections are also possible through corporate PBX equipment, and some MUSs provide voice mail functions along with text and data processing.

- Exhibit III-6 shows MUS connectivity options.

D. OPERATING SYSTEMS COMPARED

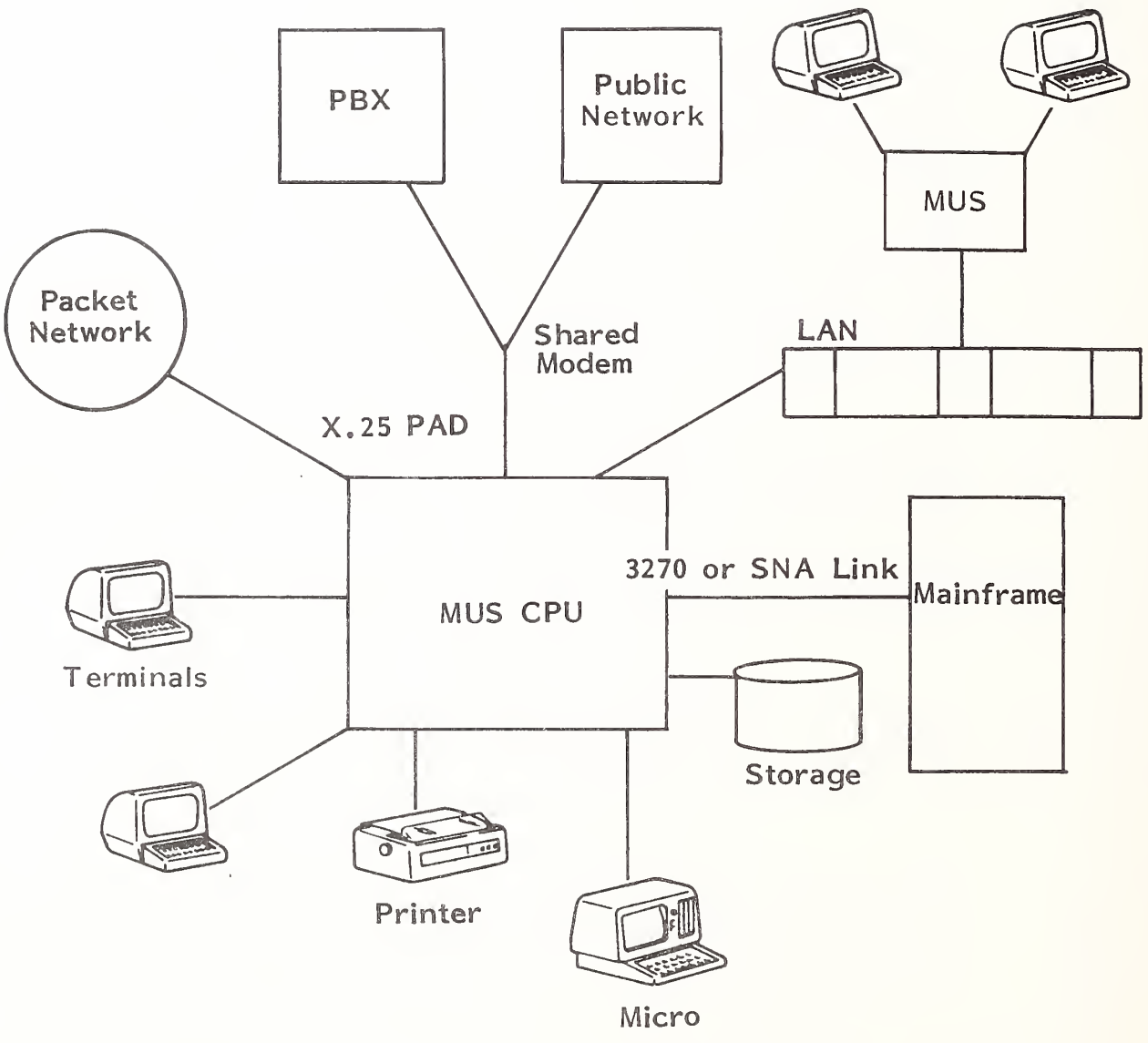
- Multi-user operating systems (OS) selection relates to the number and variety of available applications and the ability to upgrade hardware while protecting software investments.

- Most multi-user operating systems have been adapted from mainframe and minicomputer OSs.

- MUS operating systems are designed to control shared access to the CPU and storage. Some MUS manufacturer's OSs are proprietary, although they may be

EXHIBIT III-6

MUS CONNECTIVITY OPTIONS



based on one of the systems described below. Proprietary operating systems work to capture a customer base for whom hardware changes means expensive conversions.

- A MUS may support several operating systems. Links through a proprietary OSs to popular micro operating systems expand software availability but require the user to master additional commands.

- Only the major MUS operating systems are described in this section.

1. UNIX

a. Background

- Developed by Bell Labs, UNIX comes in many versions and variations, such as Microsoft's XENIX. Considering all of its implementations, UNIX is the leading MUS operating system. UNIX is viewed by many observers as an alternative to IBM's dominance of information systems technology.

- AT&T's policy of inexpensive ($150) university licensing has led to a degree of system familiarity. However, in 1984 and 1985 INPUT surveys of IS departments, the importance of UNIX to organizational plans was rated below 2, with 5 being the highest rating.

b. User Perceptions

- Some typical comments from those rating UNIX low were:

  - "We have no priority on UNIX and we have no people who have been trained in it. We just don't see any need to change from what we have."

- "There is uncertainty about its future acceptance by the industry. I can't see any use for UNIX-based applications here."

- "We're just learning about UNIX. As far as I'm concerned the jury is still out."

- "We're driven by software availability. In the banking industry, we use MS-DOS, not UNIX. It's an ugly language to the end user. You have to put 'shells' around it."

- "It requires a skilled professional. We think it's unnecessary to add new operating systems here, especially that one. It requires too much memory and it's expensive. We have no need for the functions it provides. Besides, its hard to implement in an IBM world."

- "We've tried it and we're throwing it out. It's terrible! So expensive, and the overhead! It really chews up memory and cycles. It doesn't perform to our satisfaction and it's not user friendly. It really requires a professional user."

- Many negative respondents commented that they rated UNIX low because they are strictly IBM shops, even through IBM has its own versions for mainframes (supported under VM) and PCs.

- Typical comments from the surveyed minority who rated UNIX highly are:

  - "We will use it, but only in our multi-user systems. Others have led us to believe it will be important."

  - "We see it as a fill-in for IBM's inadequacies. We will be experimenting with it soon."

- "UNIX is the only one that can use multiple mainframes. I think it will become important, especially for multitasking and for the power it offers."

c. UNIX Will Share the Standard Label

- In spite of its developmental history and AT&T's reported expenditure of $3.5 million on awareness advertising over the past year, the general lack of UNIX familiarity is clear.

- This does not necessarily mean that UNIX will fail, only that as a "standard" operating system UNIX will probably have to share that label. For it to gain significant market share, vendors will need to continue their awareness campaigns and continue UNIX improvements to overcome shortcomings reported below.

d. UNIX Advantages and Disadvantages

- Two UNIX terms need to be defined to aid understanding of the operating system.

  - The "kernel" controls hardware resources and basic file management. It can be optimized to match CPU sophistication and can manage multiple devices.

  - A "shell" surrounds the kernel and acts as an interpreter between operating system and user with menus or help screens. A shell interprets keyed commands to execute programs.

- UNIX has some very positive characteristics:

  - UNIX incorporates over 200 utilities for word processing, editing, and other functions for software development.

- Since it transfers easily from one computer to another, it is vendor independent. This means users can upgrade to more powerful machines and use existing software.

- If used on micros, minis, and mainframes, only one user interface needs to be learned.

- In a UNIX network, server functions can be handled in the background while applications run in the foreground.

- AT&T provides training and support to hardware and software vendors that license the UNIX operating system.

- AT&T's policy of inexpensive university licensing has created a pool of computer science graduates (AT&T says 90%) who have been exposed to UNIX.

- However, there are a number of disadvantages to UNIX.

  - Although it can technically support many more, in its original form UNIX works best with three to five users running COBOL or BASIC applications. UNIX System V, used on multiprocessor hardware, overcomes this limitation.

  - There are 25 commercial versions of UNIX and an equal number of UNIX clones, with manufacturers adding extentions to enhance business applications usefulness. These versions are often incompatible, causing user confusion and hampering software development.

  - Because it was designed for software development and scientific applications, the user interface is considered "unfriendly." Missing are important business functions (e.g. file locking). Newer versions of

UNIX address this problem. Shells can be adapted to special needs, but this is not unique to UNIX. Shells may also reduce system efficiency.

- Record and file locking features which prevent multiple revisons of an open file are poor. Expert programmers can break into the most well-protected UNIX files, a serious security problem. Newer versions of UNIX (e.g., XENIX) address this problem.

- UNIX minimally requires 1.5 M-bytes of disk storage, often cramping other needs.

- UNIX applications are written in C language which produces less efficient code than assembly language.

- Scientific UNIX applications are available, but business applications are difficult to locate since there is no clear distribution path. There are approximately 600 scientific and business packages available.

- UNIX software has often been adapted from minicomputer versions and tends to be less functional and more costly than other software.

- The UNIX MUS kernel does not inherently offer "realtime" capabilities without major modifications. This causes some UNIX features to be omitted and processing to be slowed.

  . Realtime is when a system responds to changes within a specified short time, compared to batch, time-shared jobs.

  . UNIX is difficult to use for transactions or for voice and image digitization because of this limitation.

  . AT&T is offering realtime versions for mini and mainframe computers which will eventually benefit MUSs. This also means even more UNIX variations.

- Documentation is very technical. System specialists are needed for software maintenance.

- Many of these problems are being addressed.

  - System V is emerging as the one UNIX standard. AT&T and Microsoft (developer of XENIX) have entered a joint development agreement to make XENIX, based on System III, more compatible with System V. The new version is called XENIX V.

  - The user interface is being improved with shells.

  - More powerful chips can accomodate UNIX's memory demands. AT&T, as well as other manufacturers, is working to encode the operating system on a single chip.

  - Realtime languages and kernels for MUS will eventually become available.

  - Several companies have developed "bridge products" to alleviate the software availability problem with DOS and UNIX applications running concurrently in configurations linking a UNIX MUS with a DOS micro.

- The benefits and limits of UNIX are shown in Exhibit III-7.

e. IBM and UNIX

- Since the 1970s, IBM has been offering VM/IX, a UNIX mainframe product intended for engineering, scientific, and research environments, to gauge demand for mainframe UNIX.

EXHIBIT III-7

UNIX OPERATING SYSTEM

ADVANTAGES	DISADVANTAGES	FUTURE DEVELOPMENTS	VENDORS SUPPORTING
Vendor Independent: Portable Over 200 Utilities Supports Customization AT&T Plus Growing IBM Support One User Interface for all Computers Computer Science Graduate Familiarity	50 Versions and Clones Hampers Compatibility Requires Shells to Ease Use Poor Record/File Locking High Storage Requirements Limited, Costly Software Limited Realtime Capabilities Technical Documentation	UNIX V and XENIX V as Standards New Chips Meet Storage Needs Realtime Kernals Bridges to Other OS Software	AT&T, ALTOS, IBM, Fortune, Morrow, ONYX, Plexus

- More recently, the company implemented several versions of UNIX: CPIX for telecommunications, IX/370 derived from Version VII, IX/370 derived from System III, Xenix from Microsoft, and VM/IX. These are in addition to Time Sharing Option (TSO), an early mainframe UNIX-like operating system.

- UNIX V will be available for the IBM Sierra mainframe, replacing VM/IX. IBM's PC-UNIX version (PC/XT) is based on System III whereas AT&T is now backing System V. Xenix will be available for the PC/AT, but files created under PC/IX and Xenix are not compatible.

- IBM's UNIX strategy is unclear. It may represent ambivalence toward the UNIX marketplace, a response to user interest, or an attempt to "hedge its bets" with UNIX, particularly for U.S. government and military markets where IBM lacks strength and where UNIX is often required.

- IBM has established a small task force for long-range planning and marketing support of the company's UNIX implementations.

  - This may signal intent to ultimately control development of the operating system and a prelude to System V availability on new micros competing with AT&T products.

  - However, a more conservative view sees the task force formed in response to anticipated competition from Amdahl's UNIX mainframes. AT&T has entered an agreement with Amdahl for UNIX System V support.

- IBM is understandably reluctant to support rival AT&T's product, but equally reluctant to pass up what may prove a promising area.

f. Analysis

- Some MUS vendors are offering UNIX due to users' perhaps inflated image of the operating system. There's a desire to give the customer what he wants.

- However, AT&T's continuing efforts behind UNIX and the support of other computer vendors (to a degree now including IBM) means the operating system must be considered by users and vendors, at least as an option on multi-user, multitasking, networked machines.

2. PICK

- Originally developed to provide an extremely user-friendly interface and recently improved, PICK is a viable alternative to UNIX.

- It is supported by approximately 17 MUS and minicomputer vendors, including Altos, Honeywell, and Prime, and on the IBM Series/1, 4300 series, and the PC. It can share files created under PC-DOS.

- PICK's advantages are:

  - It integrates a powerful relational data base management system supporting applications where locating and moving data is important.

  - It has print spooling, text formatting, and development tools for multi-user applications.

  - PICK has an English-like query language. It is easier to program in PICK than UNIX. The RPL (Realtime Processor Language) is similar to BASIC.

  - While not considered suitable for scientific applications, it is suitable for business users with little computer experience.

- UNIX is complex, with various versions and over 400 modules available around the kernel. PICK is simpler and much more portable between machines.

- PICK was developed over a decade ago, is well-developed, and has a small but growing following.

- PICK's disadvantages are:

  - The operating system is not strongly supported by industry leaders, although it has been transferred to several 68000-based computers and some vendors offer both UNIX and PICK operating systems.

  - Experienced PICK users and developers are rare and there is little literature about the system.

  - The programming language (PICK Basic) uses one or two characters instead of words. Reading code is difficult, a problem in servicing software.

  - PICK lacks floating-point arithmetic functions.

  - There is limited available software (approximately 620 packages).

- However, a new version called PICK Open Architecure will work to overcome some of the limitations.

  - The enhancements are designed to permit future hardware and communications developments to be easily incorporated into PICK software while maintaining compatibility with earlier versions.

  - PICK Open Architecture features unlimited record size.

- Users will be able to execute system commands from within applications.

- A C-language compiler will allow UNIX applications to be recompiled to run under PICK.

- Open Systems Architecture will ease the ability to run multiple operating systems such as UNIX and VM on the same machine.

- A group of PICK licensees working with vendor PICK Systems is developing a more agressive marketing strategy and standards to insure compatibility between present and future variations of PICK.

- Future planned PICK enhancements will enable it to run on the IBM PC/AT.

3. MULTIPROGRAMMING MONITOR (MP/M)

- MP/M was created by Digital Research as a multi-user version of CP/M, the leading multi-user operating system for 8- and 8/16-bit processors until being displaced by UNIX. TurboDOS is an MP/M clone.

- The advantages of MP/M are:

  - There is more software available, generally costing less than UNIX software.

  - MP/M is a realtime OS, supporting up to 16 users. It is upwardly compatible with CP/M.

  - It offers record and file locking to insure data integrity and password options for security.

- It supports dynamic memory allocation, queue management, and multiple printers.

- The primary disadvantage of MP/M is that it is considered a minimal multi-user operating system since it imparts multi-user capabilities on an 8-bit chip.

4. OASIS

- OASIS is an 8-bit multi-user, multitasking operating system for Z-80 based micros, supporting up to 16 terminals. OASIS-16 is 16-bit version.

- Since it uses its own version of BASIC, transferring programs not developed under the system is difficult.

- OASIS is designed for business use by inexperienced operators. It supports automatic and optional record/file locking, security, an electronic messaging facility, and print spooling, and keeps a user log. There are approximately 1,000 software packages available.

- Phase One Systems, the operating system's distributor, was purchased in April 1985 by a non-profit organization formed by OASIS applications developers with the goal of improving the market position of the operating system. Phase One earlier filed for Chapter 11 protection. There has been fighting within the OASIS community of software developers centering on a dispute over the commercial readiness of OASIS-16.

5. UCSD P-SYSTEM

- P-system was developed by the University of California at San Diego to offer a high level of program portability between machines. This is accomplished with a p-machine emulator, written for a specific microprocessor which translates an intermediate code called pseudo code to machine language.

- P-system's user interface is a tree-structured series of menus.

- The system includes line and screen-oriented editors and Pascal compiling facilities to ease program development.

- P-system offers concurrency (a user can run several applications simultaneously) and local area network support.

- Disadvantages are that it is slow due to the need to interpret pseudo-code. Applications are not totally portable primarily due to machine differences.

- Exhibit III-8 compares these non-UNIX operating systems and lists vendors supporting them on MUS.

- Exhibit III-9 identifies operating system vendors and gives their addresses.

6. OTHER OPERATING SYSTEMS DIRECTIONS

a. Microsoft

- The developer of MS-DOS (known as PC-DOS on the IBM PC and compatibles) has enhanced its single user operating system with UNIX-like features. DOS 3.1 is intended as a MUS operating system.

- Microsoft is the developer of XENIX, a UNIX clone. The company's intention is to provide for integration between XENIX and DOS through a supplemental networking operating system called Microsoft Networks.

- Micrsoft and AT&T have agreed to joint development of UNIX and XENIX compatibility, with XENIX V the result.

- Microsoft's Multiplan and Word applications will be available for XENIX on the AT, but the products will have no multi-user features. This is casting doubt on Microsoft's real commitment to multi-user products.

EXHIBIT III-8

NON-UNIX OPERATING SYSTEMS KEY COMPARISONS

	PICK	MP/M	OASIS-16	P-SYSTEM
Advantages	Integrated RDBMS Useful Utilities Easy, Basic-like Language Simpler than UNIX	More Software Available, Lower Cost Record/File Locking Realtime	1,000 Software Packages Record/File Locking Integrated E-Mail User Log Easy Operation	Highly Portable LAN Support
Disadvantages	Limited Industry Support Few Experienced Users/ Developers Difficult Software Servicing No Floating Point Arithmetic	Uses 8-Bit Chips	Limited Portability	Slow Operations
Vendors Supporting	General Automation, CIE	Altos, Columbia Data Datavue, Esprit, Molecular	ONYX, Molecular, IBC	Sage, Covus

EXHIBIT III-9

MUS OPERATING SYSTEM VENDORS AND PRODUCTS

VENDOR	MUS OF PRODUCTS
Digital Research Inc. 160 Central, P.O. Box 579 Pacific Grove, CA 93950 (408)649-3896	- MP/M - MP/M-86 - Concurrent CP/M - Concurrent DOS
Microsoft 10700 Northup Way Box 97200 Bellevue, WA 98009 (206)828-8080	- XENIX, XENIX V
AT&T Information Systems 1 Speedwell Avenue Morristown, NJ 07960 (800) 247-1212	- UNIX
Phase One Systems 7700 Edgewater Dr. Oakland, CA 94621 (415)562-8085	- Oasis - Oasis-16
Pick Systems 17911-D Skypark Circle Irvine, CA 92714 (714)261-7425	- PICK
Interactive Systems Corp. 1212 Seventh Street Santa Monica, CA 90401 (213)450-8363	- PC-IX(UNIX for IBM PCs)
Softech Microsystems Inc. 16885 W. Bernardo San Diego, CA 92127 (619)451-1230	- UCSD p-System

b. Digital Research (DRI)

- DRI attempted to form a new company to develop a UNIX software library, but this effort collapsed. The company will instead concentrate on Concurrent DOS (the latest version of Concurrent CP/M-86, a multitasking system with limited multi-user capabilities) and the new GEM operating system.

- Version 4.1 of Concurrent DOS allows micros to run PC DOS or CP/M programs in a multitasking, multi-user format supporting three users simultaneously. It is available for the AT&T 6300, the Compaq Deskpro, and the IBM PC/AT.

- DRI sees more opportunities for selling millions of packages based on these operating systems, rather than the thousands possible with UNIX.

c. Conversion Units/Software

- Multi-user capabilities can be given micros with add-on processor boards and system software. Adapative software blends with current operating systems to allow multiple users on the same computer through a "time-slicing" algorithm.

- The next chapter provides case studies, issues analysis, and implementation recommendations for users.

IV USER EXPERIENCES: ISSUES AND IMPLEMENTATION

IV USER EXPERIENCES: ISSUES AND IMPLEMENTATION

A. CASES

- INPUT has develped several case studies in order to provide a better understanding of how multi-user systems are chosen and used. These users were selected because they illustrate both problems which can occur and benefits which can be realized with MUS implementation.

1. A BANK'S HEADQUARTERS LOSES FAITH

a. Background

- The business banking group at a large bank's headquarters first installed a MUS. The system is used for general office operations and for specific applications by both professionals and clericals.

- The needs analysis recommending the MUS was done before microcomputers became widespread. Otherwise, according to the bank's office systems manager, another solution might have been found.

  - The choice of a MUS was based on the shared logic configuration of office systems common at that time.

  - The decision makers were impressed with the vendor's technology.

- The needs analysis showed that the equipment fit the work group as well as other groups which later bought their own systems from the same vendor. In all, 14 MUS were installed.

- The work groups quickly became dependent on the new systems, abandoning their earlier, paper-based procedures.

- After a period of satisfactory service, several problems developed.

  - As the number of users increased, response time deteriorated. The degradation was an abrupt rather than gradual process and, according to the office systems manager, was not as the vendor represented it.

    . This meant that when the work group was handling a rush project, the system bogged down.

    . The pressures of having to work with a sluggish system on tight timelines enfuriated users.

    . Although it never happened, users dreaded the possibility that the entire system would be worthless if the central processing unit went down, and that this could happen at a critical time.

  - There were other problems.

    . Technical support was unsatisfactory for quite a while.

    . Important software updates were delayed.

    . Eventually, the vendor ceased to provide service or maintenance altogether. The bank was required to seek and negotiate third-party maintenance on its own.

. High vendor staff turnover and industry press reports gave indications that the vendor might fail.

- These problems led to increasing disatisfaction with the vendor.

  - The bank had certain expectations which were not being met.

  - Users felt they made good use of the system, but now they wanted it replaced. They did not want another MUS, at least not one with shared logic.

- But any change was delayed by an eight-year bank depreciation schedule. The equipment was being carried above market value and could not be economically scrapped.

- The MUS was installed by the previous office systems manager. Admitting the experience has colored his judgement, the current manager is promoting LANs as a replacement, using IBM PCs which have become the bank's standard workstation.

- There is maturing user awareness of the microcomputer's power and capabilities. Users now wanted their "own" computer. The benefits of the MUS in sharing peripherals and data files was described as "illusionary," at least in their work unit.

  - A LAN or a simple switch box can also allow users to share printers or modems (if needed).

  - Data can be shared by "flippies"; in other words, by "flipping" a floppy disk to another user for review and revision.

- The office systems manager feels that the price/performance ratio of a MUS does not make sense. The risk that a central processor could go down, crippling the work group at a critical time, and that traffic would cause response problems in his view further reduces the value of a MUS.

- In this analysis, even multiprocessor systems would be deficient since a bus is still shared. As the lines get clogged, performance eventually deteriorates, often rapidly.

- Running applications for the work group on larger departmental processors (minis) was rejected due to conflicting demands and resources.

  - In pilot studies, data processing production bursts caused office applications, such as word processing, to be bumped off the system because processing power was needed for the data run.

  - This led to the conclusion that office applications and processing need to be separated.

- MUS usage as intermediate processors was also rejected since this would add another layer of operating system commands. Rather, for applications requiring mainframe access, the office systems manager would recommend traditional terminals. If mainframe data is needed for further manipulation, micro/mainframe links could be supported with terminal emulation packages.

b. Analysis

- This is an example of one vendor's problems coloring the experience and expectations of users.

- It also illustrates the micro mystique at work. The slogan could very well be "one worker - one processor."

- The MUS was purchased before the power of micros was recognized. Now, offices similar to those at the bank are successfully using micros.

- The vulnerability and reliability of the MUS's shared processor is a concern. Even if one micro goes down, a spare could be easily located and moved into position. With a MUS failure, finding a backup could be difficult.

  - Reliability is an important factor.

  - The redundancy of multiple micros provides at least the perception of more security than even redundant MUS architecture. The MUS is still "one box."

- While acknowledging a MUS does have its place, the specific needs of the bank's groups are seen as better served by micros connected with a LAN. The connectivity costs are becoming negligible, especially with the eventual availability of fiber optic cabling.

- Conversion costs are another factor, but fortunately, the data used in the work groups is transient and does not need to be replicated. Users are willing to learn a new system and many are already familiar with the power, flexibility, and "friendliness" of the micro.

2. A FAMILY BUSINESS BUYS ON PRICE

   a. Background

- This is the case of multiple small family businesses using the same facilities and sharing a MUS.

- The husband is involved in various enterprises, including a cable television franchise, publications, direct mail marketing, and charitable activities. The wife is director of a non-profit health institute which raises funds, publishes a journal, and runs seminars on health care issues.

- A number of office systems were evaluated. The MUS chosen was selected primarily based on price, although software and the robustness of printers available with the system were also considerations. Printers were especially important since direct mail sales and fundraising letters are customized to individual prospects, meaning volume printing.

- Word processing is needed to edit publications and for general office communications. Also needed are spreadsheets for internal planning and for inclusion in company publications.

- Two systems were purchased from the same vendor, one configured with four terminals, another working as a standalone for use at a satellite office. The hardware was OEM'd from one of the leading vendors, with software sold under a well-known computer vendor's name.

- Data could be shared between the two systems by downloading files from the hard disk to floppy disks and physically moving them. There was no need for external communications nor for communications between the systems.

- Word processing functionality was identified as most useful. However, as familiarity with the system grew, problems appeared.

  - The printers frequently had paper handling problems. Since mailings involved customized letters, this caused backups in production schedules and led to heavy overtime to meet deadlines.

  - The spreadsheet program held at least one "bug" which prevented large, complicated spreadsheets from recalculating values.

  - There were occassional "flashes" on the system's screens. Data was sometimes lost after these occurrences.

- The principals credit the vendor for prompt servicing. However, the system was purchased with performance guarantees and the threat of lawsuits eventually led to a district manager visiting the location to evaluate the problem and to determine how the customer could be satisfied.

- Short fixes were implemented but the problems were never fully resolved. Eventually, the vendor reimbursed the company an amount approaching system costs for lost service and for incurred support staff overtime.

- In retrospect, the user recognizes that perhaps the heavy printing demands were too much for the printer's paper handling capabilities and that some other method, such as letterhead forms rather than sheets, should have been used. Had the system been purchased more recently, a laser printer would have been specified.

b. Analysis

- The economical purchase of this system may have been the leading problem. Attempts to buy cheaply mean equipment may not be suitable for intended applications.

- The system was purchased in 1982, and of course the technology has advanced since that time, particularly in printers.

- The spreadsheet problem might have been related to software bugs or errors made in configuring complex spreadsheets which spanned several linked files.

- Regardless, the users recognize that the system has made productivity improvements, but that expectations have not been met, leading to frustration directed at the vendor.

3. A SMALL COLLEGE AUTOMATES, TEACHES WITH MULTIPLE MUSs

a. Background

- With increasing enrollment and the growing importance of donations, a small college initially purchased four MUS systems from a local office products dealer to replace manual systems and improve its record management.

- Student and alumni records were installed on one system's data base and accounting and payroll procedures were migrated to another, improving cash flow control. By maintaining an up-to-date mailing list, pledge contributions to the Alumni Association were greatly improved.

- Over time, additional systems were acquired and placed into student services, health services, the business school, and other areas on campus. Several systems are housed in the computer center. Another is being purchased to automate the library card catalog, using a third-party software package but requiring customized conversion of catalog data stored on state-operated mainframes.

- This particular product was chosen because of availability through a local dealer. To date, eight systems have been purchased supporting between 4 and 12 users each.

- Computer science students write programs on the systems and are taught XENIX, which is highly rated.

- Business students run financial analysis programs, and other students use word processing in the Computer Center for homework assignments.

- The communications capabilities of the system are not often used.

- Only one office administrator has done work at home downloading files to the MUS using a modem.

- A data base originated in-house was transferred over the phone to a similar system installed at a nearby college.

- IBM PC compatibles, used mostly by the business department, have also been connected with generally good results.

- The systems in the computer center were interconnected on a LAN, but LAN commands, designed primarily for programmers, were difficult for new users to learn. Students are writing programs to make LAN use easier.

- The most important features identified are print spooling, record locking, and password protections. Advanced features, such as voice/data/image integration, are not seen as important in this environment.

- The most significant problem is response time deterioration, particularly when menued applications are used by four to five concurrent users, loading down the system.

b. Analysis

- This isolated, small college selected this product because a local dealer sold them; there was little done in the way of comparison shopping. Fortunately, the systems serve needs well and additonal units are being purchased as departmental budgets allow.

- Maintenance and installation is principally handled in-house, with the dealer solving problems which cannot be solved internally.

- While software is available, the environment is such that specific applications and data bases can be designed essentially for free using computer science students.

- Instructional uses are limited to computer science and business management. Other computer-assisted-instruction (CAI) initiatives have been stalled, primarily by resistance from instructors who feel threatened by computers.

4. A BANK CONNECTS A MUS TO TWO MAINFRAMES

a. Background

- The headquarters of a regional bank purchased a MUS which it connected to two different brands of mainframes, using mass storage for files as appropriate.

- The Vice President for Planning was in charge of the project and conducted a needs analysis, determining requirements to integrate reporting information for five managers, with information shared between them.

- At the time the decision was made, LANs were not developed to the point where they could be installed with confidence.

  - The MUS was available at a reasonable cost, providing most of the capabilities of a minicomputer, which would have also served needs but would cost four to five times as much as the MUS.

  - Mainframe timesharing costs were replaced by purchasing the system with a one-time expenditure depreciated over six years.

  - The alternative of adding mainframe resources was seen as more expensive over time, with unquantified overhead costs of systems analysts, maintenance, and upgrades. The mainframes also would

perform the needed applications slower than the MUS due to sign-on/off procedures and execution times.

- For the small user environment, the MUS was seen as providing the best cost/performance.

- The mainframe connections were asynchronous, with simple file transfers.

- Applications included word processing, financial analysis, personnel functions, and a relational data base. Many applications were developed internally. The system was purchased from a local VAR who installed both the hardware and software and provided training.

- The original plan was not implemented because of internal financial problems. Although the system performed satisfactorily, ultimately one user wound up working on it due to reduced staffing. However, the bank feels it got its money's worth over three years of service.

b. Analysis

- Through no fault of the MUS, this location has moved to micros to perform many of the functions previously done on the MUS. Mainframe information is now downloaded to micros for the remaining managers' manipulation and analysis. Information is shared in paper reports or by swapping floppies, a seemingly backwards step, but one made necessary by staff reductions.

- The MUS has essentially been "retired," although it continues to be used for word processing and other routine applications.

5. A FINANCIAL PLANNER'S TROUBLES WITH CUSTOMER SUPPORT

a. Background

- A Certified Financial Planner installed three MUSs, supporting two and four users. The first system was purchased from a dealer in 1980, with two more used systems later acquired from a wholesale distributor.

- They were purchased after the planner fully researched the field and determined that this specific MUS offered the best value.

- The systems are used for financial management and analysis, planning, word processing, and centralizing the company's data base.

- The planner intends to use these systems "until they wear out." The systems have physically held up. The major problem identified is customer support. "You can't talk to the vendor."

  - The company could not get a specific program to run and a consultant working on the problem for the planner could not isolate the fault. He called the vendor using his service authorization number.

  - The customer support technician needed more information and called the financial planner directly to get specifics.

  - The planner could not talk at the time, but when he returned the call, he was prevented from talking to the technician because he did not have an authorization number, despite the return nature of the call.

- After going through three supervisors, the call was completed but the experience angered the financial planner. In fact, he considered establishing his own dealership so he could directly access the vendor.

- The planner acknowledged that the vendor needs to protect its distributors and that service calls should be handled by dealers. This particular vendor prides itself on its dealer support program.

- The planner does not feel the extra-cost service contract is beneficial. He says field service does not solve problems cost effectively. Instead, he would rather do his own repairs. For example, he has replaced a floppy drive belt for $6 in 15 minutes, compared to a service call costing $60. As would any good financial planner, he wants to save money.

- The three systems have served well over six years and this prevents the problems with the vendor from being magnified. However, one other problem was mentioned. Sometimes the systems will lock-up if illegal commands are issued or if program limits are reached. This requires rebooting and any work still buffered and not saved is lost.

b. Analysis

- Like the family business in Case 2, the planner is cost conscious. He carefully evaluated available offerings before buying and he is trying to save money on maintenance. But unlike Case 2, he has had satisfactory service.

- The planner feels confident enough to do minor repairs himself, saving field service calls and the cost of a maintenance agreement. His problems with technical support are understandable from the vendor's perspective, although it appears there was a failure to communicate on what should have been a routine call-back.

- While seeming significant to INPUT, the planner says system lockups were not a regular occurrence; however, it does suggest the need for a new system.

- The Planner has enough MP/M software for his business and says that while there are DOS programs he would like to use, they are not necessary. He does

say, however, that when the time comes to replace the system, he should "get something else," but doesn't know just what.

B. CASE OBSERVATIONS

- Vendor problems led one user organization to shy away from MUS solutions in the future. Another user's problems stemmed mostly from purchasing with price as the main consideration. The system did not adequately fit the needs. Most of this user's problems centered on the printers which came with the package and not with the computer itself, which performed satisfactorily.

- The financial planner's problem with the vendor's technical support staff is foregivable; the vendor has strict rules designed to protect its dealers, but this time they got in the way of customer satisfaction.

- Other users, not profiled here, are well served by a MUS because specifically-needed software is available from systems integrators (Value Added Resellers) who provide customized support to make certain the system fits the application.

- The college environment is perhaps unique. The standard business applications needed were available, and an inexpensive way to write new applications or adapt existing ones was readily available in the form of computer science students who earned course credit while providing services to the school.

- Exhibit IV-1 summarizes these case studies.

EXHIBIT IV-1

CASE STUDY SUMMARY

ORGANIZATION	PRIMARY APPLICATION	MAJOR PROBLEMS	KEY BENEFITS
Bank #1	General Office	Response Time, Poor Vendor Support, Risks of CPU Failure	Productivity Gains
Family Business	Publishing, Customized Mailings	Printer Jamming	Productivity Gains
Small College	General Office, Data Base, Education	Response Time	Improved Information Management
Bank #2	Coordinated Reporting, Analysis, Data Base	None Reported	Cost Savings Over Timesharing or Mainframe Enhancements/Management
Financial Planner	Financial Analysis, Data Base	Vendor Technical Support, "Lock-ups"	Centralized Data base, Easier Analysis

C. RECOMMENDATIONS TO IS

- MUS solutions are suitable for small offices, branch offices, and large company departmental use, assuming the desirable level of integration with other corporate computers can be achieved.

- IS has an opportunity to correct past mistakes, particularly those caused by uncoordinated user purchase of incompatible micros.

  - By supervising MUS implementation, IS can control future system acquisitions which will connect to MUSs.

  - The view is now toward integration. New products fitting the new order require centralized IS coordination.

  - Without such coordination, companies invariably buy incompatible equipment one piece at a time in order to improve personal productivity, jeopardizing future integration initiatives.

1. PLANNING IMPLEMENTATION

- A comprehensive planning process is helpful in evaluation the usefulness of MUS over other solutions. The ultimate application may be chosen for intuitive reasons, but planning lends credibility to the decision and confirms intuitive choices.

- The implementation planning process should include department members, since involved staff are more likely to accept and endorse recommendations.

- Some IS managers require supervisors to justify MUS for their departments. This is politically wise. The user must live with the system and the reasons for installation, and will often attempt to transfer blame for unattained benefits to the justifier.

a. Financial Issues

- The reasons for implementing MUS are economical computing, the benefits of sharing common data, and specialized applications. MUS' compare favorably to the alternatives of LAN-linked micros or minicomputer systems, as discussed in Chapter III.

- LAN-linked micros are currently more costly. Micros can cost $3,500-5,000. Each needs a network board costing $500-1,000. A LAN file server adds $10,000-15,000. The LAN and individual micros need software. There are additional cable and conduit installation costs.

- The per user cost on a typical 12-user LAN configuration can exceed $6,000. In comparison, an MUS supporting as many uses can be as low as $2,000 per user. Incremental costs for additional MUS work stations are lower than for LAN systems. In the future, these costs will change and LANs may become a better solution in some settings.

b. Productivity Issues

- The MUS justification effort should be relative to the size of the investment.

- Justifying any computerized system is appropriately based on increased productivity, better customer service, improved decision making, lower inventories and competitive advantages. However, IS managers often have difficulty quantifying these benefits. Many rely on intuition to justify office system acquisition.

- Productivity benefits can be quantified, particularly in uncomputerized settings, by monitoring work group output compared to manual systems.

- Similarly, changes "before and after" in a work group now using standalone micros can be attempted, but often such techniques are more time consuming and difficult than the benefits realized.

  - This is no different than productivity evaluation of other office systems.

  - The MUS focus should be on applications, viewing the technology as a vehicle for getting things done.

c. Equipment Issues

- When evaluating a specific MUS, the first logical question is how many users can be supported.

  - In order to accurately assess the findings, it is necessary to determine if projected departmental use will be light or heavy.

  - Volume may affect the performance of single processor systems, whereas multiprocessor systems will experience less response time deterioration from concurrent users.

- The system chosen should be sized to anticipate growing needs. Expansion costs also need to be evaluated.

- If the work group has a large number of recently purchased, adequately functional micros, connectivity may be better served with a LAN.

- If there are only a few micros and IS wishes to protect this investment, a MUS which supports micro connections should be chosen.

d. Software Issues

- Evaluate the software available, particularly that needed for industry specific applications.

  - Since MUS manufacturers are working through Value Added Resellers, the software is developed by, or made available through, the VAR.

  - A mutual understanding regarding the VAR's responsibilities for software maintenance and upgrades is necessary.

  - Don't become overly concerned about the number of packages available if what is available fits needs. MUSs are often purchased as turnkey systems; i.e., hardware bundled with specific application software and support, intended to solve specific company problems.

  - If IS plans to develop custom applications, evaluate available programming tools.

  - Users don't really care what operating system is used as long as it gets the job done.

    . Operating systems choice is an IS concern to insure that needed applications are available, that existing, perhaps customized, software can be used, and that new customized solutions can be easily developed.

    . Many MUS vendors offer multiple operating systems, often making this issue a low priority.

e. Compatibility/Connectivity Issues

- Evaluate connectivity factors. If mainframe links are needed, how does the system support them? What about MUS-MUS linkages? Can micros connect to the MUS to share data and applications?

- What about other communications solutions such as data PBXs (port selectors) for connecting the MUS to other company computers and the corporate network?

- Determine if the MUS being considered will interface with existing peripherals such as high speed printers.

f. Support Issues

- Evaluate ease of use relative to end user computer literacy levels. Most MUSs offer menu interfaces.

- Determine if on-line tutorials are available to supplement formal training modules. It may be desirable to contract with third-party training organizations. Another option is to recruit interested users as peer trainers.

- Maintenance agreements with the vendor or third-party maintenance vendors may be more manageable than IS stocking replacement parts or attempting to make in-house repairs.

g. Security Issues

- The AT began the convention of MUSs having a physical key to unlock the system. Other security measures are commonly available.

- Backups.

  . Backing up MUS data is a standard procedure and many MUSs provide for automatic backups and error recovery. Others rely on the system administrator to schedule backups on streaming tape or other media. Floppy disks are seen as unsuitable for backups.

  . Backup procedures are key but often overlooked elements in end-user training. Experience shows that one loss is usually sufficient to support the importance of this.

- Access.

  . MUS files can be secured through multilevel password protections. Files designed for common use can be placed in public storage areas.

  . The departmental "owner" of the MUS data base should ultimately be responsible for its security, using IS provided guidelines and procedures.

- File locking.

  . Updating a MUS data base requires a system supporting file protection, including notification that a file is currently being used. This prevents data from being revised multiple times by different people, resulting in several unsynchronized copies. Such situations are difficult to untangle.

h. User Ratings of Features

- Users interviewed were asked to rate the importance of various MUS features.

- Important features are:

  - Print spooling. MUSs generally allow printer sharing, and since printers function slower than system output, there may be contention. Print spooling temporarily buffers output in disk storage until the printer is available.

    . Some systems allow priorities to be assigned to documents.

    . For document-intensive applications, spooling is a vital feature.

  - Electronic mail. External messaging is seen as more useful than internal communications since small work groups can easily communicate by other means.

  - Storage backup. Tape-based mass storage is more appropriate than floppies for backups due to capacity and speed. Users rated this feature highly.

  - Damanged file and directory recovery is important for those rare occassions when the system loses data. This, too, was rated highly.

  - Security based on passwords is an important feature for protecting files from unauthorized usage. Multiple passwords can be assigned to permit read only or read and modify access. Records within files can also be protected.

  - Modem pooling and networking to other MUSs and other corporate computers is often desirable for micro-mainframe data access and to share information beyond the work group.

  - Many users did not need mainframe access and those that did had terminal emulation with downloading capabilities.

  - Modem polling is desirable as a cost savings feature.

- Voice/data integration (i.e., "smart" telephone features) are currently less than desirable, although the feature is helpful for applications such as telemarketing.

- Voice annotation has a low user priority. It requires storage which may not be available. Few MUSs offer this capability.

  - Voice annotation permits a user to dictate information relevant to the stored document or data file.

  - A displayed symbol indicates the presence of a voice note.

  - Voice annotation is most useful for executive to support staff communications and for verbally explaining shared information.

  - The voice message is ignored when the document is printed.

- Business graphics are used to illustrate statistical information. Users interviewed found this feature somewhat useful to their needs.

- Image integration (i.e., other than encoded graphics) allows a photograph or a document to be digitally stored. Applications include storing what are essentially electronic photocopies of documents such as contracts, handwritten notes, drawings or product photos for later referral. Users generally did not find this advanced feature useful.

- Many times features seen as desirable are not used, but also features initially not needed may become important as user familiarity grows and recognition of their benefits increases.

- User ratings of these features are shown in Exhibit IV-2.

2. EVALUATING SYSTEMS AND VENDORS

- Gather and organize vendor information, attend trade shows, and talk with industry peers to gain perspectives. Evaluate the alternatives.

- Recognize the influence skilled sales personnel can have on decision making.

- Evaluate the vendor's support commitment in terms of warranties, replacements, upgrading of hardware, and training.

- Interview users of the type of equipment you are considering, particularly those having similar structures. Check references and view the system in operation in settings similar to yours.

- Exhibit IV-3 is a matrix designed to help evaluate and compare MUS systems.

3. MUS COST BENEFIT ANALYSIS

- Cost benefits analysis efforts should be related to the size of the anticipated investment. If only one MUS system is being considered, then a formal, time-consuming process is not appropriate.

- However, when an investment for several departments or field offices is being considered, it becomes more important to devote attention to this analysis as part of the planning process.

- Cost benefit analysis is usually organized early in planning and revised to reflect information gathered at various stages.

EXHIBIT IV-2

USER RATINGS OF MUS FEATURES

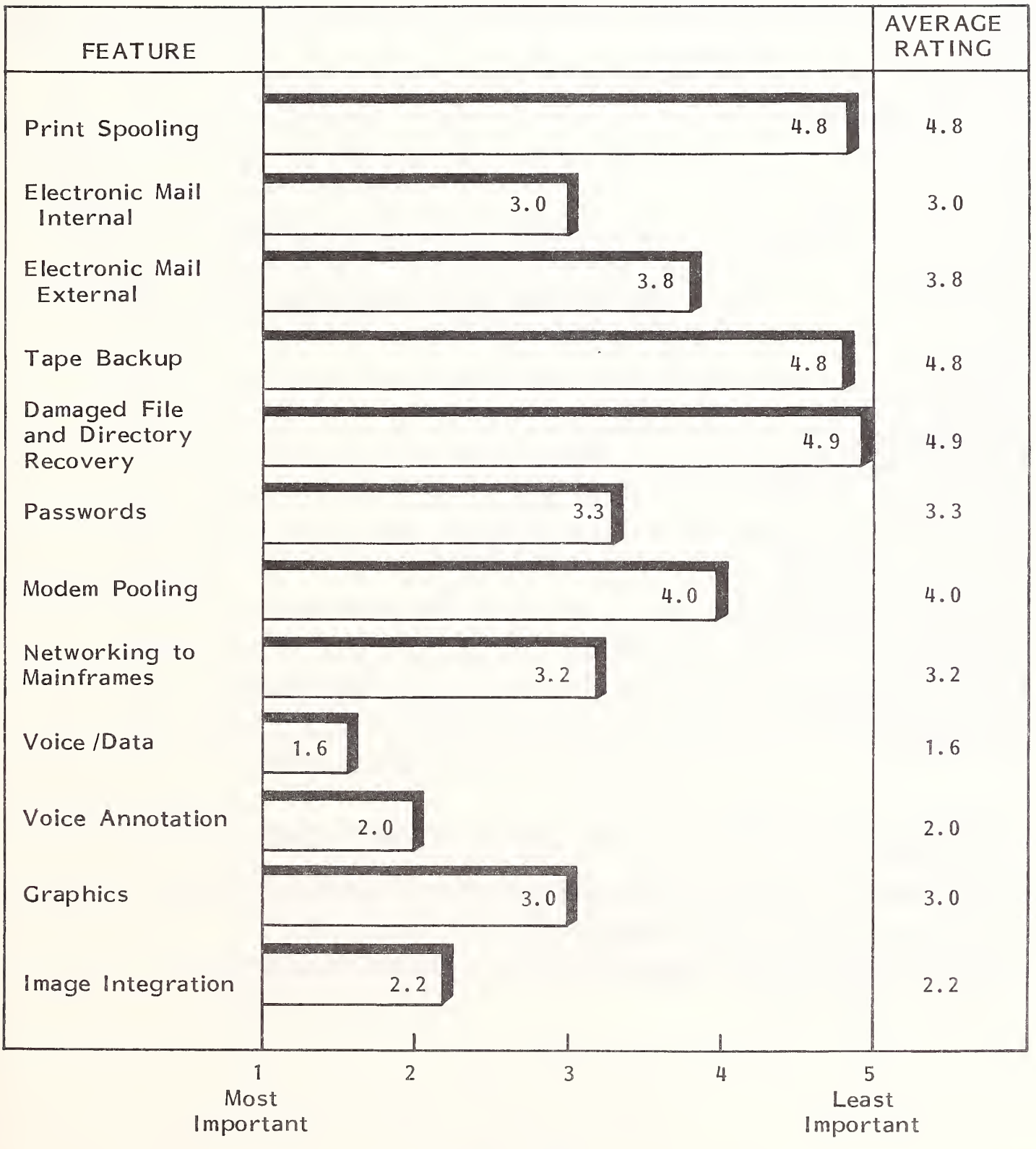


EXHIBIT IV-3

PREFERENCE CHART

Product A \ Product B	Cost	Capacity	Expandability	Facility Requirements	Ease of Use	Software Availability	Training Requirements	Installation Requirements	Maintenance	Vendor Evaluation	Availability	Numeric Value	Weighting Factors
Cost													
Capacity													
Expandability													
Facility Requirements													
Ease of Use													
Software Availability													
Training Requirements													
Installation Requirement													
Maintenance													
Vendor Evaluation													
Availability													

- Working down column "A," enter numeric value for preference of "A" over "B."
- Add numeric values across columns and enter in appropriate column.
- Average numbers to get weighting factor.
- Apply weighting factor against features of present system and all feasible alternatives.

- The steps in conducting a cost benefit analysis are:

  - Review organizational goals and priorities. Review available funding. Determine management attitudes on office systems.

  - Gather information for analysis, including department budgets, revenue forecasts, organizational charts, and job descriptions.

  - Determine if a MUS is appropriate to meet work group needs. Look at similar departments to identify similar needs to leverage purchasing with volume discounts and shared support costs.

  - Examine how the MUS can benefit the work group and, by extension, the company. Look for specific problem areas which can be improved by MUS characteristics and applications.

  - Examine corporate and departmental cultures. Is there a willingness to automate? Will the department structure support successful implementation? How can changes be handled with minimal disruption? What training is needed? It is critically important to resolve any problem areas before proceeding further.

  - Estimate costs. This means sizing the system, adding components needed, and considering any peripherals or work stations on hand. Include in the estimate both purchasing costs and those accrued internally to plan and implement the system. If possible, ongoing operating costs should be compared to existing costs.

  - Make the commitment to proceed or abandon the effort based on the above review and a financial analysis. The effort should be postponed if needed organizational changes cannot presently be accommodated. The project should continue if financial analysis indicates an estimated payback of three years.

- Estimating productivity improvements is often difficult.

- Benefits can be weighed against estimated implementation expenses and ongoing operating costs. One way of putting a dollar value on unquantified benefits is to determine how much the company would be willing to pay for them. Another is to attribute estimated revenue increases resulting from, for example, sales improvement directly to the MUS.

- Finally, organize the information. Documenting the process supports management presentations. The planning file should be maintained for future projects should implementation be delayed.

- Exhibit IV-4 summarizes the steps required to conduct a cost/benefit analysis.

4. MANAGING IMPLEMENTATION

a. Organizational Preparation

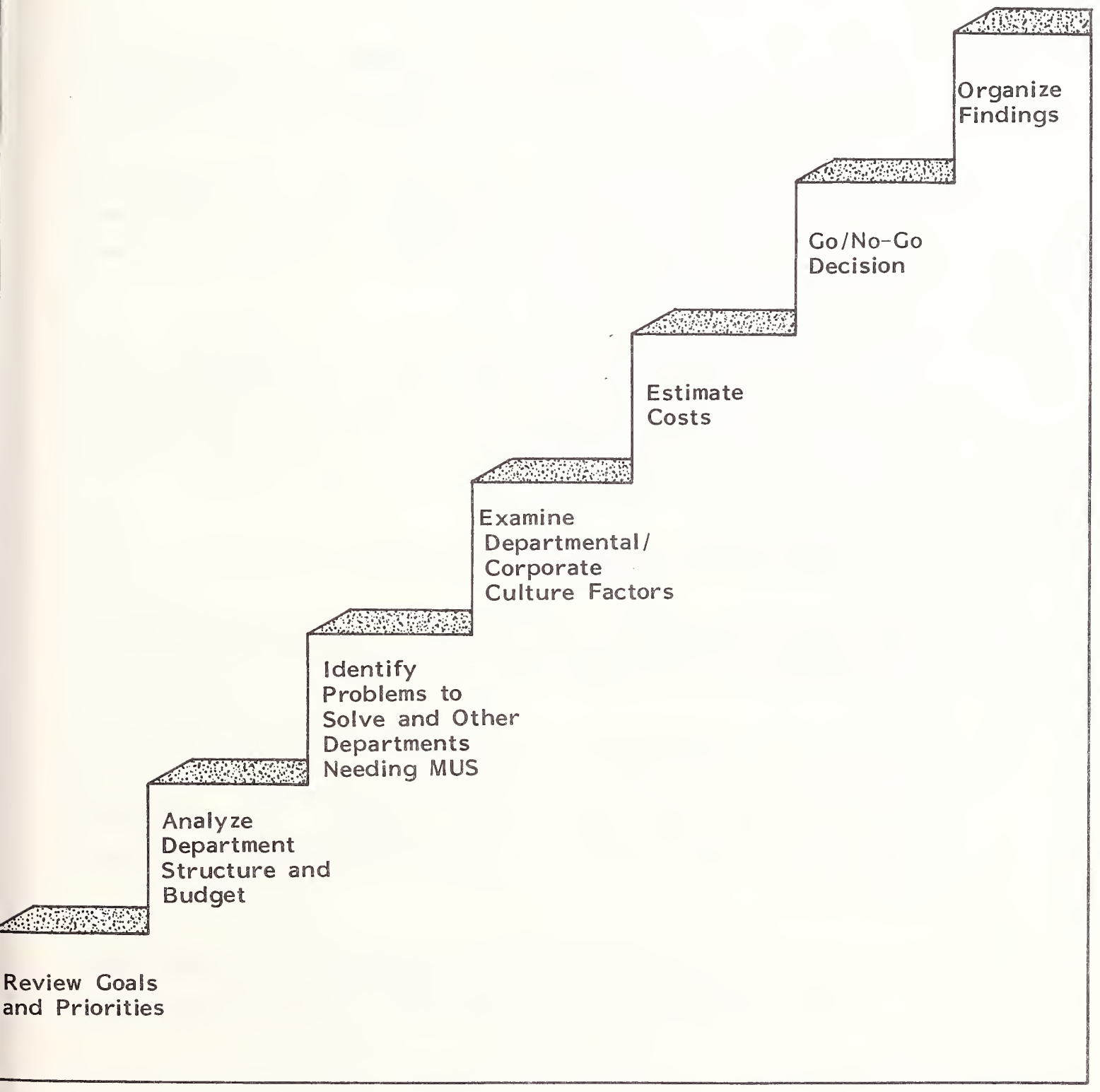
- Preparing the work group for MUS installation involves decisions on who will have access to system resources, responsibility for maintenance, training, supervision, custom programming, and cost responsibilities.

- These decisions should be made with user input before the system is implemented to ensure acceptance and thus work group productivity.

- It is important to understand the department's information management processes. Computerized implementations should follow paperflows: large scale revision of practices will be countereffective. Determine what functions will migrate to data flows and work to emulate paper processes with computerized solutions.

EXHIBIT IV-4

MULTI-USER SYSTEMS COST BENEFIT ANALYSIS STEPS



- Determine what organizational changes make sense for addressing and supporting the future information management needs of the work group due to MUS implementation. This may mean changes in departmental procedures, approval levels, and reporting roles.

b. Site Preparation

- Connecting work group users and shared peripherals requires a review of how the physical location must be changed, if at all, to accommodate installation.

- Anticipate power demands since a failure will affect every user and may cause catastrophic data losses. Uninterruptable power supplies (UPS) may be installed for protection. Adequate ventilation is needed to prevent overheating and to insure user comfort.

- Where computer flooring or overhead paneling is not available, ducts may be needed for cable placement. The dealer will usually take responsibility for installation, which may require licensed contractors under local building or fire codes.

c. The Three Ps: Prototype, Pilot, Production

- MUS implementation follows procedures similar to the implementation of other computer, office, or telecommunications systems.

- Generally, it is advisable to use the three-fold approach of prototype, pilot, and production, which follows a progression of implementation with low investment at the outset when the risks are greatest. This is particularly important when several systems will be purchased for multiple departments or field offices.

  - Prototype. One user community, perhaps within a department, tests a single system which can be upgraded later to support additional users.

This stage is designed to discover and assess technical weaknesses. Several competing products (leased or loaned) may be tried to determine which is best.

- Pilot. Wider implementation. Seeks to identify human rather than technical factors which need to be considered to confirm the MUS solution or to indicate if the solution is excessive or insufficient for actual needs. Organizational changes can be implemented if necessary. This stage can also test assumptions on "before" and "after" productivity levels.

- Production. Full implementation. The original plan may be modified based on earlier experiences.

- Sometime after full implementation it is important to conduct a post-implementation review to determine if the benefits projected are being actualized, and if not, what can be done to improve the situation.

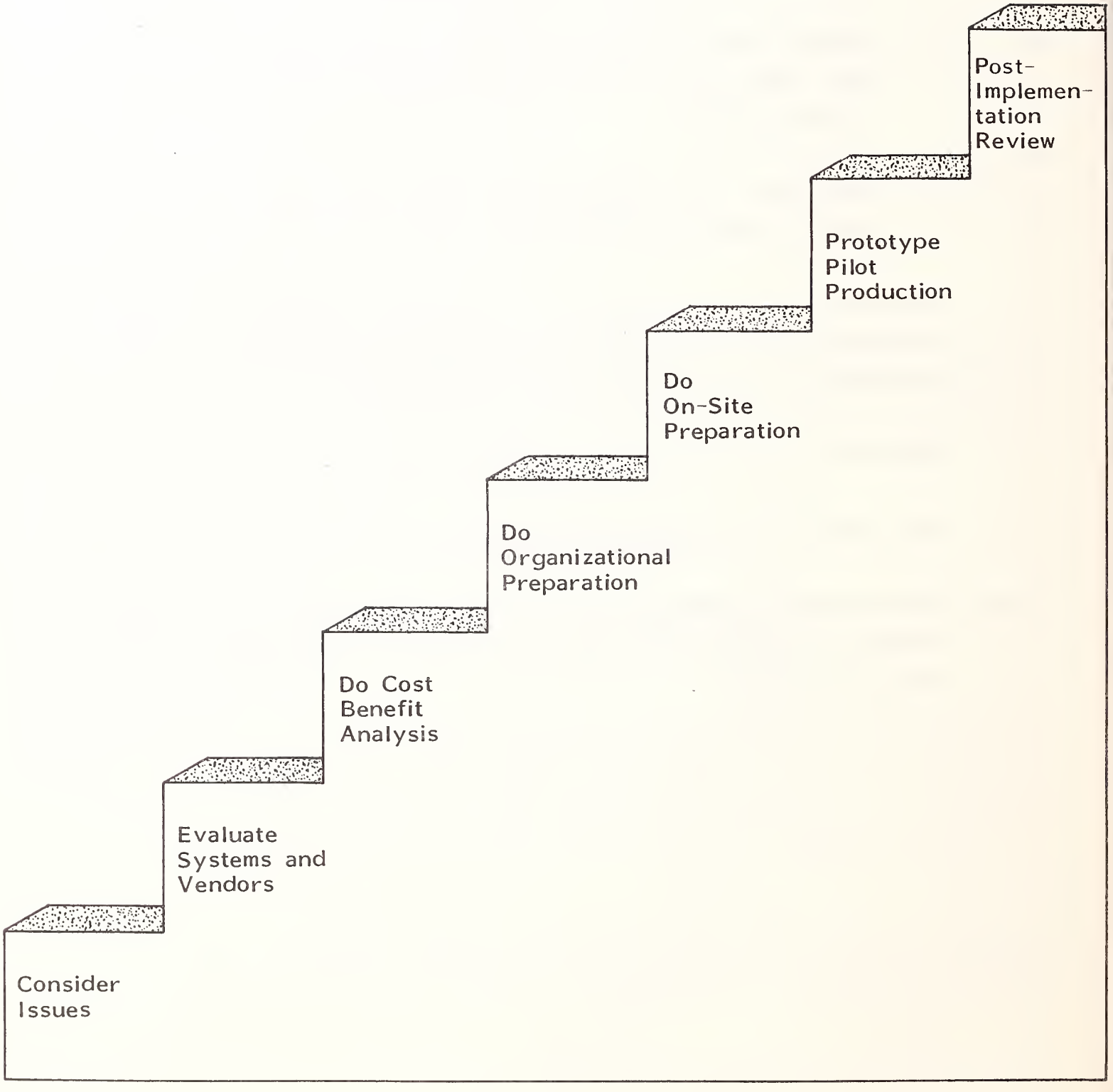
- Exhibit IV-5 summarizes MUS implementation steps.

- MUS products are described in Appendix D.

- The next chapter presents a market forecast and analyses of MUS vendors, intended as a guide for IS evaluation as well as providing information for competitive vendors.

EXHIBIT IV-5

MUS IMPLEMENTATION STEPS



V MARKET ANALYSIS AND VENDOR RECOMMENDATIONS

V MARKET ANALYSIS AND VENDOR RECOMMENDATIONS

A. MARKET SHARE AND FORECASTS

1. PERCENTAGE OF MICRO-MUSs IN BUSINESS WILL MORE THAN DOUBLE

- As shown in Chapter II, Exhibit II-4, microprocessor-based, multi-user systems accounted for 7% of the 1984 installed micro business base, representing 400,000 micro CPUs serving multiple users.

  - Only 3% of the installed base of micros are connected to a local area network.

  - An estimated 90% of all micros functioned as standalones in 1984.

- By 1990, MUSs will grow to 15% of the installed base, representing 3 million units, an average annual growth rate of 40%.

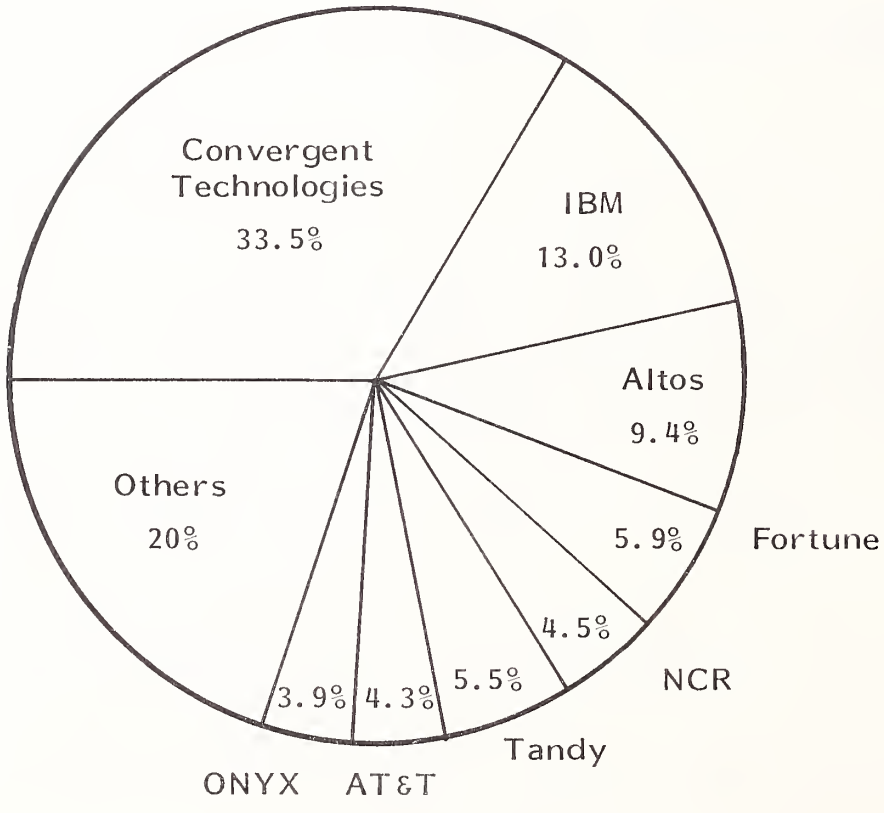
- Micros configured in local area networks will increase to 55%. LAN-connected micro and MUS growth comes at the expense of standalone micros.

2. CONVERGENT, IBM, AND ALTOS HOLD THE MAJORITY OF THE MARKET

- As Exhibit V-1 shows, Convergent holds one-third of the installed base of MUS, represented by the NGEN, Miniframe, and Megaframe. These systems are all sold through OEM channels.

EXHIBIT V-1

INSTALLED MICRO MUS BASE
(As of June 30, 1985)
BY CPU



- In its relatively short history, IBM's PC/AT has captured over 13% of the market, achieving the second position. It is important to recognize that although the AT has MUS capabilities, INPUT estimates that over half of these systems will be used either as powerful standalones (even when multi-user capabilities are available) or networked.

- Other dominant vendors are Altos with nearly 10%, Fortune with nearly 6%, and Tandy with 5.5%. INPUT estimates that AT&T's MUS have attained a 4.3% share of the market since their introduction.

3. MUS INSTALLED BASE GROWTH RATE IS 40%

- INPUT estimates that 650,000 MUS units will be installed, with 250,000 units shipped by the end of 1985. By 1990, approximately three million MUSs will be installed. There is a very low retirement rate due to system price. MUSs will be repaired or resold when they are outgrown by their current users.

4. ANNUAL SHIPMENTS GROW FAST AT FIRST, THEN LEVEL OFF

- The average growth rate for annual shipments is 17%, but the industry is categorized by a higher shipment rate in the first few years of the forecast period, becoming flat at the end of the period, predominantly due to increasing usage of LANs.

  - LANs will connect more micros as networking software becomes available and as per user prices drop, accounting for 55% of the installed micro base in 1990.

5. A $3 BILLION MARKET BY 1990

- Estimated market revenue for 1985 will be approximately $1.75 billion, growing at a 17% average annual growth rate to an estimated $2.9 billion market by 1990.

- Lowering prices driven by technological advancements and competitive pressures will result in the average system price dropping from $7,000 to $5,500 because of the high volume of smaller systems, such as the AT, supporting two to three users.

- Exhibit V-2 summarizes these findings.

B. ACCEPTANCE

- Multi-user systems are positioned to fill a perceived hole between micros and minicomputers. The validity of the need to fill this hole must be examined to verify it is not merely a convenient marketing platform.

- The central MUS premise is that sharing a CPU is less expensive than distributing multiple CPUs to individuals in the form of micros. This is an appropriate consideration with relatively high microcomputer costs, but with prices coming down, this becomes less of an issue. MUS marketing programs based solely on the economics of sharing a CPU will be short lived.

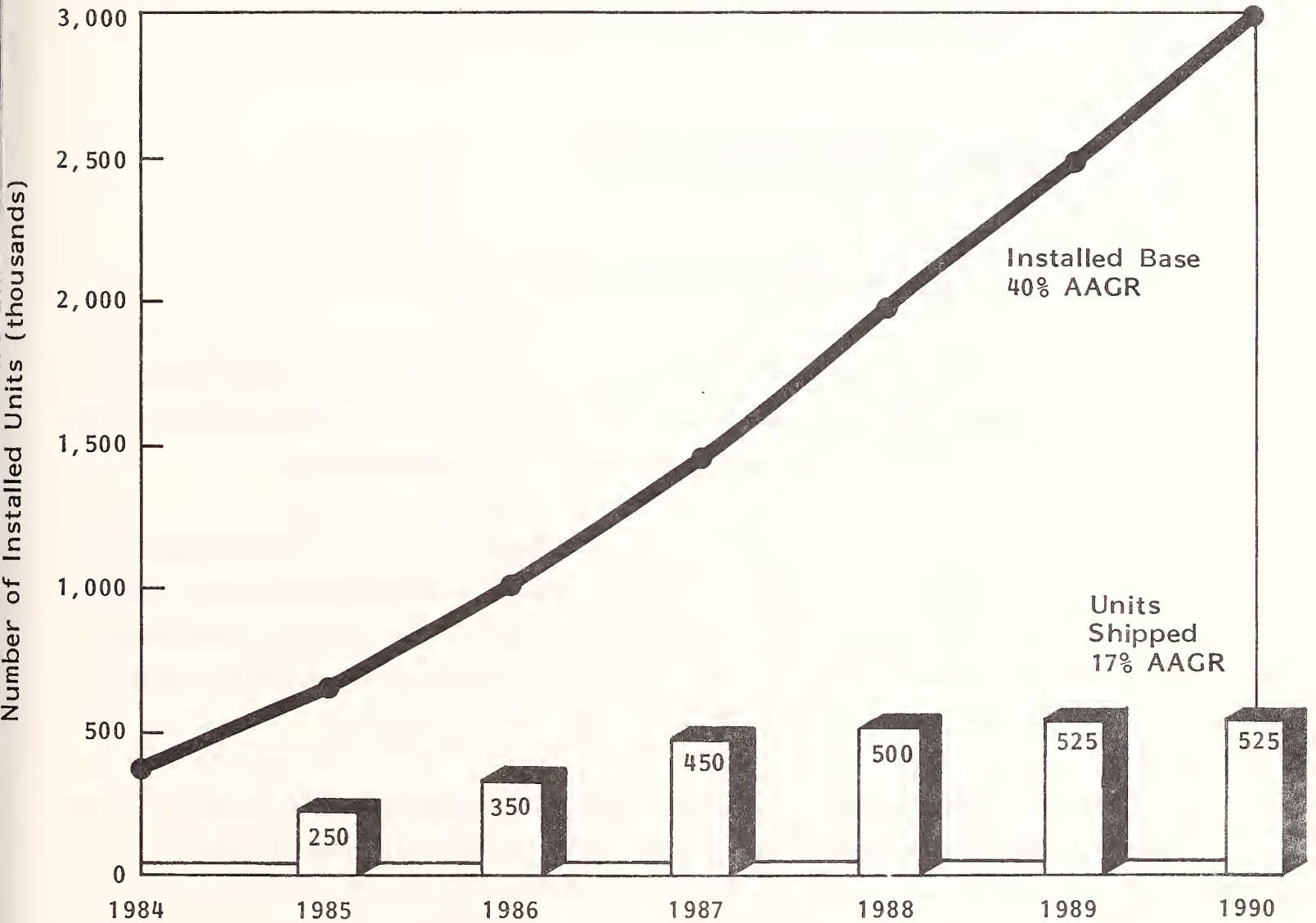
- Other benefits need to be stressed. For example, higher levels of computational power can be concentrated in the MUS CPU than may be cost-effectively installed on an individual basis.

- Also important is the MUS capability to share information between managers and information creators in the work group.

- Counterbalancing this sharing and the feeling of "belonging" in a work group is the maverick micro mystique--the user psychology of independent control over processing, a dynamic not valid with MUSs.

EXHIBIT V-2

MICRO MUS MARKET FORECAST



Installed Base	60%	62%	48%	34%	20%	21%
Units Shipped		40%	25%	11%	5%	0%

Average Annual Growth Rate

- Users need to both belong and be independent. MUS marketing strategists must recognize these emotional elements in product positioning.

- LANs are the primary technological competitors to MUSs, permitting both independence and belonging. Even though currently more costly, LANs may be better accepted by certain classes of users and the cost differentials will become less significant. LANs are often a suitable connectivity strategy in companies with a significant investment in standalone micros.

C. GENERAL MARKET OBSERVATIONS

1. ECONOMIC CONDITIONS AFFECT THE MARKET

- The computer industry in general is experiencing a slowdown even though the economy continues to grow, albeit slowly. Despite this general trend, segments such as MUS may enjoy higher than average growth.

- One of the reasons for the computer industry slowdown is user evaluation of existing and new products and the associated marketplace confusion. There is also a "wait and see" attitude, in part related to the impending announcement of the IBM PC2 and the evaluation of how this product may fit into information system needs.

- A forecast economic downturn will affect capital spending overall, but may help MUS vendors due to the cost efficiencies inherent in such systems.

- An economic slowdown will impact smaller computer makers who lack the sales volume to compete with more enduring larger companies who are cutting prices.

2. NO MUS STANDARD-BEARER HAS EMERGED

- While the microcomputer market has the IBM PC as a standard, no MUS has emerged to fill this role. The PC spawned its clones and encouraged a large software/hardware support market.

- The AT shows signs of becoming a new standard, with competitive "cloned" systems introduced to take advantage of temporarily limited AT inventories and to tap into parallel peripheral and software developments.

  - The AT is minimally a MUS, supporting only up to three users when its MUS operating system (XENIX) does become available. However, the AT should be viewed by users and competing vendors as a starting point for IBM to migrate users to larger, more powerful systems.

  - The IBM PC-2, when it is finally available, will most likely be a single-user AT machine.

  - There is still opportunity for another MUS to emerge as a standard in this segment, although IBM's more recent product introductions (i.e., the Desktop S/36) may assume that role.

3. COMPETITION IS HEAVY

- Continuing MUS firms are facing new competition from micro manufacturers upgrading their systems and mini manufacturers offering downscaled versions of their product. Minis are particularly vulnerable to MUSs in the smaller work group environments because the MUS offers much, if not all, of a mini's processing capability at a much lower cost.

- Several mainframe companies, other than IBM, have entered the market, using OEM products. Examples include Burroughs and NCR.

- MUSs are largely based on standard components and microprocessors available from several sources, meaning low barriers to entry. This has led to several hundred vendors offering MUSs, including component suppliers themselves.

- As has been seen in the microcomputer market, marginal MUS vendors will consolidate through acquisition and merger; some will fail due to competitive forces.

4. LANs WILL EVENTUALLY DISPLACE MUS

- LANs will eventually become the best solution for many users, providing MUS functions while supporting independent processing. However, currently there are problems with LANs.

  - They are difficult to configure and often do not function properly.

  - Software supporting a variety of simultaneously working micros is lacking.

  - LAN standards have not stabilized.

  - LANs are more costly on a per user basis.

  - Data transfers through a LAN are slower than those inside a MUS.

- These problems will be overcome. INPUT's forecast shows a slowing growth rate for MUSs due to increasing LAN competitiveness.

5. CONFUSION ON UNIX

- The confusion over UNIX and its various versions is delaying MUS decision making. This will become less of a factor due to the AT&T/Microsoft agreement for compatibility between System V and Xenix.

6. MUS SEGMENT COMPETITION

- There are nearly 200 minicomputer and micro-MUS manufacturers offering approximately 350 varieties of systems. Only a few have attained significant market share.

- The under-four user system segment is the most crowded. Barriers to entry are low since products can be built with standard components using independently-supplied software.

- This segment is categorized by heavy price competition and is becoming more of a commodity market.

- The key factors to success here are high volume, low cost manufacturing, and brand recognition.

7. OPPORTUNITIES

- MUS vendors will find greatest success with cost conscious, first-time computer users in small businesses needing minicomputer power at a lower price.

  - Eighty percent of all U.S. businesses have less than 120 employees according to the U.S. Commerce Department.

  - According to the Small Business Administration, employment in small businesses is growing at a faster rate than in big business.

  - A survey of over 500 small California businesses found 23% planning to purchase computers within the next three years. While California may be more advanced than other parts of the country, the national opportunity this finding represents is similar.

- There are also opportunities in larger companies where installed minis are being replaced with equally functional, but less expensive MUSs, and where standalone micro purchases are reaching levels where buyers are now considering linking them or getting rid of incompatible systems entirely by installing MUSs as a replacement.

- The factors affecting the MUS marketplace are shown in Exhibit V-3.

- Key market trends are shown in Exhibit V-4.

D. STRATEGIC OPTIONS

- Marketing strategy can take two general approaches:

1. HIGH VALUE-ADDED APPROACH

- The vendor must focus customer attention on superior solutions for targeted problems in specific vertical markets.

- Field service, training and technical support must be strong and a full product line must be offered filling customer needs for various sized systems.

2. COMMODITY APPROACH

- A commodity is a product selling at or near actual production and distribution costs.

- Vendors taking this approach need to leverage existing distribution channels and insure the availability of a large number of software packages.

EXHIBIT V-3

FORCES AFFECTING THE MUS MARKET

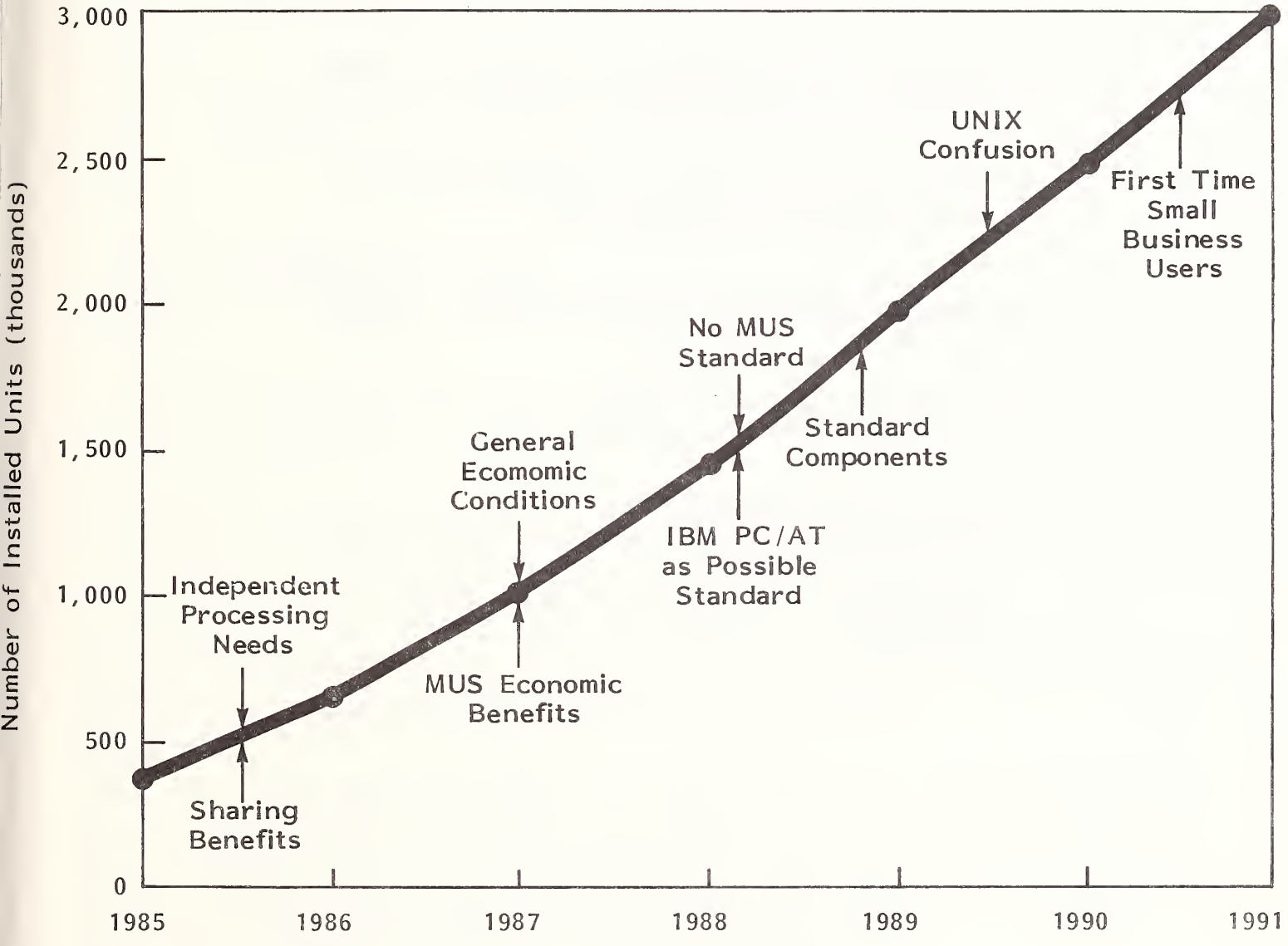


EXHIBIT V-4

KEY MUS MARKET TRENDS

- Smaller, Newly Computerized Business Users Recognizing Current MUS Value
- MUS Promoted to Replace Obsolete Minis and Incompatible Standalone Micros
- Heavy Competition Leading to Vendor Failure, Acquisitions, and Mergers
- Increasing LAN Competition
- Less UNIX Confusion
- IBM PC/AT or Desktop S/36 Recognized as Standards

- Cost leadership may help a vendor achieve market share with volume shipments.

- Because of low margins in commodity strategies, ease of use and installation are important to reduce support costs.

- The commodity approach requires building brand recognition through advertising, merchandising, and promotional campaigns.

- With either value-added or commodity approaches, product differentiation is important to develop a unique identity for the company and its products.

E. SELLING AGAINST IBM

- Makers of AT clones have attempted to compete against IBM based on price, a risky strategy.

  - IBM has cut PC prices, apparently in preparation for new products and also to insure that the PC becomes solidly entrenched.

  - The PC then becomes the base for an upward migration to more powerful IBM systems, including MUS offerings.

- Large corporations have a bias toward IBM which is difficult to overcome. This may be countered by supporting IBM PC (and PC-2) connections to the MUS configuration and by supporting connections to IBM mainframes for increasingly important micro-mainframe applications.

- Vendors also need to overcome the saturation level of micros in large corporations. New systems will often be replacements for obsolete systems, less of a growth area. Unfortunately for the independent vendor, customers are most

often inclined to continue with a familiar, compatible product line when upgrading their system.

- Smaller companies generally have been slow to embrace computer solutions and have further to go before saturation is reached. They are also more price conscious than large businesses and are the main opportunity for multi-user system sales.

- MUS vendors need to strengthen their ways of reaching these fertile prospects quickly to preempt IBM initiatives.

- MUS vendors' strategic options are described in Exhibit V-5.

F. RECOMMENDATIONS FOR NEW MUS VENDORS

- Vendors developing new MUS products must recognize the highly competitive marketplace, particularly for smaller (up to four users) systems. Latecomers need to overcome the market lead of existing vendors, including those with greater brand recognition.

- While this is not an easy task, there are a number of strategies available. The most critical strategy for new vendors is to avoid direct competition with market leaders. Success may also be found by going against trends and identifying very specialized needs.

- New vendors should focus attention on value added reseller channels and vertical markets. Resellers configure existing hardware with industry specific software to solve information management problems. Packaging MUS with special software (e.g., for medical or legal offices) will be more successful than positioning a new product for general office use.

EXHIBIT V-5

MUS STRATEGIC OPTIONS

HIGH VALUE APPROACH	COMMODITY APPROACH
• Superior Solutions	• Leverage Distribution Channels
• Niche Marketing	• Attain High Volume and Market Share through Cost Leadership
• Strong Support	• Reduce Support Costs

- Differentiate Products
- IBM Co-existence or Competition

- Specialized niche products allow for higher margins permitting small, entrepreneural companies to participate profitably despite the lack of economies of scale enjoyed by larger companies.

- New entrants should leverage their marketing flexibility and their ability to address developing niche markets quickly.

- Exhibit V-6 summarizes these recommendations.

G. RECOMMENDATIONS FOR EXISTING MUS VENDORS

- Minicomputer vendors need to recognize the risks of jeopardizing their current product line by designing strategies for upward migration and compatibility with their continuing products. Mainframe and mini vendors should concentrate on their service and user support abilities, building on their existing distribution strengths and product line compatibility.

- These recommendations are shown in Exhibit V-7.

- Both existing and new vendors need to differentiate their products from those of competitors. As functionality and price/performance issues become less important due to product similarities, attention needs to be focused on support, economics, and stylistic considerations.

  - For many prospects, vendor support, image, and style may be deciding factors between two otherwise similar products.

  - A design fitting corporate office decor, especially in high client contact industries, or fitting user self image may be favored.

EXHIBIT V-6

NEW MUS VENDOR RECOMMENDATIONS

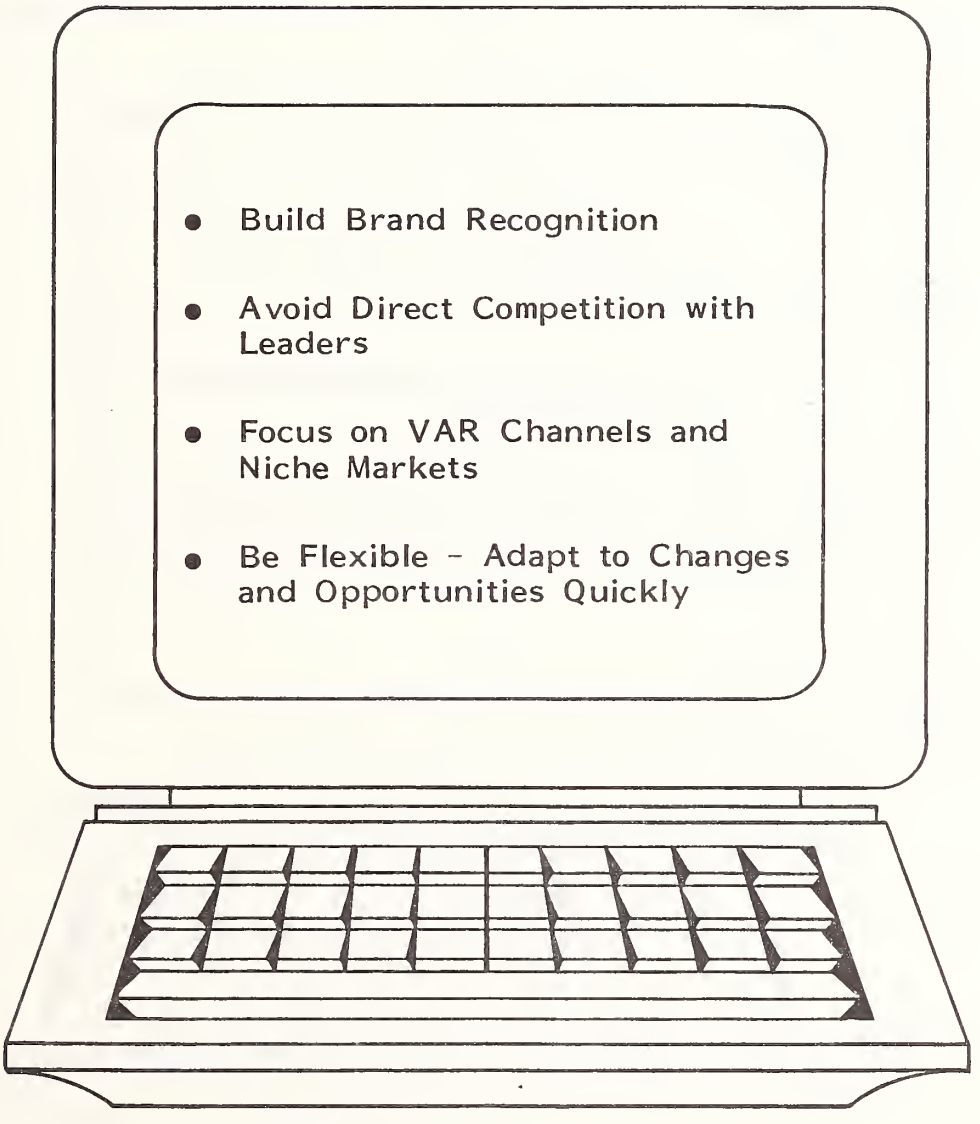
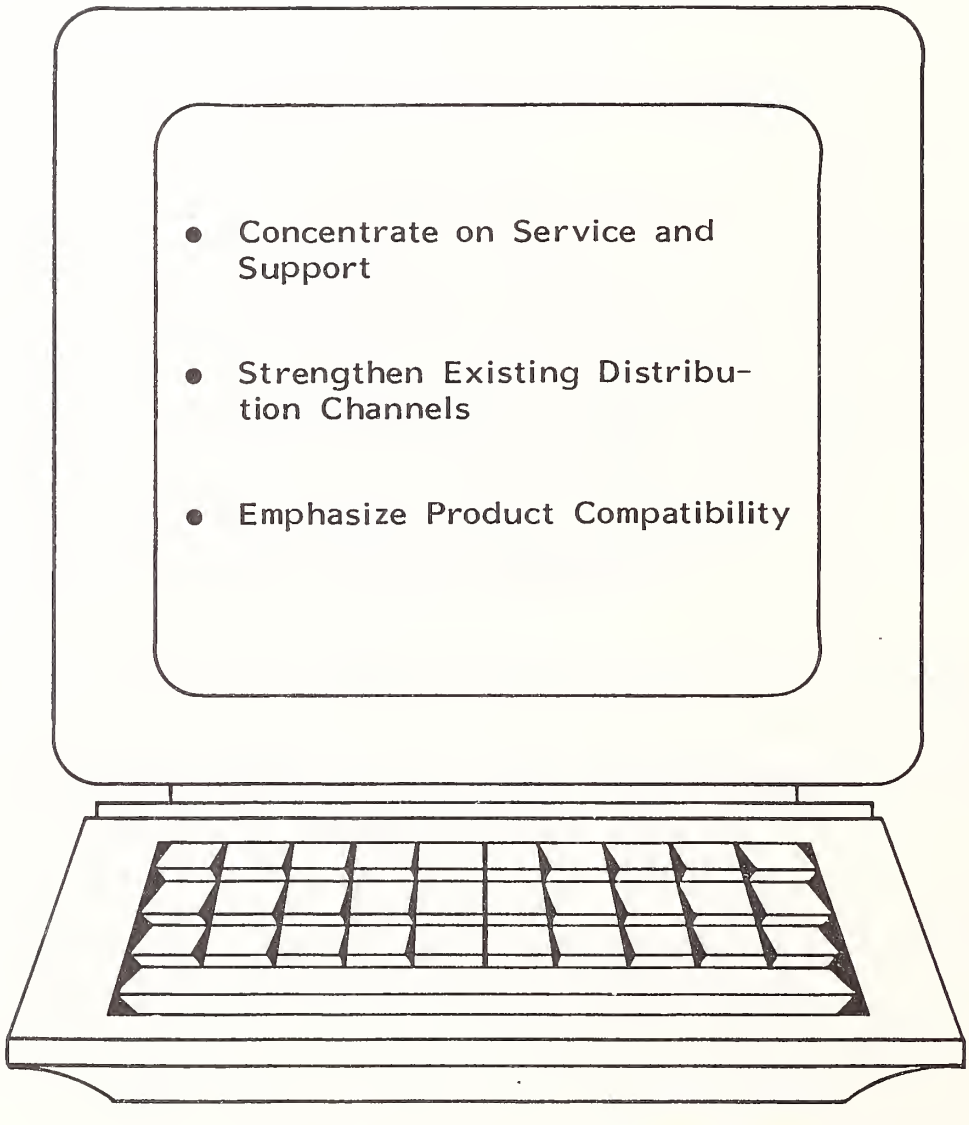


EXHIBIT V-7

EXISTING MUS VENDOR RECOMMENDATIONS



H. DISTRIBUTION OPTIONS

1. DIRECT SALES

- Direct sales, while costly, account for approximately 25% of MUS sales.
- Sales directly to end user department managers will often bypass IS, and managers will be recruited as champions for the vendor.
  - This relationship is risky as IS may resent the end run around its perceived responsibility, a situation remembered and quickly controlled when microcomputers were introduced.
  - Vendors need to cultivate this surrogate relationship carefully, bringing IS into the decision loop.
  - In some settings, end user departments do have responsibility for office system selection with minimal IS involvement, especially when mainframe linkages are not required.
  - A benefit of selling directly to end user departments is less bias toward mainframe and minicomputer vendors whose products are used for data processing.

2. ORIGINAL EQUIPMENT MANUFACTURERS (OEM) INCLUDE TELECOM, OA COMPANIES, AND SOFTWARE VENDORS

- OEMs buy software and hardware as components for systems sold under the OEM's name.
- Smaller MUS firms should investigate OEM relationships, particularly with the now divested Bell Operating Companies (BOCs) entering office system markets and with companies seeking to diversify their product lines.

- Several of the BOCs are buying or opening their own retail chains, hiring experienced sales staff and combining sales, service, and financing under one roof.

- Other possible office system OEM channels include peripheral manufacturers (optical character readers, terminals, printers, modems), telecommunications vendors, and software houses who have much to gain by integrating their software, particularly for vertical industry applications, with hardware.

3. NEW ROLES AND RESPONSIBILITIES FOR RETAILERS

- Retail outlets have offered limited success to some MUS vendors due to profit margin pressures, system complexity, and requirements for after-sale support.

- However, other vendors interviewed say retail channels have been responsible for over one-third of all computer system sales to business overall and an even larger share of sales to small companies. If a vendor can secure shelf space, the retail route works, at least for micro sales.

- Retailers in general do need to improve the quality of their sales staff with training programs, and must work to overcome the high turnover rates common in the trade.

  - Some chains are using closed-circuit satellite television or videotape training programs.

  - These private broadcasts and videos present sales training modules, policy issue discussions, new product announcements, vertical market seminars, guest speakers, and client training.

- Similarly, vendors need to help retailers to ensure system familiarity and sales staff expertise.

- If they fail to improve service provided to customers and vendors, the retailer's role may change to lead generation, with incentive programs and finder's fees replacing markups.

- Independent retailers may be recruited in a hybrid of the VAR approach; retailers have visability in their communities, but need to develop vertical industry knowledge and skilled staff able to configure systems to specific client needs.

4. THE CRITICAL IMPORTANCE OF VALUE-ADDED RESELLERS

- VARs are typically software companies which write industry or function specific software, package it with hardware, then sell the resulting system under their label.

- VARs are particularly important in the UNIX segment of the market as their software works to overcome the user interface problem. Applications are designed so users work with a simplified package rather than with the operating system, which essentially becomes transparent.

- VARs are using the portability of UNIX to lessen their dependence on specific hardware vendors with proprietary operating systems. Software written for one UNIX machine can be easily moved to another. Some VARs are moving away from expensive minicomputers toward microprocessor-based multi-user systems.

- The ability to transfer applications to other machines makes it more important for hardware vendors to support VARs in various ways to prevent them from changing to competitive machines.

- Sales through VAR channels are less price sensitive than retail sales, where outlets often compete on price.

- VAR strategies may be critical for smaller vendors hoping to survive the marketing force of major vendors. VARs may also work through independent retailers who offer local market area awareness.

- Smaller businesses are less committed to buying IBM products than large businesses where compatibility is an important issue. For many vendors, turnkey approaches to small businesses will be the only viable strategy.

5. VALUE-ADDED DEALERS

- VADs are similar to VARs except that third-party software is usually bundled with a single equipment line for specific needs and the resulting product is not renamed. The strategic benefits are the same as for VARs.

- Exhibit V-8 shows MUS distribution channels.

6. COMPUTER MARKETS

- Another sales route is the computer market concept, a showroom where users can compare competing systems.

- Computer markets are geared to small and medium businesses, which should be the principal MUS vendor targets. The showroom can provide visibility for companies without the resources for a direct sales force.

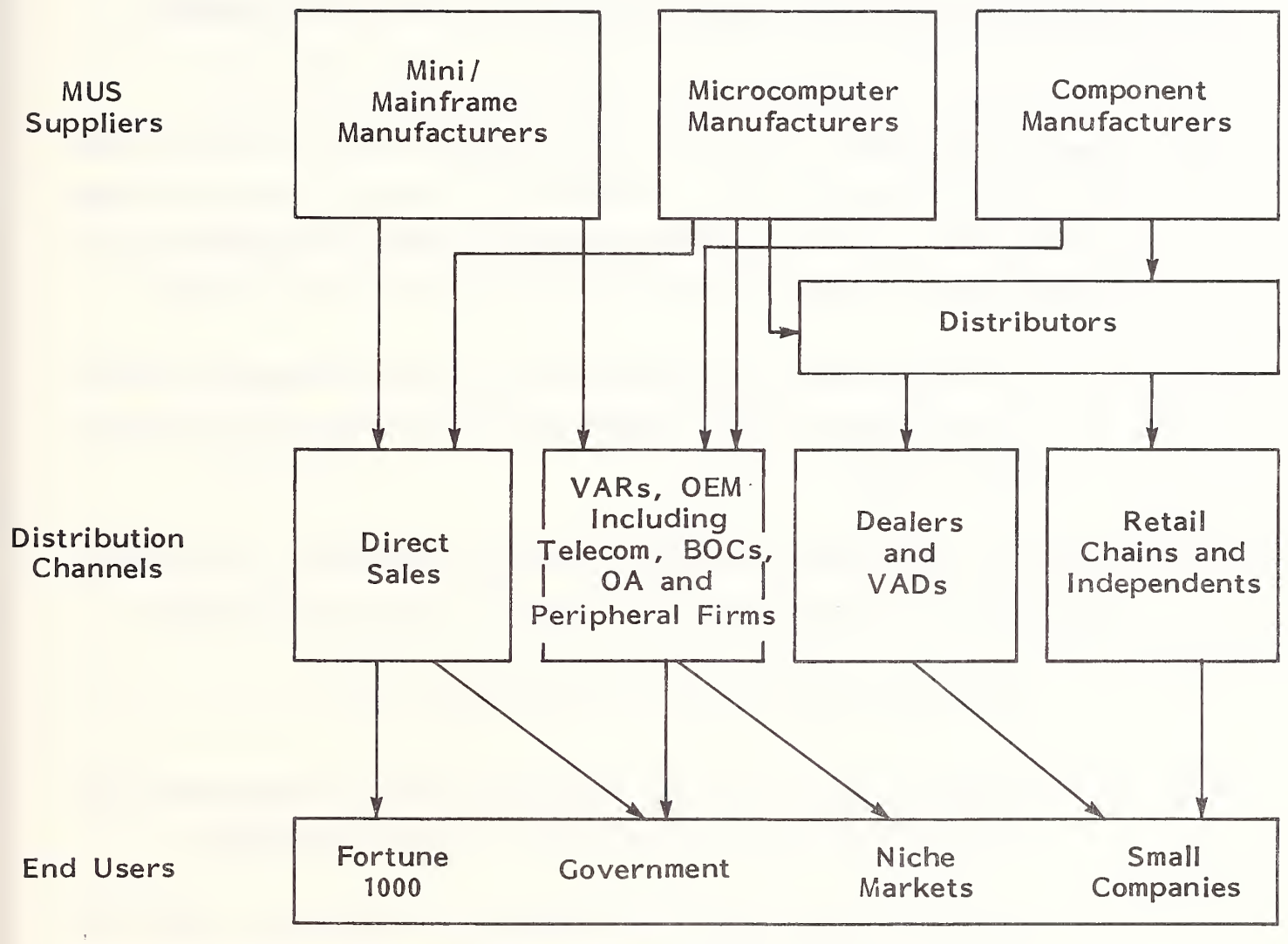
- However, the computer market is still unproven.

7. CULTIVATE CONSULTANTS

- Computer consultants are becoming more important to users, helping them evaluate the complexities of a confusing market, new technological approaches, and the range of choices available.

EXHIBIT V-8

MUS DISTRIBUTION CHANNELS



- MUS vendors need to develop good working relationships with consultants through special briefings and other outreach efforts to ensure that specific product features are recognized for specific customer needs.

I. CONSIDER MERGERS, ACQUISITIONS, AND STRATEGIC PARTNERING

- Merger and acquisition activity in the information services industry topped $3.5 billion in value last year. This strategy is viewed as a path to a larger revenue base, a means of providing single-source service to customers, and a way of building strength with the whole exceeding the value of the parts.

  - The MUS market has had several acquisitions and mergers this past year: Corvus and Onyx, Zitel and Gifford, and Durango and Molecular are examples.

- An option to acquisiton and merger is strategic partnering, with companies entering trial agreements eventually leading to more permanent bonding.

  - Each takes a role in a master strategic plan.

  - Strategic partners can gain control over business areas outside their current capabilities or resources due to current specialization.

  - Many computer vendors have entered such agreements: AT&T with Amdahl and Convergent, and IBM and various component manufacturers are examples. VAR agreements are also a form of strategic partnering.

- However vendors should be forewarned that strategic partnering cannot prop up weak companies lacking competitive strength. Rather, such relationships will often exacerberate current weaknesses.

- Small companies may have advantages in rapidly developing markets. Their flexibility means faster decisions, not easily achieved by larger companies. In the volatile MUS marketplace, this means quick responses to developing niche opportunities, new products preempting announced but not yet available systems, and the exploitation of developed marketing channels.

- More information on strategic partnering can be found in INPUT's 1985 study Merger/Acquisition Strategies in the Information Services Market.

J. CONSIDER INTERNATIONAL MARKETS

- While the U.S. is experiencing a slowdown in the information services industry, there are opportunities overseas, particularly on the European continent.

  - Europe has had slow, steady growth in demand for computer products.

  - Vertical market opportunities, such as in insurance and banking, are developing quickly.

- International marketing usually requires overseas partners to handle distribution and support.

K. CREATIVE MARKETING IS NEEDED

- Competition is heavy for essentially the same users. Products are being perceived as having similar capabilities. Accordingly, vendors should evaluate their marketing approaches.

- One vendor seeks trade industry endorsements for vertically targeted systems.

- Direct mail campaigns can be targetted using brokers' lists. Brokers often allow list testing, meaning results can be projected using a relatively small and inexpensive sample. Direct mail is useful for lead generation.

- Telemarketing, complementing other marketing methods, has brought impressive returns to companies which properly plan their campaigns. Telemarketing is useful to qualify prospects and for customer service.

- Emerging media may offer unique marketing opportunities.

  - Videotex services, while slow to gather subscribers, are often used by computer literate prospects.

  - Videotex services and on-line data bases often have on-line shopping and advertising.

- Business television programs are produced by the Financial News Network, the Wall Street Journal, and local independent producers.

  - There are several computer and business-oriented Public Broadcasting Service (PBS) programs. PBS underwriting rules have been liberalized over the past few years and offer a cost effective way to reach qualified prospects while enhancing corporate imagry.

  - Radio business report sponsorships are another option.

- The key focus of marketing efforts should be the unique appropriateness of the product for solving specific business problems and the image presented to establish product and company identity.

- Exhibit V-9 completes INPUT's recommendations to MUS vendors.

L. TECHNOLOGICAL RECOMMENDATIONS

1. ARCHITECTURE

- Bus standards enable add-on upgrade board sales, giving the user flexibility and a second source of components. Vendors can participate in this after-sale market by using joint marketing arrangements to become an outlet for add-on product vendors.

2. CHIPS

- Eight-bit technology is increasingly seen as a technology of the past. Sixteen-bit, 16/32, and true 32-bit processors are the emerging dominant technologies. MUS vendors with a significant 8-bit installed base must provide migration paths to higher level systems.

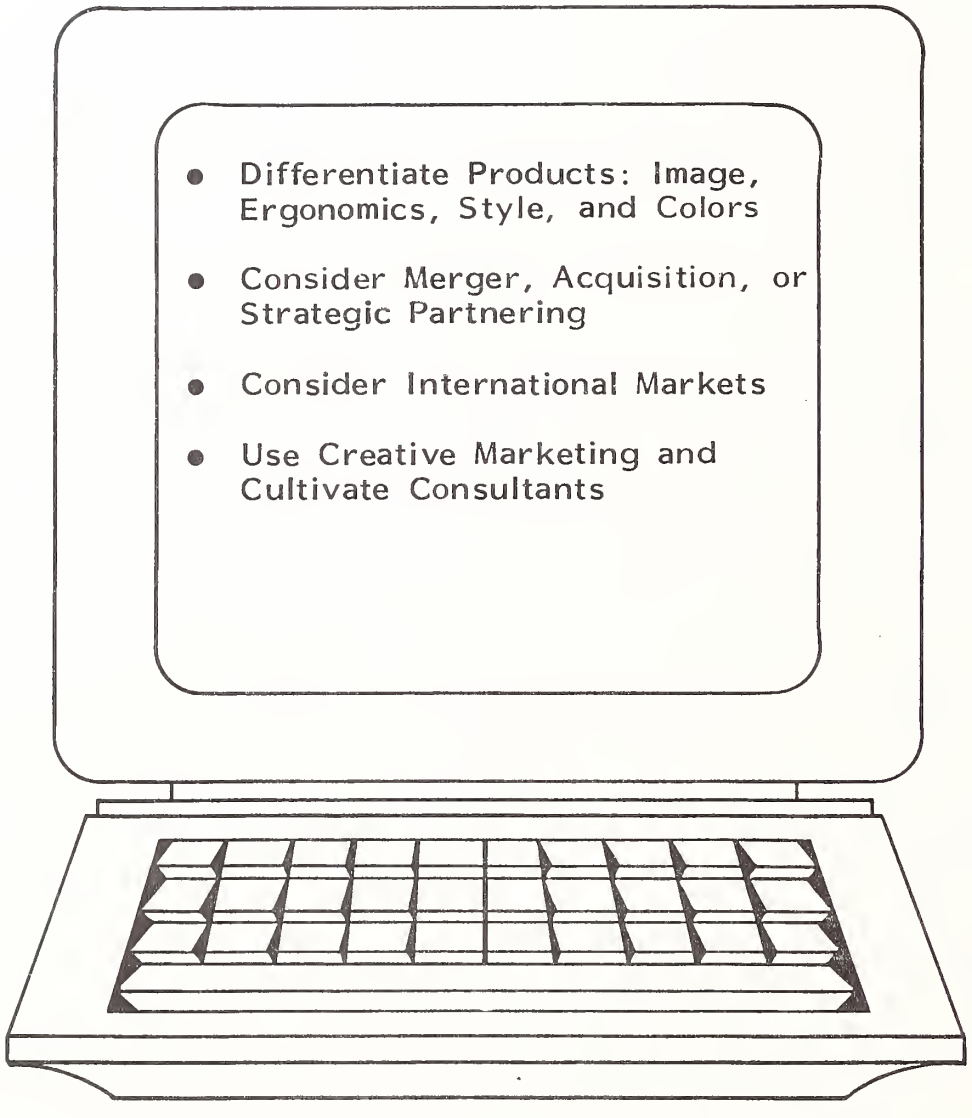
- Using standard chips (e.g., the Motorola 68000 or Intel's 80286 - used in the AT) is an advantage in component sourcing and software availability, and since more software is available to users, system utility and perceived value is improved.

3. SOFTWARE

- In the past, software and operating systems were proprietary to a MUS manufacturer's equipment, but this has changed significantly due to availability of these elements from third parties.

EXHIBIT V-9

RECOMMENDATIONS FOR ALL MUS VENDORS



- Bundling software with equipment can be an important competitive strategy, but also one which affects margins, particularly in the retail channel.

- The perception of limited MUS software availability must be addressed. Users do not really need thousands of packages, but a large number of choices feeds user needs for the security that an application needed will be found.

- Increasingly, minicomputer software is being adapted to MUS systems. Channels for making this software available need to be strengthened by vendors.

- Applications developers need to take advantage of new chips and operating system capabilities to write easier-to-use, more concise solutions to users' problems.

- MUS software is needed for UNIX systems, especially since this market will become more significant in the medium term (1988-1990) and since it will remain important, even after losing dominance to a projected new IBM operating system.

- Software written in C can be transferred to UNIX systems and may be adapted to emerging operating systems as well. MUS support of other languages (Fortran, Cobol, Basic, and Pascal) and fourth generation languages also leads to more available applications and facilitates in-house customization.

- There are opportunities to establish popular MUS products, similar to the way certain applications, such as Lotus 1-2-3, have become "hits" on microcomputers. There are also needs for MUS communications software and program development tools.

- Software development for MUSs is similar to mainframe development, but is much more difficult than writing programs for 8-bit microcomputers.

- Micro software could be relatively primitive. However, the 16- and 32-bit chips featured in modern MUSs are exponentially more complex than their predecessors.

  - Development requires programmer discipline through organization, planning, and review of the work. Many micro programmers are unprepared to deal with the complexities. The risks of failure or inefficiency are great.

  - Attention needs to be paid to special languages, compilers, and operating systems for realtime multitasking, multi-user systems.

- The most effective way to develop MUS software is to adapt mainframe and mini versions and use proven, available components, utilities, and development tools, rather than initiating the project from its basic elements.

- Such development often requires a team approach, with each member responsible for a segment of the overall application.

4. OPERATING SYSTEMS

- Multiple operating systems must be offered on any MUS to expand software availability.

- Bridges to popular single user software packages should also be bundled with systems to serve this function. This takes advantage of user familiarity with functional packages, even though users must sometimes give up multi-user capabilities while using them.

- While UNIX is viewed poorly at the present, there is every indication that it will be a significant MUS operating system in the 1988-1990 timeframe, especially since UNIX System V and XENIX will essentially become one. This

will to some extent solve the problem of too many UNIX variations. Another factor, of course, will be the staying power of AT&T and its commitment to UNIX.

- However, the significance of UNIX may diminish when IBM introduces an equally if not more capable operating system, probably based on PC-DOS and TopView, thus establishing a second MUS operating system standard.

  - However, IBM's overall strategy is still linked to mainframes. In environments without mainframes (or without the requirement to communicate with mainframes), IBM's advantage will be dependent on its service, support, and migration paths.

  - Other vendors must provide the optional capability to link with IBM mainframes.

- UNIX acceptance as one standard will diminish user commitments to proprietary hardware and software turnkey systems. This encourages hardware manufacturers who have less strength in software (e.g., the Japanese).

5. SUPPORT AND TRAINING

- MUSs are being considered for applications that formerly were served by minicomputers. Mini vendors have traditonally provided extensive service and support for users.

- INPUT's 1984 study Service Market Analysis and Forecast: Office Products reports a drop in interest for third-party maintenance of MUS and an increased reliance on system vendors.

- Support and training are important ways to increase revenues over system sales. Some vendors have moved away from using third-party sources for these services to allow greater profit participation.

6. USER INTERFACE

- Ease of operation is an important MUS aspect, especially since they are often sold to those with low computer literacy. The interface is a combined function of software, hardware, and operating system design.

- User friendliness leads to less required support and training which can affect profit margins. The required overhead may affect CPU peformance, however.

7. VOICE/DATA/IMAGE INTEGRATION

- Voice/data integration initiatives are logical extentions of the integration of services, but as yet have failed to be wholeheartedly embraced by users. This is partly due to separate purchasing channels for voice and data communications and to slow recognition of the benefits of integration.

- This is changing, with awareness being created by AT&T's voice/data office systems and with integrated products from Sydis, IBM/Rolm, and others.

- Voice data integration takes two forms:

  - Voice communications is merged within the workstation, adding "smart telephone" features such as directory dialing, conference calling, speakerphones, and perhaps voice mail functions.

  - Voice annotation incorporates instructions or comments within the body of an electronically stored text document.

- Voice/data integration should be an available option. Vendors should accomplish this through private labeling of add-on boards and software or by selling third-party modules, not by developing these products themselves.

- While the market for voice/data terminals has yet to emerge, availability of these features helps the vendor's image, with the products representing "cutting-edge" implementations.

- Essentially, image integration other than machine encoded computer graphics digitally photographs and stores documents or visuals. This has applications in banking (for signature verification), real estate (for property presentations), and electronic filing systems.

- Both voice and image integration demand increased storage capacity and supporting software.

8. FEATURES

- Section C-1-h of Chapter IV describes the functions most desired by users.

- While in practice many features are unused, their availability enhances perceived product value and improves the evaluation rating given competitive products.

- Exhibit V-10 summarizes INPUT's technological recommendations.

M. PRICING TRENDS

- Multiprocessing technology advancements will continue, leading to declining per-unit MUS costs but requiring short-term recovery of research and development expenses.

- Since the barriers to entry are low, due to the availability of off-the-shelf hardware and software components, competitive pressures are increasing.

EXHIBIT V-10

MUS TECHNOLOGICAL RECOMMENDATIONS

RECOMMENDATION	BENEFIT
Standard MUS Architecture	Vendor Component Sales on OEM Basis
Use Commodity Chips	More Software, Greater Utility
Third-Party Software Availability	Profit Participation, Greater Utility, Avoid Development Risks
Multiple Operating System Support, Including UNIX	Extend Software Available, Linkages to Mainframe, Free Users Captured by Proprietary Operating Systems
Vendor Support/Service	Profit Participation
User Friendliness	Improve Value to New Users, Reduce Support Costs
Third-Party Sourced Voice/Data Image Integration Options	Enhance "Cutting Edge" Image
Full Feature Availability	Improves Perceived Value

- Offshore component manufacturing and economies of scale will also reduce costs and prices.

- Minicomputer firms such as DEC are competitively pricing their MUS products, focusing on fully integrated, supported, easily used, compatible product lines rather than attempting to become price leaders.

- Mini firms are also moving their MUS products to greater performance levels while maintaining price levels--the "bigger bang for the buck" strategy.

- Venture capital (VC) support of vendors and bank loans are harder to obtain. Many VC firms are denying second and third financing rounds and are increasing profit margin pressure.

- Competition from Japanese firms will not likely lead to immediate pressures on MUS pricing. However, in the long term, the combined competitive effects of AT&T, Japanese vendors, and IBM's MUS movements will lead to pricing competition, especially if any of these companies (other than IBM) fails to gain market share within the next five years.

- Prices will tend to stablize in the near term (two to three years) in the $4,500-7,500 per user range (12-16 user systems), due to the need to maintain adequate margins for the VAR, VAD, OEM, and retail channels used in marketing MUS. Small system (two to three users) average prices are approximately $7,000.

- By 1990, prices for 12-16 user systems will drop to the $2,500-5,000 per user range, seen by vendors as necessary for the mass deployment of equipment.

  - This range is also seen as the bottom end, since it is difficult to maintain profits below this level and since hardware prices will tend to be dwarfed by training and installation costs.

- Small system prices will average $5,500, primarily due to technological improvements by 1990.

- The opposing forces affecting MUS pricing are shown in Exhibit V-11.

N. TECHNOLOGICAL TRENDS

1. CURRENT TRENDS

- Most of the recently introduced MUS micros feature multiprocessor architecture. This architecture is more reliable and offers improved response times and greater software and operating system flexibility than do single processor systems.

- Some recently introduced MUSs such as the Fortune 32:16 also use 32-bit microprocessors. There are four principle 32-bit buses; others are under development.

  - These buses are designed to optimize component performance, fully exploiting Very Large Scale Integrated (VLSI) technology.

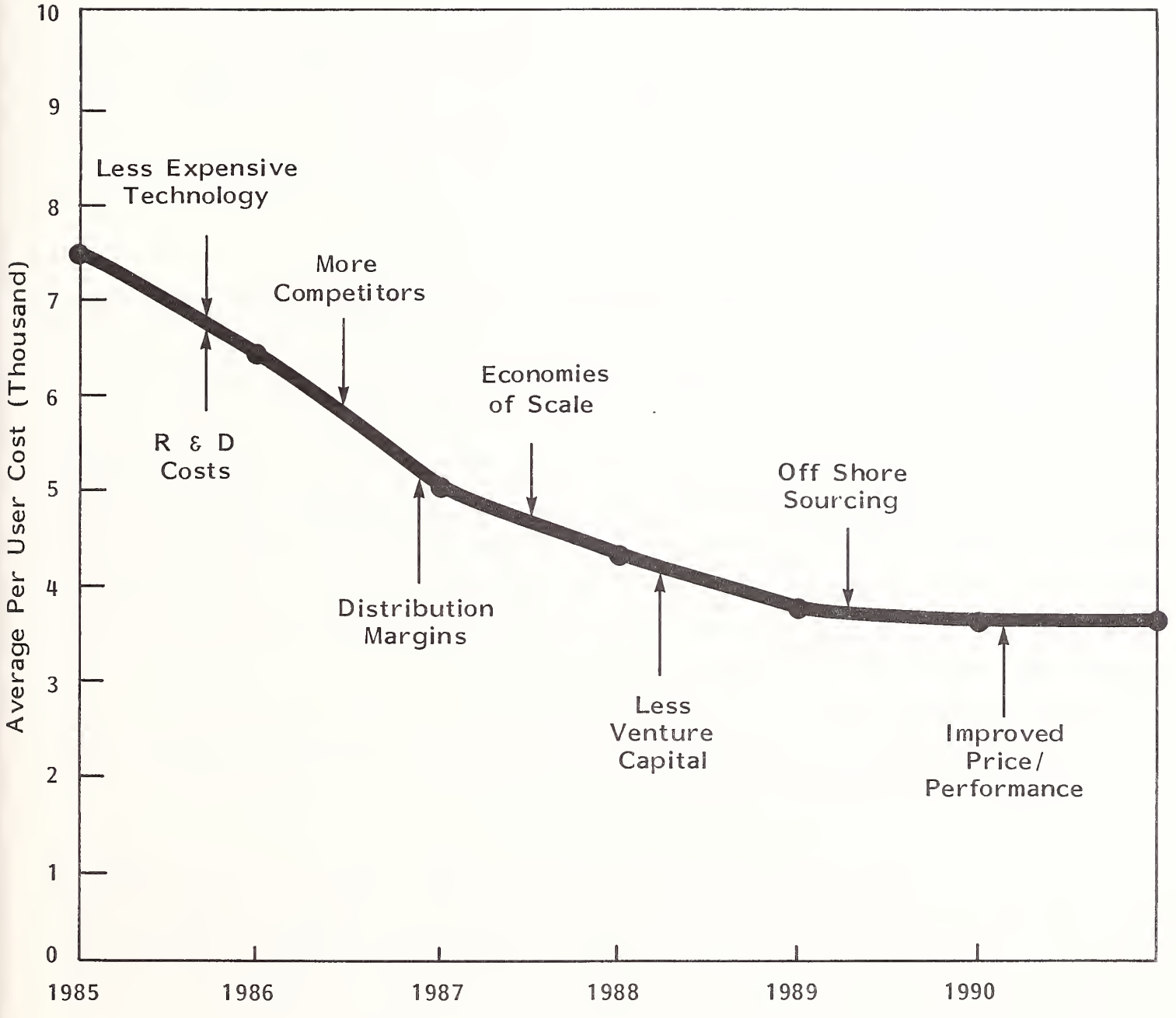
  - VLSI technology provides for more capabilities in smaller components, usually at a lower price than earlier technologies.

- Common chips are being used, especially the 32-bit Motorola 68000 and Intel's 16-bit 80286 series, leading to more standardization.

- The use of coprocessors, giving greater CPU efficiency and providing compatibility with PC DOS systems, is another trend.

EXHIBIT V-11

FORCES LEADING TO MUS PRICE STABILITY



- For example, IBM is expected to offer coprocessors on its desktop minis, allowing them to function as standalone PCs or as multi-user systems.

- A coprocessor will also give the AT cluster controller (3274) capabilities supporting the connection of 3270-type terminals to corporate mainframes through the AT.

- The trend toward MUS standards means open systems allowing users to interface with applications, operating systems, languages, and hardware. Closed systems only allow interaction at the application level.

2. FUTURE TECHNOLOGY

- Microprocessor speeds are improving, with 25 MHz speeds already possible.

- Memory improvements will continue in both RAM and mass storage.

  - Laser disks, eventually with economical read and write capabilities, promise exponential increases in storage capacity. Laser disk readers are expected in the market in 1985, with Sony's planned drive which can be inserted in a micro and Digital Equipment Corporation's Digital CD (for Compact Disc) Reader available for the MicroVAX and also licensed to IBM.

  - Memory increases are also possible with magnetic disks using vertical recording technology.

  - Advances in integrated circuits and the expected 1986 availability of AT&T's "megachip," capable of storing over 1 million rapidly accessible bits, promise to bring impressive RAM capacity improvements to MUS.

- The next generation of the Intel 80286 (used in the IBM-AT), designated the 80386, is expected in 1986-87. It will be compatible with the earlier chip and provide even more 32-bit minicomputer-like functionality.

- With these advances, supporting software improvements are needed. For example, laser disk storage makes possible voice and image applications, requiring multi-media document processing software.

- Key MUS technological trends are shown in Exhibit V-12.

O. COMPETITIVE ANALYSIS

- Evaluating competitors' products and strategies is important for both new and continuing vendors in order to aid in forming a company's own plans and also to identify possible candidates for acquisition or strategic partnering. This section profiles the MUS vendors.

- Representative MUS products of these companies are described in Appendix D.

I. ALPHA MICRO SYSTEMS

- Founded in 1977, this low profile company was an early leader in the MUS marketplace but has experienced a slowdown due to the introduction of the IBM AT.

- Observing longer sales cycles in VAR channels, Alpha is emphasizing OEM channels, where it hopes to attain half of its revenues within four years.

- The company also agreed with a Japanese systems integrator to offer Alpha products in the U.S., a change from the usual Japanese strategy of selling components for domestically assembled systems.

EXHIBIT V-12

KEY MUS TECHNOLOGICAL TRENDS

- Current Trends
  - Multiprocessor and Coprocessor Architectures
  - VLSI
  - Motorola 68000 and Intel 80286 Chips
  - Open Systems
- Future Trends
  - Faster Microprocessors Including the Intel 80386
  - Laser Disk and Vertical Recording Magnetic Mass Storage
  - Increased Capacity RAM Megachips
  - Supporting Software Improvements

- Alpha's strategy is to offer an inexpensive upgrade path for users who are outgrowing their standalone micros.

- Alpha is counting on a line of videotape-based storage and communications products for market differentiation.

  - Its video based wide and local area networks carry data like a TV signal.

  - The network can be used by cable television systems and data can be broadcast via satellite, allowing customers to set up low cost webs based on $1,500 satellite dishes.

- Alpha is establishing factory direct field service offices by buying service companies.

  - This will give it more control over service, especially for national account customers with dispersed locations.

  - It will provide better feedback from customers and the field.

  - The company will participate in service revenues generated by the installed base.

- In addition to its proprietary AMOS operating system, Alpha offers CP/M bridges and will introduce UNIX and MS-DOS options to increase software access beyond the several hundred now available for vertical industry applications.

- The company had a 78% sales increase and a 15% earnings increase in 1984. Although sales dropped in 1985, Alpha has done better than many other MUS vendors.

- Alpha's service strategy (designed to help it get closer to its customers), the fine tuning of its distribution channels, and its product line and differentiation are all indicators of continued participation in the MUS market.

2. ALTOS COMPUTER SYSTEMS, INC.

- Altos was the first with a single board MUS. It is one of the most successful MUS vendors, with a reputation for competitive prices, reliability, and product advancements.

- Central to its strategy are Altos-sponsored business training workshops for approximately 1,500 value added resellers. Less than one-fourth of its sales are through direct channels and the only retail chain used is MicroAge.

- Altos' promotions include corporate sponsorship of sporting events. It advertises in vertical market publications and general business journals. Dealer promotional costs are shared. The company has an aggressive lead generation program with queries quickly leading to local dealer followup.

- The company actively seeks trade group endorsement for its turnkey systems. These endorsements reportedly cut selling cycle time in half.

- Altos projects that vertical markets will account for at least half of its 1985 growth. Targetted sectors are dental, medical, pharmacy, construction, insurance, real estate, wholesale distribution, accounting, auto repair, local governments, and manufacturing.

- The Altos 16- and 32-bit systems use the XENIX operating system, and there is less emphasis on its older Z80-based 8-bit machines. The new 20-user 2086 is compatible with the IBM AT. The company concentrates on selling the upper end 3068 machine to OEMs and large accounts.

- The Altos Software Availability Program (ASAP) evaluates and provides XENIX/UNIX products from third-party software vendors.

- Altos uses its relative financial strength as a competitive point against other MUS vendors, such as Fortune. The company expects to become a $1 billion company by 1990.

- Altos sees acquisitions strengthening its market position. For example, it owns one-third of terminal maker Wyse Technology and is buying an equal position in an unnamed software company.

- Altos' reputation for competitively priced, reliable MUSs is intact. It is regaining confidence with its dealer network and is overcoming management changes, including the return of former company executives. It should maintain a respectable portion of the MUS marketplace.

3. AT&T INFORMATION SYSTEMS

- This unit of the divested communications giant is going into office systems in a big way and shows every sign of applying its resources for the long haul. Many view its UNIX-based systems as the only viable alternative to IBM dominance in information management.

- However, AT&T's initial computer products, such as the first release of the PC 6300, were considered to have mundane capabilities and software applications. The company has has been slow to develop IBM mainframe links for its computers.

  - Products offering this capability have been recently announced and are necessary, given the realities of the market.

  - Newer systems and upgrades better illustrate AT&T's technological potential than did its first computers.

- AT&T has been preoccupied with its divestiture. It is handicapped by regulations prohibiting bundling its communications and computer capabilities, but this will change.

  - The company hopes IBM's recent purchase of up to 30% of MCI and the earlier acquisition of Rolm will lead to an easing of regulatory constraints.

  - The IBM purchase will be used as proof of competition in information services, meaning less reason to limit AT&T.

- The conversion from a regulated monopoly to a free market player has not been without growing pains. There have been mid-course marketing corrections and a reorganization into three lines of business. AT&T has strengthened its national accounts sales staff with recruits from IBM. It has retrained sales personnel in the art of tailoring computer systems to meet customer needs.

- AT&T's computers are entering their second generation, but the company has some significant challenges ahead.

- The 3B series of minis and micros are primarily sold to the regional Bell Operating Companies. AT&T's UNIX machines are not likely to sell in significant numbers until more software is available. While the hundreds of packages available are enough for most users, user psychology requires thousands of software applications to feel "safe" with a product.

- AT&T sold less than 30,000 micros in 1984, compared to IBM's sale of 1.5 million. The projected short-term shipments of AT&T's computers (under 100,000) may not be enough to encourage software developers to write applications, a chicken and egg situation. It is estimated that in 1985 less than 50,000 UNIX PCs will be ordered from Convergent, which builds them for AT&T, and approximately 70,000 are estimated on order for 1986.

- AT&T recognizes the software availability problem. It has agreed with Microsoft to build compatibility between UNIX System V and XENIX. It has reorganized its software development efforts to focus on vertical market applications. It co-labels applications from independent software vendors (ISVs) who support those packages.

- AT&T recognizes a need to draw on others for both software and hardware. Alliances are central to its strategy, but some have criticized this strategy as being without focus.

  - AT&T purchased one-fourth of Olivetti, acquiring both manufacturing capability and a European partner.

  - It may buy a software company.

  - There is partnering with Amdahl to sell UNIX mainframe software and reported discussions with Control Data.

  - There is an exclusive long-term contract with Convergent Technologies for the production of the UNIX PC MUS.

  - There are other alliances for shared tenant services (with United Technologies), electonic banking/brokerage (with Chemical Bank and Bank of America), and financial information systems (with Quotron Systems), as well as agreements with Japanese companies for Value-Added Network services and equipment.

  - There is speculation about a microcomputer company buyout to gain expertise in specific niches.

    . Companies named as possible AT&T targets include Apple, DEC, NCR, Wang, and Xerox.

- However, it is more likely than any acquisition will be a small, leading-edge company involved in a specialized, high growth area such as health care.

- The company objective is to sell half of all AT&T micros to corporate America. It has a 6,000 member sales force dedicated to this task and most of their compensation will come from commissions as an incentive.

- AT&T also wants to sell more PCs through retail outlets; however, other MUS vendors have not found this channel as productive as might be wished. Retailers are also resentful of the company's national accounts program. Still, more retailers are carrying AT&T's products, and company plans call for nearly 2,000 outlets by the end of 1985.

- The company reportedly has signed 50 VARs focused in vertical markets such as brokerage, financial services, health care, accounting, advertising, public relations, and scientific markets. This niche strategy will continue.

- AT&T's technological strategy revolves around highlighting the communications capabilities of UNIX, particularly for distributed data processing.

  - This ties into AT&T's telecommunications strengths, which it hopes will give it an edge over rival IBM.

  - Siemens, Phillips, and partner Olivetti have adopted UNIX for European markets, hoping to counter IBM's dominance in these countries.

- Selling office systems and telecom gear are two different, although now more closely related, processes. AT&T's technology is respected, but its new sales force needs time to develop the personal relationships which are an important element in selling. AT&T does have the time.

- Considering the company has only recently been allowed to enter the computer business, and considering its size and resources, the chances for success are good. But that success probably lies in the mid- to long-term future (after 1989). Meanwhile, its rivals (IBM included) are also selling UNIX machines.

4. COMPAQ

- Compaq is a computer history success story, with its IBM PC compatibles making it the second largest supplier of 16-bit microcomputers and the largest supplier of portables.

- In 1985, the company introduced desktop and portable AT compatibles. These machines run AT software up to 30% faster than the machine they mimic, according to Compaq officials.

- Compaq enjoys loyalty from its dealers, supporting them with advertising, training, and liberal discounts. It avoids competing with dealers with its own direct sales.

- Its success is attributable to its strategy of IBM PC compatibility with systems that are portable and in some ways more functional. Users have IBM software and peripherals readily available and dealers do not have to stock unique Compaq products.

- The company is well managed, controls its finances, and buys components inexpensively. It recognizes its continued success is volume dependent.

- Continued success is forecast for Compaq. Because of its market position, it will migrate users of its earlier systems to the new AT compatibles as well as sell to first-time users.

5. CONVERGENT TECHNOLOGIES

- Convergent continues to be the dominant MUS vendor though its OEM agreements, innovative products, and strong management team. It has virtually no close competitors in this segment, but it pays the price by operating on close margins.

- Convergent introduced the IWS (for Integrated Work Station) in 1980. The company refocused its efforts from distributed data processing to office systems to meet the needs of their OEM customers. The AWS (for Advanced Work Station) was introduced in 1981 and cost approximately half of a comparable IWS, due a simplified modular design.

- The NGEN, introduced in 1983, is sold exclusively through OEM channels. NGEN's modular configuration has been expensive for the company and profit objectives may be elusive for the near term. In fact, Convergent first announced one price for the NGEN, discovered it cost more to make than first estimated, and hiked prices, resulting in angry customers.

- Convergent also makes AT&T's UNIX PC workstations. In 1985, the company wrote off a sizeable investment in the WorkSlate laptop computer. The UNIX-based MegaFrame had initial development problems, but both it and the MiniFrame MUS/supermicros are said to be selling well, with approximately 15,000 installations as of June 30, 1985.

- Some of Convergent's recent problems are linked to component shortages and the resulting slow order processing. The company is developing self-sourcing capacity and implementing new operating cost controls.

- Convergent has licensed its major customers to make the NGEN themselves (e.g., Burroughs) as a way of meeting high demands, but this affects its profits.

- Convergent's future plans may include:

  - A lower cost, less modular (and hence less flexible) system, built around Intel 80286 chips, compatible with the NGEN. If offered, this will be targetted to users more concerned with price than the flexibility offered by higher priced systems.

  - Voice/data/image workstations or modules for attachment to existing workstations.

  - Advanced interfaces or gateways between Convergent's and other vendors' products to supplement the SNA capabilities already offered.

- These prospective new products will require software upgrading. For example, word processing would become multi-media document processing for voice/data and image. Also needed will be new processors and new memory systems based on either optical disks or vertical recording magnetic disks.

- Convergent is in a good cash position, using its funds to increase inventories. It has also borrowed from a consortium of banks and has a $100 million credit line.

- Convergent needs better growth management, new products, and new customers to continue its growth. Convergent's systems will be around for a while, under many recognized names, but not Convergent's name.

- The company will continue as a player in the MUS market, although it is at risk should its principal customers take their business elsewhere.

6. CROMEMCO, INC.

- Cromemco sells a MUS based on the S-100 bus which is adapted to specific applications by adding boards. The company sells the basic CPU without

terminals or other peripherals for scientific applications, flight simulation (for the U.S. Air Force), and television weather maps.

- Add-on boards represented approximately one-fourth of the company's 1984 income. Their sale is designed to attract economy-minded customers, permitting them to buy functional boards as needed and allowing the configuration of flexible, easily upgraded systems.

- After ten years of operations, the company claims approximately 60,000 machines in service with approximately half installed outside the U.S.

- Cromemco has maintained profitability although flat sales in 1984-85 resulted in a layoff of 60 employees (out of 450) after the Air Force contract expired. However, the company claimed the cutback was due to the opening of 13 regional service centers, lessening the need for technical support people at headquarters.

- Sales are accomplished primarily through value added dealers and electronics distributors.

- Cromemco holds the unique position of being the largest manufacturer of S-100 board-based systems, recognized by some for their flexibility while viewed by others as old technology.

- The company is closely held and conservative by nature, willing to accept slow steady growth rather than fall victim to the radical ups and downs other companies experience.

7. DATA GENERAL (DG)

- DG suffered erosion in its sales early in the 1980s since it did not have the larger minis or micros that other vendors (notably DEC, Apple, and IBM) offered. The company fell into a corporate malaise and suffered somewhat from autocratic management.

- But it has changed with new management (many from IBM), technological innovation, stronger marketing, and more focus on end users rather than its traditional OEM channels.

- The company entered the micro market with the Data General/One laptop. It is putting greater emphasis on office systems for its Desktop Generation line while reducing its efforts in the CAD/CAE and scientific markets where there has been less capital spending. DG is repositioning itself as a full-service company.

- DG did well in 1984. Sales were up over 40%, net income climbed 150% (helped by strong overseas sales), and field service revenues climbed 75%.

- However, in June 1985, DG announced it would lay off 1300 employees and shut down manufacturing for five days. It also announced an expected operating loss. Both events are attributed to market conditions.

- DG is expected to introduce a desktop MUS called the MicroEAGLE, priced at approximately $10,000, to compete with DEC's MicroVAX (see next profile).

- The company's strategy is to continue to be a broadly based manufacturer, capitalizing its strengths in selected vertical markets such as small businesses, factory automation, medical, scientific, and government markets, but not overly dependent on a few. It will pay more attention to office systems markets.

- However, DG needs to develop alliances to be successful with this risky strategy. The company may be too small to attain generalist successes in the age of niche marketing.

8. DIGITAL EQUIPMENT CORPORATION (DEC)

- DEC began as a manufacturer of minicomputers. As a result, it is fairly well known among IS managers. However, middle managers serving on office system task forces are not as familiar with its offerings. This affects its MUS marketing profile.

- The company recognizes the MUS threat to its principle mini business and has introduced downscaled systems in response.

- DEC's new MUS is the MicroVAX 2, described as a step to developing an entire family of VAXs. Initially targetting engineering and scientific users, the company will eventually aim at small businesses through DEC's OEM channels and through direct national account sales to Fortune 500 companies which have its All-in-1 integrated software office system.

- The MicroVAX 2 is priced at $19,000-44,000, lower than competitive systems in the initially-targeted engineering workstation market.

  - The aggressive pricing strategy is designed to attain market share.

  - The company hopes to add to the number of VAX users, leading to more software development and working to encourage customers to later upgrade to larger systems.

- The MicroVAX should do well, assuming compatibility with DECs larger minis. It offers substantially the same performance as larger systems. However, it cannot be configured in cluster arrangements as can VAXs.

- The company has had a fragmented office systems marketing strategy affecting its MUS efforts. This is attributed to poor management structures and coordination problems among product groups. This situation is now being corrected. Earlier, customers felt that DEC was not moving toward integrated systems and looked for other vendors' solutions.

- There has also been criticism of DEC's approach to its customers. With its microcomputer line, for example, it required users to buy pre-formatted diskettes.

- DEC suffers from a relatively late office systems entry and the associated lack of experience with selling these systems. DEC has traditionally sold to IS departments. The IS role in office systems procurement is changing with a view toward integration. DEC does have the advantage of name recognition and a huge minicomputer base. This makes it easier for its users to justify buying a DEC MUS over other vendors' incompatible systems.

9. DURANGO SYSTEMS (SUBSIDIARY OF MOLECULAR COMPUTER)

- Durango Systems is an example of a company put at risk by the directly competitive IBM PC/AT. After cost cutting measures and a withdrawal from application program development, Durango became a subsidiary of Molecular Computer.

- Durango had major problems in finding OEM customers other than Molecular and in lining up retail outlets. It has been unprofitable for over two years. Strong overseas sales accounted for over half of its sales.

- The merger with Molecular strengthens both companies and expands their product lines. Durango's IBM PC compatible single and MUS products complement the CP/M, MS-DOS, and XENIX systems offered by Molecular. Sales, marketing, and administration functions of the two companies will be merged, with staff reductions resulting in a lower break-even point.

- The merger is important to the survival of both companies. The results will be observed by other MUS vendors; more acquisitions, alliances, and mergers will be seen as small companies seek to remain afloat in a highly competitive environment.

10. FORTUNE SYSTEMS

- Fortune has not been fortunate. It has lost millions each year since its 1980 founding. It has reduced its workforce by half. Its founders have left.

- Fortune's products suffered from poor performance and reliability. It settled a major retailer's breach of contract suit filed because of these problems.

- Merger discussions with North Star, seen as needed by both companies, were abandoned. In 1984, a $3 million software development effort collapsed. Its reputation has suffered.

- But Fortune is fighting back.

- Funds raised in a public offering improved its cash position. The company committed 15% of annual revenues to research and development. It has written down inventories kept high anticipating non-materializing demands.

- It has introduced new products. The operating system based on UNIX has been enhanced and more users can be supported without performance degradation. Additonally, Fortune will support PC-DOS and provide bridge products to link with Wang and IBM software, tapping into more applications.

- Fortune has cut prices, reorganized management, and streamlined operations. The company moved its corporate offices back to its original manufacturing facility to cut costs.

- Retail channels have diminished in importance as the company recognizes that dealers are unequipped to handle the sophisticated demands of multi-user system and software support and also that dealers shy away from a company in trouble. VARs, direct sales to Fortune 1,000 companies, and international OEM relationships are the current focus.

- The OEM tactic is important, as it works to avoid end users' concerns about the survivability of a small company.

- Fortune continues to work with North Star on such agreements.

- As a result of its efforts, sales are increasing and the break even point has been cut by nearly 60%.

- Fortune's strategy is to avoid direct competition with IBM and AT&T through vertical marketing and business alliances. It is looking for partners. Management is making strides to turn the company around, but Fortune faces heavy competition in the UNIX MUS market.

- Fortune is working hard to put its problems behind it. It projects 1985 will be its first profitable year. Fortune's market share will certainly decline and an eventual merger is probable.

- Without a merger, it may be too late for Fortune to overcome its past problems, particularly in light of a sluggish market and heated competition.

11. GIFFORD COMPUTER SYSTEMS

- See Zitel profile below.

12. IBM

- The dominant computer vendor usually sets the standard. Other vendors price their products to be competitive with IBM's. Many vendors' successes are based on manufacturing compatible equipment or "clones" to take advantage of temporary product shortages.

- Some vendors recognize IBM's impact by making a point of announcing they will NOT compete with IBM, but rather work to identify markets IBM has overlooked.

- As the PCjr illustrates, IBM is not infallible. The company's portable computer will probably join the ill-fated home machine on the list of products "supported" but not longer made by IBM.

- IBM's size and bureaucracy works against it, with divisons sometimes releasing competitive products.

  - IBM has recognized this problem by reorganizing into two divisions, one for national accounts and one for all other channels.

  - It has also established independent business units (IBUs) which work across departmental lines without getting bogged down in bureaucracy.

- The company is rarely an innovator. It usually enters a market with superior products and marketing after the pioneers have made inroads.

- The powerful PC/AT micro was released before its XENIX operating system was available to provide multi-user capabilities. This caused users to wait-and-see and has slowed sales of rival MUS products. The announced, but not yet available, IBM local area network has had a similar effect.

- IBM is active in many office systems segments, but its product line is so diverse, coming from various divisons within the company and developed over so many years, that there are difficult incompatibility problems. There have been attempts to address this with the SNA standard, DIA/DCA document protocols, and the like, but IBM is still seen as several years from offering fully integrated office systems.

- IBM is one of the most profitable companies and has a research and development edge. The company's importance is illustrated by the axiom that "no one was ever fired for recommending IBM." It clearly has name recognition and its large corporate image is being buffered by its Charlie Chaplin ads stressing computing for every man.

- IBM's marketing strength is formidable. Its service and support record is outstanding and is usually cited by users as the one of the reasons for buying IBM products.

- Central to IBM's strategy are its mainframes. IBM appears to have been reluctant to sell mid-range computers which might adversly affect its highly profitable large computers. Its marketing, built on large mainframe sales, is not applicable to smaller systems, such as MUS. But this is changing, signaled by the AT which will be the cornerstone of future MUS and mid-range offerings.

- IBM has its own product centers to complement retailing channels such as computer chains and Sears for smaller system sales.

- IBM will seek to leverage and strengthen its VAR/OEM/VAD channels for PCs with more capable MUS and minicomputers. The majority of these existing reseller channels service small vertical markets where MUS opportunities are the greatest.

- The strategy is to migrate PC users to more powerful systems. The PC/AT represents the entry point to these systems, including new desktop minis and existing minis. This strategy requires PC-DOS compatibility.

- The company needs to standardize what is now a largely incompatible mid-range product line.

- Based on its PC strategy, IBM will probably cut prices on existing mini equipment lines prior to introducing these new systems.

- IBM's multi-user AT may very well establish the standard, or at least a standard, for MUS. In addition to standard minis, IBM is now offering desktop minis with the power of larger computers in PC sizes for MUS applications.

  - The Desktop System/1 is a minicomputer adaptation using coprocessors for XT and AT functions. The two models come from different, competing company divisions.

  - Other desktop "minis" in micro form are the Desktop System/36 and the Model 9000.

- IBM will always be a major player. The strategy of announcing that a company will NOT compete with IBM is often a wise one.

  - Competitors need to consider the ubiquity of IBM products in their designs.

  - MUSs need the ability to attach IBM PCs as work stations.

  - IBM mainframe communications must be supported due to its dominance in that segment.

- Niches in the IBM armour will be targetted by its rivals, but its only real competitors in the MUS segment will probably be DEC and AT&T. But as noted in the DEC profile, MUSs may tend to be purchased by departmental managers, rather than IS directors who are more familiar with DEC's minicomputer products. Both sets of managers are quite aware of IBM and will remain so far into the future.

13. KAYPRO

- Kaypro was slow to enter the IBM compatible market. The Kaypro 16 came after nearly 60 other PC clones were already available.

- However, it was the first to introduce an AT clone, the Kaypro 286i (also called KAT for Kaypro AT). The 286i is bundled with software and sells for approximately $1,250 less than a PC/AT.

- Kaypro was making 400 units per month starting in March 1985, with plans to ramp up to as many as 2,000 per month, depending on demand. The company offers a one-year, rather than a 90-day, warranty to match IBM's warranty.

- Kaypro has approximately 300 VARs and will initially sell the 286i through them. It is also adding more than 150 office supply dealers to its over 1,000 independent computer dealers.

- Kaypro is staying away from the XENIX market, which it sees as oriented primarily to scientific users, and focusing on business computer users.

- Kaypro became the successor to Osborne, with its aggressively priced transportables which became top sellers. However, the company suffered from a high growth rate, high management turnover, product delays, and financial problems. The company is recovering from losses due to excess inventory. It is improving its marketing expertise and internal controls.

- Kaypro's micro success gives it a strong base of customers familiar with, and respectful of, its robust bundled systems. By moving to more powerful systems and IBM compatibility, the company's prospects have improved.

- The key questions facing Kaypro revolve around a family business style, its management resources, and the ability of its VAR and retail channels to sell higher powered, more complex systems. The fall-out in retail stores puts greater emphasis on other channels.

- The company is able to develop new products quickly. It has a loyal dealer and customer base. Its traditional small business buyers are more price conscious than corporate buyers, who might spend the extra money to get a bona fide IBM machine.

- Assuming the company can keep up with its growth, its position as a lower cost alternative to IBM should bring it continued success with its micro MUSs, particularly with smaller businesses where much of its past strength has been.

14. NCR

- NCR is a 100 year old company with over $4 billion in sales. It was originally named the National Cash Register Company.

  - NCR now makes various workstations, terminals, mainframes, and micros, including multi-user systems.

  - It also makes data communications products, micrographic systems, and semiconductor products and components, and provides data processing services.

  - NCR has one of the largest service organizations in the industry.

- NCR has specialized in on-line transaction systems such as ATMs, but has branched out, largely by licensing or being an OEM for computer products.

  - For example, the WorkSaver office system is based on Convergent Technologies' NGEN worstation.

  - The technology for its micros is licensed from Faraday Electronics.

- A member of the BUNCH family of non-IBM mainframe manufacturers (along with Burroughs, Sperry, Control Data, and Honeywell), NCR is nearly a household name, yet it lacks strength in Fortune 500 companies.

- NCR's multi-user system offerings start with an AT compatible PC8 in the micro line and carry over to the 32-bit Tower series.

- NCR was the first to replace its older minis with the "supermicro" Tower, which has enjoyed good sales largely by providing a less expensive replacement for its earlier systems.

  - There are an estimated 20,000 of the older minis in service which represent a migration opportunity for the company's new multi-user systems.

  - The success of the Tower has led to new products since the first Tower model was introduced in 1982.

- However, NCR's first attempt to enter the PC market with the ill-fated Decision Mate V failed due to distribution problems.

- NCR's new line of IBM PC compatible micros, including an IBM AT clone, is heavily promoted with an advertising campaign featuring comedian Dom DeLuise.

- The purpose of the campaign is to create general public awareness of NCR's micros machines and the fact they are available at retail outlets. It is a gamble.

  - Division losses have run in the millions due to advertising, distribution, and start-up manufacturing costs. The losses will likely continue until 1986.

- NCR acknowledges difficulties with its retail strategy, but believes that if they do more than their rivals, they will succeed.

- NCR's micro efforts may not mirror the success of the Tower, which is sold through VARs, distributors, and direct sales channels.

  - NCR entered the micro market late, and although it hopes to have 550 dealers by the end of 1985, there are too many competitors for dealer shelf space to guarantee a presence.

  - The company has also entered a slowing micro market.

  - After six months of operation, NCR closed its South Carolina PC manufacturing plan and is now making subassemblies in Germany with final assembly in U.S. facilities.

  - However, the company is taking a long-term view.

- The UNIX-based Tower 1632 was first introduced in 1982. The top of the line XP came in 1984 and the MiniTower came in April 1985.

  - The upper end systems are intended for data processing.

  - The product family is competitive with AT&T's UNIX PC and Convergent's Mini and MegaFrames.

  - Prices start at approximately $7,000, with a basic XP configuration priced at $19,500.

  - When configured with Officeware, the Tower uses intelligent workstations, such as IBM compatibles, to offload processing from the CPU, which then acts as a file server.

- NCR products are less expensive than IBM's. The company's advertising campaign helps dealers and provides funds for local advertising. NCR also gives institutional discounts to multiple buyers such as school districts. Direct sales representatives pass sales of less than 20 systems to dealers.

- NCR's management structure features decentralized planning. The company encourages internal competition and entrepreneurial spirit among its groups. This makes a large company responsive to market needs. Given the nature of the industry, long planning cycles often mean missed opportunities. But the decentralized structure has inherent inefficiencies and redundant efforts.

- NCR has integrated technological advances into its products. It is diversified enough to survive industry cycles. It has a strong financial positon and the staying power to make a dent in the MUS market, especially with the Tower series. It maintains tight cost and inventory controls.

- It is an open question whether or not many sales of the AT clone will be achieved at the retail level, given the limits of that channel. Volume is needed to generate a profit for the retail strategy to be successful. However, the visibility the company has achieved with its advertising should bring benefits to its continuing direct and OEM sales efforts for both the PC8 and the Tower series.

15. MOLECULAR

- See Durango Systems profile above.

16. MORROW DESIGNS

- Morrow's sole MUS is the Tricep which runs UNIX and MS-DOS programs. It is sold directly, primarily to software developers, university computer labs, and other sophisticated users. The earlier Decision I UNIX MUS is no longer available.

- The company claims 125 Tricep installations, with 30 added monthly. Over half are sold in Europe through a distributor who sells to VADs.

- The machine is sold to help the vendor understand UNIX MUS markets for future development. Since the company provides little software support, prospects are investigated to make certain they can manage the system.

- The company's focus is on micros, including a portable machine.

17. ONYX SYSTEMS (CORVUS SYSTEMS)

- Pending SEC approval, Onyx and Corvus Systems will merge and the name Onyx will disappear from the list of MUS vendors.

- Corvus manufacturers the Omninet microcomputer LAN, Winchester disk drives, tape backup systems, and workstations. Onyx makes 8-bit and 16-bit microcomputers running on UNIX, MP/M, Oasis, and the proprietary Thoroughbred OS operating systems.

- Both firms reported 1984 losses, but lately have returned to profitability. The merger is necessary to help them overcome recent business downturns by combining Onyx's MUS technologies with Corvus' networking products, and by focusing on complementary management strengths, combined financial position, and joint operating efficiencies. The move is intended to support more agressive competition.

- Onyx's strength appears to have been in providing OEM systems to value-added resellers. The company's UNIX II based systems allow vertical software development integrated with the computer's menu system. Data from these applications can be shared with Onyx-produced software.

- In 1984, Onyx entered a three-year, 1,000-system agreement with a pharmaceutical distributor for UNIX MUSs for a retail chain's in-store pharmacies. The pharmaceutical company (Foxmeyer Corporation) announced plans to network the entire system.

- An international distribution network, approximately 300 VADs, and a direct sales force handled Onyx system sales. Onyx owns Mercator Business Systems, which markets in Europe.

- In 1983, Onyx announced plans to sell through high-end independent retailers who resell into specialized business markets. Dealer training, support, and cooperative promotional programs were provided.

- Onyx offers an integrated software package called "Onyx Office" bundled with its systems to overcome objections on software availability.

- Quarterly net income reported in December 1984, for Onyx and Corvus was slightly over $500,000 each, but Corvus reported a $10.6 million loss for fiscal 1984.

- How the newly-formed company will fare remains uncertain. The reasons behind the merger make sense and may represent the only option available.

18. PLEXUS COMPUTER INC.

- Plexus is targetting OEM and VAR channels for its high-end UNIX-based MUS, with a retroactive discount program that increases the discount on previously purchased products after a VAR reaches a certain number of orders.

- The company also establishes computer service centers, with VARs paying for service technician training. Plexus repays the VAR on a formula linked to service revenues.

- Plexus distributes bridge software products to allow its users to run DEC, Wang, and Basic Four minicomputer software in addition to UNIX System III software. Its line of 16/32-bit dual processor machines is particularly strong in government and health care sectors.

- The company has backing from leading venture capitalists and institutional investors.

- Despite its strategy and support, Plexus has been unprofitable since its 1980 founding. It has had to overcome management and product difficulties. This is an especially critical period due to the state of the computer market in general. Accordingly, the company's new management team needs to develop a long-term strategy in order for Plexus to survive.

19. SENSORY

- Sensory is a new MUS entrant, introducing its product in late spring 1985. The product is positioned as an office systems solution.

- A few months afterward, Sensory reduced its staff by approximately half, with the president and marketing vice president also leaving.

  - The reason given for the cutback were market conditions and a need to cut expenses.

  - Sensory is looking for a larger corporate partner with distribution strengths and/or manufacturing capabilities.

- The company was formed in 1983 with backing from several venture capitalists and Information Technology Limited (ITL) of the United Kingdom, which licensed its technology to Sensory. ITL and Sensory have joint engineering and development agreements.

- Sensory's market is seen as $50-250 million commercial firms. Its original marketing plan called for avoiding the Fortune 500 where other vendors are heavily competitive.

- The Sensory product is targetted to work groups of less than 12 people who are not presently automated.

- The targeted user work group environment is text intensive, with free form document creation and heavy verbal communications which benefit from the product's voice annotation/voice mail features.

- As they have been recently introduced and as the company is going through changes, it is too soon to evaluate Sensory's success, which now hinges on finding a partner.

20. TANDY

- The electronics company's distribution through 431 outlet Radio Shack computer retail stores, in addition to approximately 6,300 electronics outlets, is its major strength. The chain is the second largest in the U.S. behind Computerland and the company is the third leading micro manufacturer behind IBM and Apple.

- Tandy's earlier systems operated under the proprietary TRS-DOS operating system. More recently, the company has introduced IBM-compatibles. The 16B has been upgraded, renamed the Tandy 6000, and sold as a XENIX MUS.

- Tandy appeals to companies too small for IBM to consider. The 6000 is also targetted to Fortune 500 companies using the machine for specific applications.

- Tandy systems' price/performance is attractive to users, but vulnerable to continuing IBM price cuts which affect Tandy's profitability and ability to maintain market share.

- Tandy enjoys economies of scale, a broad product line, and volume sales. With its own distribution channels, margins can be lower than for other companies. Through its retail chain it is close to its customers and able to react quickly to market demands.

- Tandy manufactures many of its own electronic parts, plastic moldings, and cables. Its factories are more vertically integrated than those of its rivals. It is opening up its software offerings to third-party labeled packages. Previously, all software sold by Tandy had the company's name on it.

- Repair facilities are being consolidated in 54 cities with one-day service the goal.

- The company will continue to pursue large accounts and VARs. It has about 100 active VARs, accounting for 1-2% of computer sales. It is testing a small national account sales force in six larger markets. If successful, this may replace the current method of store personnel working with district managers and three, centrally based national sales managers. However, Tandy recognizes that volume end-user sales are its major strength.

- Tandy's biggest problem is its hobbyist image. It has renamed its computers from TRS-80 (for Tandy-Radio Shack) to Tandy in an effort to overcome the derisive "trash-80" nickname. It is also paying attention to design details in its products, at its stores, and in its advertising. There has been talk of renaming the stores.

- Based on its distribution strength and its well received products, Tandy will continue to be a player in computers, including its MUS offering. However the company needs to pay more attention to training its computer sales force, categorized by low pay and high turnover.

21. TELEVIDEO SYSTEMS

- TeleVideo began in 1976 as a low-cost video monitor maker, later adding low-priced smart terminals. It now makes micros and a 16-bit MUS which uses micros as intelligent workstations.

- TeleVideo's micro line is designed to provide a migration path from single to multi-user configurations while protecting existing hardware and software investments. Standard product design eases board replacement and upgrades.

- The company launched a large multi media advertising campaign to gain identity and applied much of a 1983 stock offering's proceeds to research and development. However, its entry into the micro market is partially responsible for its reduced 1984 revenues (down 3.4%) and an earnings decline of 80%.

- TeleVideo buys customized, industry-specific software from other vendors rather than develop its own. Also, CP/M and MS-DOS software can often run on their micros.

- The Personal Mini/16 MUS uses an operating system based on Novell's NetWare which allows intelligent workstations to do their own processing under CP/M or MS-DOS and be networked to share information from a common data base.

  - It is a hybrid system in that micros, including the company's driveless workstations, rather than terminals are used. While architectually a MUS, the system is closer to a file server.

  - The PM/16 is linked, in some respects, to the success of the IBM PC and compatibles, since these micros can be used as workstations.

- TeleVideo uses a large network of distributors who sell to VARs. It also sells directly to large corporate accounts, to OEM channels, and to service companies which lease or sell systems. TRW provides maintenance.

- Embracing the IBM PC as a standard for workstations on its MUS is a good strategy; however, the per user price is therefore higher than that of systems using terminals. Still, user processing independence is the result. The Personal Mini is more competitive with local area networks and file servers than microprocessor based multi-user systems.

22. VECTOR GRAPHICS

- Founded in 1976, Vector was an early microcomputer vendor. However, as the market developed, the company's sales suffered primarily because of the IBM PC's domination of the market and the effects of competition for retail shelf space.

- Vector also suffered from management turnover, equipment problems, premature product announcements, and development delays. There were a series of layoffs as the company attempted to cope with economic and market conditions as well as its internal problems.

- The company moved from attempting to sell into general markets to focusing on vertical markets. It sells through independent retailers and VARs to small businesses. It was unique with its systems for agriculture and also sold legal and government packages. Vector maintained a good support program which was largely unaffected by layoffs.

- Vector reported losses of $3 million in 1983 and $7.6 million in 1984. These losses did not help build customer confidence, exacerbating its problems.

- In April 1985, after nine consecutive quarterly losses, the publicly-held company merged with privately-held Dual Systems Control Corporation.

- Dual is a five-year-old MUS and board level products manufacturer specializing in scientific and engineering applications.

- The merger with Dual is designed to enlarge the dealer base for the combined companies and expand the product line.

- It is too soon to evaluate the prognosis for the newly formed company. The strategy to sell into vertical industries is a good one, but now many other companies are doing the same thing.

23. VIASYN (FORMERLY COMPUPRO)

- Founded by board building pioneer William Godbout, this 12-year-old California company originally sold S-100 bus components, but now offers upwardly compatible 8- and 8/16-bit MUSs, running under MP/M.

- Bundled with software, the machines avoid the IBM compatible world since they do not run MS-DOS. This means popular software available only in such versions (such as Lotus 1-2-3) cannot be used. Other popular packages, including WordStar and SuperCalc, are available.

- Installation and support is handled through approximately 100 regional centers. The company was the first vendor to bundle repair service into the initial purchase price with a one-year on-site maintenance agreement assuming the user is within 100 miles of a Xerox service center.

- While holding a small share of the market, Viasyn's products are well regarded by systems and software developers. Although the most popular packages cannot run on its systems, there are ample CP/M applications. If there is a need for an alternative to the MS-DOS, IBM-compatible world (other than UNIX), Viasyn will continue to meet the demand.

24. WICAT SYSTEMS

- Wicat is a good example of a company focusing on vertical markets.

- The company was formed in 1977 by a group of educators as a nonprofit firm specializing in research for videodisk-based computer-aided instruction (CAI). It incorporated as a profit-making company in 1980 and became publicly-owned in 1983.

- Wicat leveraged its educational experience to develop CAI hardware and software systems, but also markets business and engineering systems. Eighty percent of its first year's revenue came from the sale of large 68000-based general purpose systems targeted against minicomputers and supporting up to 31 users.

- Wicat uses a proprietary operating system and an enhanced UNIX version. The WISE system supports courseware development incorporating graphics, animation, and advanced speech responses. Wicat created a special school to test educational products.

- Wicat's software covers various educational subjects and educational administration. There have been industrial and military training systems contracts.

- Sales are direct and through OEMs.

- The company reported losses shortly after its public offering as it suffered from softness in educational system sales. It recognized a need to put more attention on marketing.

- In late 1984, Wicat jointed with Control Data to provide elementary school educational systems, covering instruction, administration, student management, and testing. Control Data also took an option to buy approximately 5% of the company's outstanding stock.

- This agreement is important to Wicat's continued existence. Control Data has marketing expertise and a presence in educational markets. Its Plato line of educational products will use Wicat's hardware. Independently, Wicat will continue efforts to penetrate consumer education markets.

- However, major computer companies such as IBM and Apple are also targeting the education market. Wicat's software strength and expertise will benefit any other vendor's forays into this segment.

25. ZITEL

- Zitel manufactures memories and memory intensive micro systems. In late 1984, it acquired Gifford Computer Systems, an operating systems developer and microcomputer integrator.

- Gifford develops MP/M-86 and Concurrent DOS operating system enhancements. Zitel sales are to OEMs, and Gifford has sold through dealers, VARs, and integrator channels for delivery to vertical markets. Gifford has also acted as a VAR, packaging its software with CompuPro's micros. It had approximately 260 dealers representing its products.

- The acquisition brings operating systems expertise to Zitel's objective of providing total OEM systems. The companies will jointly develop a new MUS to be sold under the Gifford name. Gifford will operate as a subsidiary.

- Gifford will now move from end user sales to dealer distribution and move from CompuPro hardware to its own MUS.

- The success of the venture hinges on recruiting dealers being abandoned by hardware suppliers who are moving from MP/M to UNIX systems. Zitel has been able to bring to market quickly components needed by other companies and enjoys long-term relationships with its customers. The venture faces

competition, but based on the past strengths of the two companies, modest success is possible.

P. MARKET CONCLUSIONS

- The MUS market opportunity has been quickly recognized by both old and new vendors and there are literally hundreds of similar product available. This coupled with user confusion, economic uncertainty, and software concerns means that the MUS market is a difficult one in which to participate.

- Nevertheless, there are opportunities, particularly for penetrating the large number of uncomputerized small companies, vertical markets, and departments and field offices of larger companies to replace obsolescent minicomputers with less expensive, but equally capable, systems.

- INPUT's indicators for success and problems in the MUS market are shown in Exhibit V-13.

- The next chapter summarizes INPUT's findings on MUS.

EXHIBIT V-13

SUCCESS/PROBLEM INDICATORS

- Indicators of Success
  - Upgrade Path for Large Installed Base
  - Large, Supported VAR/Retail Distribution Network
  - Targetted Vertical Markets
  - High Price/Performance Ratio
  - Non-Proprietary Operating Systems
  - Accommodates IBM PC/AT and Mainframe Connections
  - Product/Corporate Differentiation
  - Name Recognition
- Indicators of Problems
  - Poor Quality Control
  - Proprietary Operating System/Software
  - Low Name Recognition
  - Marketing Weaknesses
  - Late Market Entry
  - Non-Connectivity
  - Bad Press Leading to Cautious Buyers

VI CONCLUSIONS AND SUMMARY OBSERVATIONS

VI CONCLUSIONS AND SUMMARY OBSERVATIONS

A. USERS SHOULD COMPARE MUS SOLUTIONS TO ALTERNATIVES

- For users, a MUS offers attractive, cost effective, and functional solutions to information management problems. Instead of gradually adding individual micros or investing in more expensive mini systems or difficult to configure LANs, the MUS can fill current needs, and be upgraded incrementally at a lower cost than these alternatives currently offer.

- Companies in various vertical industries will find value added resellers offering hardware bundled with software directly meeting specialized needs, coupled with training and other services.

- Companies or departments which have not yet purchased computerized systems should investigate MUS options as a vehicle for doing things more efficiently than current paper-based methods. A cost benefit analysis will usually show gains in productivity and competitive position with a relatively short payback period, although actions based on intuitive point of view are often as valid.

- Given the constant flow of new and improved products, timing becomes a critical issue: When should a company proceed to get the best return on its investment, taking advantage of the latest technology?

- Often the answer to this question is "now," as the benefits attained in the interim will overcome any advantage in waiting for "later" products.

- Upward compatibility of purchased hardware and developed or purchased software is an important consideration, however.

- Of course, MUS does not meet universal needs. Companies needing large amounts of processing capacity or requiring extensive networked applications need other solutions, ranging from minicomputers to mainframes.

B. VENDORS FACE DIFFICULT TIMES IN THE SHORT TERM

- The current information services industry slowdown affects MUS vendors of all sizes, and many companies are suffering. After optimistically hoping for a 1985 turnaround, it now appears that recovery will not occur until 1986--if then.

- The computer industry as a whole will continue to grow, although there will undoubtedly be fewer companies participating. Some will disappear through merger and acquisition, others through Chapter 11.

  - The current situation may be viewed as a temporary lull in progress.

  - The growth trend of the industry will probably proceed in cycles rather than as a smooth curve.

- This underscores the importance for vendors hoping to survive to consolidate their positions, enter alliances of various forms to build strength, reduce break even points, but continue research and development efforts utilizing new technologies in anticipation of better times ahead.

- The opportunities in unaddressed niche markets for MUSs should also be identified, particularly by smaller vendors able to respond to needs quickly.

- Companies planning to continue competing in nearly saturated segments need to differentiate their products and their corporate image to develop unique identities in the crowd.

- Users are evaluating the currently available products, as well as the systems they have already purchased, before deciding on the next stages of implementation.

  - Uncomputerized businesses remain an opportunity regardless of the economy, but they need to be convinced of MUS efficiencies.

  - Customer objections regarding software availability, system response time degradation, the desire for individually controlled processors, and the effect of CPU or bus failure on all users need to be addressed.

- General economic slowdown may encourage users to seek more cost effective computing solutions, well represented by increasingly powerful, cost effective multi-user systems. Growing recognition of the need to share information in the work group will continue, to MUS vendors' benefit.

C. CONCLUSIONS

- Once, minis were seen as effective multi-user systems. Then microcomputers became available, making growth in computer familiarity and personal productivity at low cost and low risk possible.

- Now, micro-based multi-user systems, many offering the power of more expensive minis in compact, low cost-per-user configurations, are available, extending personal productivity to the work group and, by extension, to the corporation.

- Bundled with more powerful application software, specifically oriented as well as designed for general businesses, and featuring "friendly" user interfaces, MUS capabilities are now recognized, leading to a crowded marketplace.

- Users are somewhat confused by the choices available, but ultimately they benefit. Well defined vendor strategic plans and informed market analysis will also be ultimately rewarded.

APPENDIX A: DEFINITIONS OF TERMS USED IN THIS REPORT

APPENDIX A: DEFINITIONS OF TERMS USED IN THIS REPORT

- CONCURRENCY - Multiple tasks can be accomplished, and one task does not prevent others from taking place.

- INTERRUPTS - A process which preempts current processes to enact critical functions. System reacts to I/O commands, inquiries, replies, and interactive processes.

- LATENCY - The maximum time a system requires to react to an interrupt.

- MICRO-MINI COMPUTER - A downscaled minicomputer which generally uses discrete, board-level logic for general or special applications. (Also see "supermicro.")

- MULTI-USER SYSTEM - A microcomputer with added processing, storage, and operating system enhancements to support a number of simultaneous users sharing peripherals, central processing, and storage. Now commonly use 16- or 32-bit processors to address large memories and to support faster operations than micros.

- MULTIPROCESSING - Permits multiple programs to operate simultaneously, with assigned memory areas and individual central processing unit.

- MULTITASKING - Several programs operate in the same computer, often under the direction of a single user.

- MUMPS - Multi-user, multiprocessor system, dedicating processors to each user or providing several processors which are shared by active users.

- MINICOMPUTER - Uses discrete board-level logic rather than microprocessors, supporting 20-60 users. Minis are more powerful and more expensive than multi-user systems, although MUSs are approaching the capabilities of minis.

- ORIGINAL EQUIPMENT MANUFACTURER (OEM) - OEMs buy software and hardware from other companies to be incorporated as components into products or systems and sold under the OEM's private label.

- PRINT SPOOLING - A feature which allows output to be temporarily filed in disk storage until a printer is available. Some systems allow priorities to be assigned to documents.

- PROPRIETARY - Computer equipment, operating systems, or software developed for a specific brand of computer.

- PORTABLE - The ability to transfer an operating system or an application from one computer type to another.

- REALTIME SYSTEM - A system which responds to environmental change within a specific time period.

- SHELL - A system of commands, menus, or help screens which ease user interaction with an operating system.

- SUPERMICRO - Applied to 32-bit machines, which may be multi-user or powerful single-user systems designed for special or general applications.

- VALUE-ADDED DEALER (VAD) - VADs are similar to VARs (see below), except that third-party software is bundled with equipment for specific needs and the resulting product is not renamed.

- VALUE-ADDED RESELLER (VAR) - VARs are typically software companies which write industry or function specific software which is packaged with hardware and sold under the VAR's name.

APPENDIX B: VENDOR QUESTIONNAIRE

APPENDIX B

MULTI-USER SYSTEMS VENDOR QUESTIONNAIRE

NOTE TO INTERVIEWER: First reveiw product literature, entering appropriate product information in question1, and verify product names, prices as appropriate.

INTRODUCTION:

INPUT is a high technology management consulting and market research firm. We're preparing a report on multi-user systems, describing both the market and how end users can evaluate and plan for installing them. We would like your participation to help us make the study complete.

We will be sending you the executive summary of the report as a way of thanking you for your help.

This interview should only take about 15-20 minutes and will be a big help. Is now a good time?

Our study is going to focus on micro-level multi-user systems.

With this limitation in mind. . . . . .

1. What micro-level multi-user systems do you now offer?

   a. Product one: _____, Features: _____

   _____

   _____

   b. Product two: _____, Features: _____

   _____

   _____

   c. Product three: _____ , Features: _____

   _____

   _____

   What are the price ranges? _____

2. a. What size company or size department do you market these systems to?

b. How do you think the features of your systems give you a competitive advantage over other companies?

3. a. How do you convince a buyer to purchase your systems rather than buy standalone micros?

b. How do you convince a buyer to purchase your systems rather than buy minicomputer systems?

4. Could you talk a little more on what you see as being the most valuable ways of selling against these other systems?

5. What features are you finding your customers want most?

6. Can your multi-user systems connect with each other? _____ Yes _____ No

If yes, how?

7. Can your multi-user systems connect with corporate mainframes?

8. Can your systems be used for external data base connections, such as Dow Jones, or for external electronic mail? _____

_____

9. Can you briely describe the kind of support you give you customers?

_____ Hotline

_____ Training Programs

_____ Software Upgrades

_____ Other Support: _____

10. Does your company have any relationships with system integrators or value added resellers? _____ Yes _____ No

If yes, can you describe what these companies typically offer their customers?

_____

_____

11. Is your equipment OEM'd; in other words, are your systems sold under other company names? _____ Yes _____ No

Whom? _____

12. What special applications or industries have you designed your multi-user systems for? _____

_____

13. a. What operating systems do your multi-user systems use? _____

_____

Are there any plans for other operating systems? _____ Yes _____ No

b. On a scale of 1 to 5, with 5 being very important, how do you rate the importance of UNIX? 1 2 3 4 5

Why this rating? _____

_____

_____

14. a. It is generally thought that multi-user systems have limited software. Any comments? _____

_____

_____

b. Do your products include bundled software? _____ Yes _____ No

Which? _____

_____

c. Do you customize software for clients? _____ Yes _____ No

If yes, for what reasons is this typically done? _____

_____

15. Are you in any partnerships with software companies? _____ Yes _____ No

If yes, which ones? _____

_____

16. a. Who do you consider your primary competitors? _____

_____

b. Who, in your opinion, are the market leaders in multi-user systems, and can you estimate what share of the market they have? _____

_____

_____

c. What do you estimate to be your share of the market now? _____

_____

d. What do you think is the total size of the market:

_____ Now _____ In 1987 _____ In 1990

e. How many systems do you have out there - installed base, by product units?

_____

_____

f. Can you (or anyone else in your company) tell me the revenue received for for each of your products?

16. g. Do you have any figures regarding your revenue projections for 1987?

_____

... for 1990? _____

_____

17. Do you sell directly, through distributors, through OEM channels, or through retail outlets? _____

18. How does your company sell against products from IBM? _____

_____

19. Do you think an Informart (in Dallas), Boscom (in Boston), or any similar computer market is a good place for selling multi-user systems? Why or why not?

_____

_____

20. Where do you think multi-user systems are going; in other words, what do users need that your company or others might put into place in the future?

_____

_____

21. Are there any other trends effecting the market now? _____ Yes _____ No

What about trends effecting the market five years from now? _____

. . . in 1990 _____

22. Can you refer me to any of your customers who are particularly good examples of effective MUS use? _____

_____

THANK YOU FOR YOUR HELP. We should have the executive summary ready to be sent to you in about six weeks. THANKS AGAIN!!

APPENDIX C: USER QUESTIONNAIRE

APPENDIX C

MULTI-USER SYSTEMS USER QUESTIONNAIRE

This is _____ calling from INPUT, a high technology research and consulting firm in Mountain View, California. We are doing a study on micro-computer-based multi-user systems. We would appreciate your comments on issues to be examined in our report.

We will be sending you the executive summary of our report as a way of thanking you for your help. Is now a good time?

1. How many micro-based multi-user systems, by manufacturer, do you now have?

   Manufacturer _____ Number _____

   _____ _____

   _____ _____

2. How many new multi-user systems do you estimate you will be adding:

   This coming year? _____ In 1987? _____ In 1990? _____

3. a. What applications are most used on your multi-user systems? (Check all that apply)

   _____ Word/Document Processing

   _____ Financial Analysis

   _____ Personnel Functions (such as payroll)

   _____ Decision Support

   _____ Graphics

   _____ Other

   b. Are there any applications that are not available that you think are needed?

   _____

   _____

4. Next, I'm going to read you a list of features which are available on multi-user systems and ask you to rate them on a scale of 1 to 5, with 5 being most important to you and 1 being the least important. The first one is:

   Print spooling, 1 2 3 4 5

   Electronic Mail to Others on the System, 1 2 3 4 5

   Electronic Mail to Other Terminals Inside or Outside the Company, 1 2 3 4 5

   Storage Backup (such as tape), 1 2 3 4 5

   Damaged File and Directory Recovery, 1 2 3 4 5

   Password Security, 1 2 3 4 5

   Modem Polling, 1 2 3 4 5

   Networking to Other Systems, or to Corporate Mainframes, 1 2 3 4 5

   Voice/Data Integration (e.g., Smart Telephone Features Integrated in the Workstation), 1 2 3 4 5

   Voice Annotation of Documents, 1 2 3 4 5

   Graphics, 1 2 3 4 5

   Image Integration (Other Than Encoded Graphics), 1 2 3 4 5

5. a. THANK YOU. Now, typically, how many individuals are on each multi user system you have? _____

   b. How many simultaneous users can your systems support? _____

   c. Do you ever find that a system capable of supporting multiple users is often only used by single users? _____

6. a. You indicated your rating of the importance of connecting the multi-user system to a mainframe computer. Why do you think this is (or is not) important?

   _____

   _____

   b. How would this be done? _____

   _____

7. a. On a scale of 1 to 5, with 5 being very important, how important is it for your multi-user systems to be able to communicate outside the company, say to a public data base? 1 2 3 4 5

b. Why this rating? _____

_____

c. How would this be done? (Check one)

_____ Dial-up _____ Leased Lines _____ Public Data Network _____ Other _____

8. a. What do you see as the alternatives to MUS? (Check all that apply)

_____ PC Local Area Network

_____ Minicomputer

_____ Integrated Office System

_____ Standalone Micros

_____ Other: _____

b. Why would you use a multi-user system rather than standalone micros?

_____

_____

_____

c. Why would you use a multi-user systems rather than LAN-linked micros?

_____

_____

d. Why would you use a multi-user system rather than use a minicomputer?

_____

_____

_____

9. a. Who (by job title) makes purchansing decisions for multi-user systems in your organization?

_____ Departmental Managers

_____ IS Managers

_____ Purchasing Directors

_____ Office Automation Managers

_____ Other: _____

b. Are any vendors preferred over others? _____ Yes, _____ No.

Who? _____

Why? _____

10. What type of support do you expect from vendors of multi-user systems, as opposed to third parties?

CODE

_____ Training

_____ Programming Support

_____ Installation

_____ Maintenance

_____ Other: _____

11. a. What kinds of support does IS need to provide users of multi-user systems?

CODE

_____ Training

_____ Programming Support

_____ Installation

_____ Maintenance

_____ Other: _____

11. b. If you have determined the costs of this support function, can you estimate the cost either totally, or per user for each: (Check either total or per user.)

TOTAL	PER USER	
_____		Training
_____		Programming Support
_____		Installation
_____		Maintenance
_____		Other: _____

12. a. What have been the biggest benefits of multi-user systems to your organization?

_____

_____

b. What have been the biggest disappointments or unanticipated problems?

_____

_____

c. Is compatibility with your mainframes a problem? _____ Yes _____ No

On a scale of 1 to 5, with 5 being 'an extreme problem', how would you rate this problem? 1 2 3 4 5

d. Is compatibility with IBM PC's or compatibles a problem? _____ Yes _____ No

On a scale of 1 to 5, with 5 being 'an extreme problem', how would you rate this problem? 1 2 3 4 5

HOW HAVE YOU DEALT WITH THESE PROBLEMS?

13. a. How did you/will you cost justify purchasing MUS? _____

b. Have your multi-user system costs been more than expected? _____ Yes _____ No

If yes, why? _____

c. Where there any hidden costs involved? _____ Yes _____ No

If yes, please explain: _____

14. On a scale of 1 to 5, with 5 being 'very important and 1 being least important', what is your opinion of UNIX as an operating system for multi-user systems?
1 2 3 4 5

Why this rating? _____

15. What changes in your organization, either functionally or in terms of how you're structured, have multi-user systems made necessary? _____

16. a. People say that multi-user systems lack software. Any comments? _____

b. Have you internally written or customized any software? _____ Yes _____ No

If yes, please explain: _____

17. What factors influence your decision to buy on system over another? _____

_____

_____

18. How do you typically buy multi-user systems?

_____ Direct from the manufacturer

_____ From a distributor

_____ Retail

_____ From a value added reseller or retailer

_____ Other, _____

19. Who, in your estimation, are the market leaders in multi-user systems, and what percentage of the market do they hold?

VENDOR	PERCENT OF MARKET
_____	_____
_____	_____
_____	_____
_____	_____

20. Have you done any post-implementation analysis? _____ Yes _____ No

Why or why not? _____

_____

What were the results of your analysis? _____

_____

21. Are there any internal planning documents or articles we could see which would help us develop a case study? We would conceal your company identity.
_____ Yes _____ No

22. Do you have any other comments? _____

_____

THANK YOU!!

APPENDIX D: REPRESENTATIVE MICRO-BASED MULTI-USER SYSTEMS

APPENDIX D: REPRESENTATIVE MICRO-BASED MULTI-USER SYSTEMS

- Representative products are profiled in this appendix. New products, features, and capabilities are announced frequently by vendors. Prices are given when available, but users are cautioned that prices are subject to change and are dependent on exact configurations.

A. ALPHA MICROSYSTEMS

- Alpha has introduced the first of what it expects to be a new family of UNIX-based multi-user systems, supporting up to 16 users. The AM-1172 runs under the AMOS operating system, MS-DOS, and UNIMOS, based on UNIX System V. A three-user desktop is priced at approximately $9,000.

B. ALTOS COMPUTER SYSTEMS

- The four-user 486 is priced at $6,500, runs under XENIX as well as MP/M-86, and also shares MS-DOS files.

- The 586 supports up to five users, the 986 up to nine, and the Altos 68000 up to 16 users.

- The newly-introduced 2086, for up to 20 users, is priced starting at under $20,000 and is aimed at VAR channels servicing mid-sized and selected vertical markets, including accounting, medical, construction, and manufacturing sectors.

C. APPLIED DIGITAL DATA SYSTEMS (NCR SUBSIDIARY)

- The Mentor 1500 Computer System, supporting three users, is upwardly compatible with the company's 2000, 4000, and 5000 systems, which support up to 64 users. It runs under an enhanced PICK operating system, as well as MS-DOS, in an IBM PC/XT compatible mode.

- The system highlights PICK's data base management capabilities.

D. AT&T

- AT&T is expected to be directly competitive with MUS made by Altos, Fortune Systems, and Tandy. The 3B2/300, although considered a high-end micro, provides better performance than most MUS sold by these companies, but is less functional than a DEC mini. It supports up to 18 users.

- The 3B2/300 runs UNIX System V software and uses the Western Electric 32000 microprocessor. It is compatible with other AT&T machines.

- The PC Interface can link the 3B2/300 to MS-DOS machines. Files can be exchanged, with the PC Interface handling required conversions.

- AT&T offers enhancements to its previously introduced PC 6300, manufactured by Olivetti, making it more competitive but less expensive than IBM's PC/AT.

- PC 6300 enhancements include a communications board adding voice/data capabilities and support for Microsoft's XENIX. The company has a joint development agreement with Microsoft for XENIX V compatibility with UNIX V.

- Also added to the 6300 is a high-speed math co-processor, a display-enhancement board, a mouse, new operating and applications software, and a new model with more memory and a 20 megabyte hard disk.

- The new UNIX PC Model 7300, manufactured by Convergent, combines voice/data communications capabilities with a multi-user, multitasking UNIX operating environment.

- The UNIX PC has a 10 MHz Motorola 68010 microprocessor with virtual memory, an integrated modem, telephone management functions, electronic messaging, and a menu interface to the UNIX System V operating system. Priced starting at $5,590, it can be expanded to handle 10 users.

- AT&T also offers the AT&T STARLAN Network to connect 20-200 UNIX and MS-DOS computers using twisted-pair wiring.

E. CADO

- The Tiger ATS-8, -16, -32, and -64 models support 8 to 64 users with a proprietary operating system. The 16 is priced starting at $13,000 and the 32 at $28,000. The company's DS/PC and DS/XT IBM-compatible micros can link with the Tiger systems.

- Systems are sold through a network of approximately 200 VARs serving medical, construction, legal, and restaurant sectors.

F. CALLAN DATA SYSTEMS

- Unistar model 200 supports up to four users, and the 300 supports up to 16 users, running under UNIX. The 300 is targetted for OEM, VAR, and software development markets. The 200 is priced starting at approximately $17,000, the 300 at $20,000.

G. CONVERGENT TECHNOLOGIES

- Primarily an OEM manufacturer, the company began shipment of the popular NGEN ("Next Generation") workstation in 1984. Software is compatible with earlier company workstations. The units are made of modules which plug together in various configurations.

- The NGEN supports 5 to 16 users and runs under XENIX, MS-DOS, CP/M-86, and a proprietary operating system.

H. COMPAQ

- The new Deskpro 286 and the Portable 286 are AT compatibles and, according to the company, are faster than the IBM PC/AT. The systems are priced at approximately $4,500 and $6,300 for two models in each series.

I. DATA GENERAL

- The Desktop Generation System model 45 was introduced in the spring of 1985. It operates under the Uniplus+ operating system, a UNIX clone, and is designed as a UNIX development system. It is priced from $12,000 and will support up to 12 users.

- Earlier MUSs include the models 10, 10 SP, 20, and 30, priced starting at approximately $12,000.

J. DIGITAL EQUIPMENT CORPORATION

- Primarily a minicomputer vendor, DEC is downscaling its technology with the MicroVAX 2 MUS which uses the "VAX-on-a-chip."

- Priced between $19,000 and $44,000, four general purpose system packages support between 16 and 21 users, with processing performance nearly that of the company's VAX-11/750 minicomputer.

- The system uses the MicroVMS operating system, a subset of Ultrix (DEC's version of UNIX), and can also run VAXElan, a realtime operating system. The MicroVMS operating system is priced on a per user basis, at $2,000 for two users, $4,000 for up to eight, $6,000 for up to 16, and $8,000 for more than 16.

- Also available is the MicroPDP-11/SV, an entry level, four-user system using the F-11 processor. The system is priced at $6,000 and can be upgraded. Software available include the A-Z Integrated System of business applications.

- Voice synthesis peripheral DecTalk converts ASCII text to speech for remote access, conversion of electronic mail, and training applications.

- DEC also introduced the Digital CD Reader, an optical disk system for the MicroVAX, which can store 200,000 single-spaced, read-only pages on a 5.25 inch laser-encoded disk.

K. DURANGO SYSTEMS (SUBSIDIARY OF MOLECULAR COMPUTER)

- The Poppy 286/186 supports up to 12 users, with a proprietary operating system operating as an MS-DOS interpreter and a XENIX shell. The system is priced between $4,400 and $12,500, depending on configuration.

L. FORTUNE SYSTEMS

- The Fortune PS-20 is priced starting at $7,000 and supports up to five users under For:Pro, a UNIX-like operating system. Also available is the 32:16.

M. FOUR PHASE/MOTOROLA

- The 6300 supports eight users under UNIX. A two-workstation configuration is priced at approximately $15,000.

N. IBM

- The PC/AT is designed as a MUS for up to three users, but these capabilities have not been fully implemented by IBM as of this writing. It is geared to run PC XENIX (from Microsoft) as a MUS when it becomes available. Add-on third-party products do provide MUS capability currently. The AT is priced at approximately $4,000 for a basic model.

- The IBM PC network will let an AT act as a file server for up to 72 ATs, PCs, or XTs.

- The AT has primarily been used as a powerful standalone single-user micro. An attachment, priced at approximately $6,000, permits the system to run the 4,000 System/36 mini software packages.

- IBM recently introduced a desktop version of the System/36 mini as a four-user MUS, priced around $15,000 with software and peripherals--about one-half the entry cost of the System/36 mini.

- The CPU will be the same as the floor-mounted System/36, but in a smaller, denser package. It will support up to one megabyte of main memory and over 40 megabytes of disk storage. It will run the more popular operating systems and programming languages.

- Also available is the Desktop Series/1 in two models; one with a Series/1 processor on a chip, the other with either an AT or modified XT, allowing the use of Series/1 applications or standalone operation as a PC. The unit can serve as a gateway in a network of PCs for communications to other PC networks or mainframes.

- The 9000 Series model 9002 from the Instruments Computer division operates under XENIX and supports up to four users. It is directed at instrumentation applications and priced upwards of $6,500.

O. KAYPRO

- Based on the same 80286 chip as the IBM AT, although an older, pinless version, the Kaypro 286i comes with 512 Kbytes of RAM two, 1.2 Mbytes floppy drives, and bundled software.

- The 286i does not come with a hard disk, although dealers can add this at the buyer's option. The lack of a hard disk was a marketing decision, with Kaypro saying its customers don't really want the memory. The system has eight slots, five of which are available to the users, compared to the AT with eight slots, all but one available.

- The 286i runs the same software as the AT, but, like the AT, requires PC-DOS 3.0 (sold separately) to run popular software such as Framework and dBASE III.

- The system without a color monitor ($595) is priced at $4,550.

P. NCR

- The NCR PC8 is an IBM PC/AT clone. It can run most AT software and support most AT hardware attachments. It uses XENIX in the multi-user configuration, supporting up to 16 users, although the company recommends limiting usage to 12 users to prevent response time deterioration.

- The PC8 will act as a file server when connected to the company's PC LAN, and will service up to 63 users in this configuration.

- A basic PC8 costs $3,800. An enhanced, expandable version costs $5,500.

- The UNIX-based Tower 1632 supports up to 14 IBM compatibles as intelligent workstations, although four to eight are recommended for optimal performance.

- The Tower XP supports up to 16 users and comes standard with 1 Mbyte of main memory, 46 Mbytes of disk storage, and a tape back up system. It is expandable and priced starting at $19,500.

Q. MORROW DESIGNS

- The Tricep supports four to eight users using UNIX System V operating system as well as MS-DOS, and is priced starting at approximately $9,000.

R. NEC

- At the high end of MUS (and really a 32-bit minicomputer) is the Astra 300 Series from NEC Information Systems.

- Priced from less than $15,000, the Astra systems can support as many as 32 workstations, including NEC's Advanced Personal Computers.

- NEC claims that custom chips provide twice the performance and quadruple the storage of such machines as Digital Equipment Corporation's VAX Series at two-thirds the price.

S. NORTH STAR

- The IBM-compatible Dimension will support up to 12 users, with system prices between $7,500 and $40,000. Interfaces to Ethernet and Omninet LANs will be available late in 1985, allowing connections of several Dimensions. The systems are sold through system houses and VARs.

T. ONYX

- The C5000 Series supports up to 11 users under Concurrent DOS, Oasis-16, UNIX, and the proprietary Thoroughbred operating system. Onyx office application packages are available. Prices range between $5,000 and $15,000.

U. PLEXUS

- The company recently introduced the P/20, based on dual processors, supporting up to 16 users under a custom version of UNIX V. It is priced at $6,025 for OEM customers and is targetted for field office use in vertical industries.

- The P/15 supports from one to eight users. The P/35 (which may be replaced by the P/20) supports up to 16 users. At the upper end is the 40-user P/60.

V. SENSORY

- The Sensory Office System consists of a network controller, workstations, and integrated applications. It features voice annotation and voice mail functions. The system is bundled with software for telephone management, electronic messaging, word processing, spelling checker, spreadsheet (Multiplan), and forms creation/management. MS-DOS software can be transferred to the system.

- It is designed to support five users, up to 32 with incremental upgrades. Controllers can be linked together to form a larger network.

- IBM PCs may be attached, and mainframes can be accessed through BSC 2780/3780 protocols.

- A proprietary network is used for "latency" in order to support the voice applications. A laser printer for graphics can be installed.

- The proprietary, realtime multitasking operating system is needed because of realtime interrupts with various applications needing to be serviced.

- A system configured for 12 users lists for approximately $80,000.

W. SYDIS VOICESTATION 110

- VoiceStation with integrated handset is connected to the Sydis Information Manager with 3.2 gigabytes of storage (no local disk drives), which the company says can support over 200 users.

- VoiceStation works behind any PBX or on Centrex systems. A mouse/icons interface is optional.

- The system has IBM 3270-type and VT-100 terminal emulation capabilities through a protocol converter.

- VoiceStation operates under UNIX. Applications include data base, messaging, calendar, calculator, and spreadsheets. It also supports voice annotation of text.

- Price ranges from $5,000 to $8,000 per workstation, depending on configuration.

X. TANDY

- The Tandy 6000 (formerly 16B) is a XENIX-based machine which also runs TRS-DOS software (in a single user mode). It supports three to six users and is priced at $4,500, with a hard disk version at $5,500.

Y. TELEVIDEO

- The PM-16 Personal Mini supports up to 16 intelligent workstations or IBM PC-compatible micros equipped with interface cards. The operating system is Infoshare, an MS-DOS-compatible version of Novell's NetWARE. The CPU include both an 80186 and a Z80A microprocessor.

- Processing takes place within the workstations, with the CPU serving as a "network-in-a-box" or a file server rather than a typical MUS with centralized processing. Workstations are connected with 14-conductor shield cable or a fiber optic/modem combination.

- A four-user system is priced at approximately $19,000.

Z. VIASYN (FORMERLY COMPUPRO)

- The CompuPro 10 Plus is priced at $7,500. It supports up to four users. The system runs Concurrent CP/M 8-16, an operating system that permits 8- and 16-bit simultaneous operations.

- The 816G supports up to 16 users, with Concurrent DOS supporting PC-DOS programs, and is priced between $12,500 and $24,000.