Title: Optimizing the Utilization of Personal Computers

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Report No: P87001

Abstract: Team members researched separate areas of interest related to their work experience and needs. Each discusses, in a separate section of the report, the potential applications of personal computers (PCs) in each area, and identify the leadership skills and methods necessary to effectively utilize Pcs to optimize engineering and engineering management performance.

OPTIMIZING THE UTILIZATION OF PERSONAL COMPUTERS

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T. Lee, C.M. Hood, and D. Kanis

EMP - P8701

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OPTIMIZING THE UTILIZATION OF PERSONAL COMPUTERS

Good report but the individual parts have not been integrated enough

A Research Project

EAS 541

Portland State University

Masters Program in Engineering Management

Research Areas

System Planning - Darrell K. Cross
Communications - Richard L. Perlas
Project Management - Brian L. Ray
Manufacturing Support - Teri Lee

Fall 1987

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EXECUTIVE SUMMARY

PROJECT OBJECTIVE: To identify the leadership skills and methods necessary to effectively utilize personal computers to optimize engineering and engineering management performance.

APPROACH: Team members researched separate areas of interest related to their work experience and needs. Each discusses, in a separate section of this report, the potential applications of personal computers (PCs) in each area, the probable inhibitors to effective use, and recommended leadership actions.

RESULTS:
APPLICATIONS - In the four areas studied, the following specific PC applications were determined to be prevalent and/or growing in use.

- Scheduling and prioritizing
- Status reporting
- Data Access
- Graphics preparation
- Local area networks
- Document processing
- Computer-aided process control
- Data management
- Electronic mail
- Bulletin boards
- Enhanced PC capabilities tied to facsimiile (FAX) transmission

INHIBITORS: Seven general categories of inhibitors to effective PC useage were identified. Each functional area report and the summary tables provide more depth into the factors comprising each category. The inhibitors were not found to uniformly apply to all functional areas investigated.

- Limits of system capabilities
- Obsolescence
- Human nature
- Lack of management support
- Cost
- Inadequate training and education
- Inadequate application design

LEADERSHIP SKILLS/METHODS: Today's business environment is more dynamic and managers are being required to pay close attention to all aspects of management to maintain a competitive edge. As the use of PCs increases, the capital investment grows and the company becomes more dependent on their use. Effective leadership is required to maintain and enhance the productivity of this resource and the staffs assigned to operate the systems. This means managers must become more knowledgeable about the systems, use them in their daily duties, monitor costs and benefits (system performance), provide essential training and system support, be willing to adapt as organizational needs and PC technology changes, and recognize and reward superior performance. These characteristics were determined to be essential in all application areas.

Team Members and Research Areas:

- Darrell Cross.....System Planning
- Richard Perlas.....Communications
- Brian Ray.....Project Management
- Teri Lee.....Manufacturing Support

INTRODUCTION

This report represents the combined efforts of Project Team No. 4. The project statement (or goal) was as follows:

> To identify the leadership skills and methods necessary to effectively utilize personal computers to optimize engineering and engineering management performance.

Personal computers were chosen as the central issue because of the opportunity they offer engineering managers. The opportunity is in the form of productivity improvements; the ability to store, organize and manipulate data; and the opportunity for engineers to make smarter decisions.

The growth of personal computers is illustrated in figures 1 and 2 on the following page. This growth is the result of decreasing cost and increasing performance of hardware and software. For example, in 1981 an IBM PC with 64k of memory and one 160k disk drive had a retail cost of $2400. In 1986 an IBM PC with 256k of memory and two 360k disk drives cost $1600 (reference: Personal Computing, p57, October 1986). Similar advancements are expected to continue for years to come.

The challenge for engineering managers is to stay abreast of personal computer developments. Managers must identify applications, review costs, and implement systems when they are appropriate.

Contributing members of the project team were:

Name	Affiliation	Research Area
Darrell Cross	Hyster Company	System Planning
Richard Perlas	Bonneville Power Ad.	Communications
Brian Ray	CH2M-Hill	Project Management
Teri Lee	Precision Castparts	Manufacturing Support

PERSONAL COMPUTER SALES GROWTH

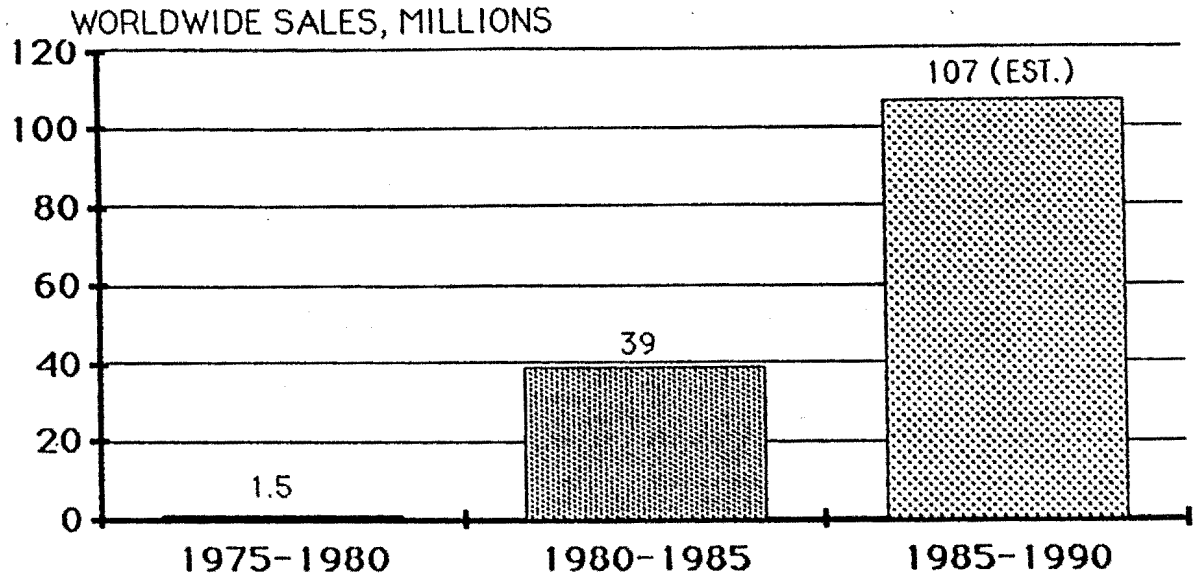

FIGURE 1

PERSONAL COMPUTER GROWTH TRENDS

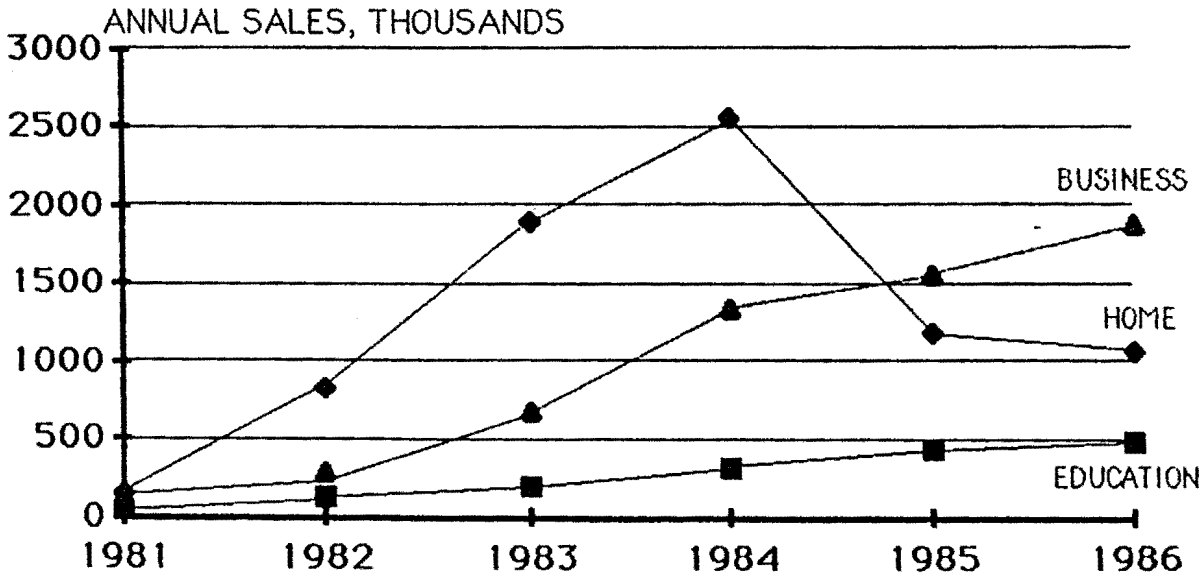

FIGURE 2

SOURCE: PERSONAL COMPUTING, OCTOBER 1986

DKC/11-29-87

Each member completed a study of the research area described above. Those results follow the Introduction. Conclusions were then derived based on the findings.

Source information was obtained by literature searches, interviews, and personal experience. A bibliography follows the discussion in each research area.

Research guidelines were established before the study began. For each research area, team members were asked to: 1) fully explore the opportunities for personal computer use, 2) list the inhibitors and obstacles to full utilization, and 3) describe management actions to remove those impediments. This systematic approach to the research effort resulted in a consistent presentation format and led to some interesting conclusions.

OPTIMIZING THE UTILIZATION OF PERSONAL COMPUTERS

A Research Project

EAS 541

Portland State University

Masters Program in Engineering Management

Research Area - System Planning

Fall 1987

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SYSTEM PLANNING

INTRODUCTION

In this section, the use of personal computers is evaluated for the engineering function of System Planning. The goal is to appraise the methods and leadership skills necessary to effectively use personal computers. Applications in the field of System Planning are reviewed, followed by a discussion on inhibitors and obstacles, and a description of possible management actions to remove those impediments.

For the sake of this study, System Planning is defined as the scheduling and prioritizing of engineering activities. Although engineering work is emphasized, the principles apply to other departments, such as manufacturing and marketing. Indeed, a complete systems analysis often involves all departments and the environment. In theory, System Planning may apply to the actions of an entire company or country, and includes such functions as operations research and strategic planning. The scope of this study was narrowed down to the engineering system, and those planning applications for a typical engineering manager. In this context, there is little difference between System Planning and Project Management. A system plan may involve several projects or tasks, but the same key scheduling elements are involved. Those elements are Gantt charts, PERT networks (Project Evaluation and Review Technique), CPM (Critical Path Method), and development of status reports. For this reason, the findings in this section are similar to those reported in the Project Management section.

The capabilities of available hardware and software is presented in broad terms. Sufficient information will be covered to allow the reader to draw some conclusions on cost and performance. Once again, however, it is beyond the scope of this study to cover this voluminous material in great detail.

Most of the information presented in this section is based on a literature search. Because of the topical nature of personal computers and software development, all of the relevant literature was found in magazines or similar periodicals. A bibliography follows at the end of the section. Report references to the bibliography are designated by numbers in parenthesis. For example, "(8)" refers to the reference source number 8 in the bibliography. Some of the information presented is based on personal experience and informal interviews. This author has been employed as a project engineer and supervising engineer for Hyster Company, and currently holds the position of manager of corporate product planning. This study is of particular value to the author, because I am considering the purchase of a personal computer and System Planning software.

OPPORTUNITIES FOR PERSONAL COMPUTER USE

Computer applications for System Planning are more than 30 years old. They began with large scale military systems, where terminology and techniques were developed. To date, the available "...software simply automates traditional ways of charting project tasks with techniques such as CPM and PERT. It does not address subjects such as quality control, employee motivation or any other abstract issues which human managers must grapple." (1)

Programs were first developed for mainframe computers and then applied to minicomputers. The programs are typically complex and require a lot of time to administer and adapt to specific applications. Costs for the programs alone range from $15,000-300,000, and some involve service contracts (at extra cost) with on-site consultatnts. (1) It is no surprise that such programs are limited to large businesses or government/military organizations.

The situation has radically changed in the last 5 years with the advent of personal computers. Over 100 programs exist today at prices that range from

$50-5,000. (2) The lower prices make System Planning/Project Management software viable for medium to small businesses, if not start-up companies and entrepreneurs. (3) Tremendous growth is forecast for the software.

SYSTEM PLANNING/PROJECT MANAGEMENT
SOFTWARE GROWTH

	1985	1990
Software Market Share		
Mainframe computers	66%	29%
Minicomputers	7	16
Personal computers	27	55
Total	100%	100%
Total Value	$151,500,000	$431,000,000 (1)

This prediction says something about software advancements and the benefits users are expected to derive.

Personal computer systems offer the same features as mainframes and mini's. The primary limitation of personal computers relates to the complexity of the system to be analyzed. For example, a typical personal computer system would provide for the analysis of 1500 tasks/projects, 300 resources, and 20 predecessor activities. A mainframe system could provide for 20,000 tasks, 10,000 resources, and 1000 predecessor activities. (2) The personal computer system will handle most of the planning requirements for engineering managers. Moreover, personal computer systems become more powerful with each passing year.

Available hardware alternatives for personal computer systems can be divided into two groups: A) IBM and compatibles and B) Apple Macintosh. Other personal computers do not have the capabilities or System Planning software for serious consideration by engineering managers.

IBM and compatibles account for about 70% of personal computer sales. Apple's market share is increasing, and now represents 25% of sales. (4) Excluding compatibles, IBM's share was 23% in the last fiscal quarter.

In the November 24, 1987 issue of PC Magazine, IBM was compared to Macintosh

for overall performance. (5) The best model of each was evaluated: IBM's PS/2 model 80 and Apple's Macintosh II. Despite the fact that PC Magazine caters to IBM and compatible users, the results of the comparison were mixed. Computing speeds were equivalent. The IBM came out ahead with respect to business software and keyboard functionality. The Macintosh had higher ratings for graphics applications, innovation, and ease of use. The retail price for the hardware with a 12 inch color monitor and 40-Mbyte hard disk drive were as follows":

IBM PS/2 model 80	$7,895
Apple Macintosh II	$7,226 (5)

Note that other PS/2 and Macintosh models are available for about half the price, that easily meet the needs for System Planning software.

Based on personal experience, and the PC Magazine findings (and similar articles in MACazine and Macworld) this author recommends the following hardware selection: A) Choose the Apple Macintosh if your business has no computers or if it already has Macintoshes. "On ease and pleasure of use, the Mac's on top." (5) Ease of use is an important consideration for the first time computer user. B) Choose an IBM or compatible if your business already has similar personal computers. The potential for networking and the compatibility with other software is an over-riding consideration. Moreover, the new PS/2 models are closing the gap with Macintosh with respect to ease of use and innovation.

As previously mentioned, there are over 100 programs available for System Planning on personal computers. The most popular software and retail prices are shown below:

A.	Apple Macintosh	
	MacProject	$195
	Micro Planner	$430
	Timeline	$410

B. IBM and compatibles

Microsoft Project	$370
Super Project Plus	$350
Harvard Total Project Manager	$430
Timeline	$410

The engineering manager is advised to visit a computer retail dealer when making a software selection. This author feels it is inappropriate to make a broad recommendation because software advantages depend upon the manager's individual situation.

It should be possible to buy a computer with printer and System Planning software for about $4,000. This assumes a conservative 20% business discount from retail. Prices would be about twice that amount for top-of-the-line hardware models.

There are many applications for System Planning/Project Management software. The most significant examples discovered in the literature search were as follows:

> "In general, any undertaking that involves more than two people and more than a few dozen tasks represent a likely candidate for project management software. Looked at another way, where an inflexible budget or demanding schedule is part of the picture, tracking the project with a software package may be the key to success." (1)
>
> "With a good scheduling system, you construct a model of a project. That model allows you to test possible solutions to problems." (7)
>
> "Proponents say project management software can give managers an instant status report on all facets of a project. This helps control costs and aids managers in guiding projects to completion." (2)
>
> "...programs that help people measure progress against goals and then focus graphically on the results make it worth the executive's time to get involved with software." (8)

INHIBITORS AND OBSTACLES

Inhibitors fall into three general categories: A) human factors, B) inadequacies of available hardware and software, and C) cost justification.

The human factors category presents the greatest number of obstacles. The following list was developed based on the literature search and personal experience:

a. Fear of technology. (2)
b. Cynicism of the capabilities of new technology (belief that computers are over used and capabilities exaggerated).
c. Old habits (gotten by without computers in the past).
d. Lack of knowledge regarding costs and capabilities of current personal computer systems. (3)
e. Lack of training on the principles of System Planning (Gantt, PERT, CPM, etc.). (7)
f. Lack of training on the use of personal computers. (2)
g. Belief that managers are above the use of personal computers. (9)

The last point was discussed in Macweek magazine. "The major problem in effective use of computers by management is not technical; it's cultural... schools produce managers who envision a big office with a clean desk because what they teach people is that a good businessman delegates responsibility and authority." (9) The author of that article advocated hands-on leadership by the manager.

The inadequacies of available software and hardware primarily related to ease of use. "The slow acceptance of micro project management can be traced to the complexity of the theories behind the software and to the difficulty in using the packages." (2) The obvious shortcoming of personal computers relates to the limited memory and computational abilities relative to mainframes and minicomputers. A program will crash if the input variables exceed the program/computer limits. (1)

The final inhibitor category relates to cost justification. John Richards, a supervisor of scheduling for the 1988 Winter Olympics in Calgary, Alberta makes this point "...companies cannot always cost-justify the acquisition of project management software in terms of payback. I've done major projects with no computer system at all, and when I say major, I'm talking about the

$2 billion range." (1) He was referring to a nuclear power plant project that was identical to another plant that had been built. Nevertheless, Richards is a strong advocate of System Planning. He was called in when the Winter Olympics got behind schedule. "In nine months we were able to analyze the networks and bring the project up nine weeks. The net savings for the company totaled an average of $400,000 a day for each of those nine weeks." (1)

MANAGEMENT ACTION TO REMOVE IMPEDIMENTS

An effective manager must address all of the inhibitors discussed above.

The human factor issues can be resolved by training, choosing user friendly hardware/software, and demonstrating hands-on leadership abilities. "The easiest approach is training. A properly trained user, in theory, is more likely to use project management software productively." (2) Software vendors employ a variety of approaches to train users. For example, Microsoft Corp. includes a training diskette with its Microsoft Project. The diskette includes 30 lessons, with an average length of about 10 minutes per lesson. (6) The importance of user friendly software was pointed out in MACazine:

> "Many people at Martin Marietta use Micro Planner not only for its power but because its learning curve is quite short. As we interviewed people for this article we heard time and again that the learning curve for using Micro Planner was quite short (less than a day for some people) and that meant we found very senior people using the software--people who wouldn't use the software if it took 40 or so hours to learn." (3)

Hardware and software limitations should be scrutinized before a purchase is made. A manager must first be sure System Planning software is needed, and then choose the most appropriate system for the application. Some software companies allow trial use of their product for a month. Still others have sample diskettes, that although are not complete programs, allow the user to get a feel for ease of use and performance. (6) At a minimum, it would

be desirable to evaluate performance with a small purchase, before committing to a large acquisition of computers and programs.

Cost justification deserves equal consideration. It seems probable that a cost/benefit analysis would lead to a buy decision based on the low system costs described earlier. If a manager already has access to a personal computer, then it becomes even easier to justify the costs of software alone. The Calgary Olympics example shows that System Planning software can be a good investment. Ford Motor Company uses a "...theme of productivity improvement and success stories of other users to encourage those reluctant to try project management software." (2)

CONCLUSIONS

There are many opportunities to improve productivity and managerial performance by the use of System Planning software with personal computers. The inhibitors to full utilization can largely be addressed by training and managerial leadership. As computer hardware and software costs come down because of technological advancements, it becomes easier to justify the initial investment.

A final note is that the purpose of a computer is to save human effort and predict problems. The computer becomes a part of the decision support system, but it can never supplant human judgment. "Project Management software, worthwhile and capable as it is, is no miracle worker. It is still up to the manager to make an accurate assessment of resource needs, activities and costs. Interpretation of results and intelligent decision-making remain in the providence of management, not the computer." (1)

Darrell Cross

DKC:bc

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OPTIMIZING THE UTILIZATION OF PERSONAL COMPUTERS

A Research Project

EAS 541

Portland State University

Masters Program in Engineering Management

Research Area - Communications

Fall 1987

Prepared By:

Richard L. Perlas
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I. Introduction

The need for a multi-disciplined manager is more evident now than ever before in history. The laws and practices that govern corporate, government, and individual actions are proliferating and are more complex; the technology on which progress and production is based is more rapidly changing; and the increased need for more timely information of financial and program status are all factors increasing the challenges for engineering managers. In addition to these "technical factors", the profile of a good manager in terms of personality, style, and interrelationship and leadership skills is constantly being redefined with renewed emphasis being placed on employee and customer relations, marketing, thinking strategically, and organization building. Physical separations in large offices and dispersed facilities can dramatically reduce the possibility of frequent communications. 1/

These technical and personality factors can overstress the present communications channels, work methods, and tools used by managers and can reduce organizational and individual effectiveness. Today's personal computers (PC's) represent an effective means of meeting these new challenges since new models are being designed with a higher level of applications capability and built-in processing power. Information technology has now become a competitive weapon as well as a catalyst for change in the business environment. Because of this, the marketplace demand has led to the creation of extensive libraries of software and instruction manuals to facilitate the increased uses of these machines.

However, their effective utilization requires proper planning, system design, and implementation to avoid wasted time and expenses evident in situations where the workplace was not prepared for their introduction. This research paper presents a synopsis of major PC applications for interoffice and interorganizational communications and presents a summary of the major inhibitors to optimal utilization. The report concludes with recommendations to organizational managers on what actions can and should be taken to assure effective incorporation within their organization. This paper is essentially based upon the author's 25 years of experience in major engineering design and construction organizations, and as an executive. Additional information was obtained from computer specialists, publications listed in the bibliography, and other Project Team members.

II. Major Applications

Communications, for the sake of this study, is the transference of knowledge and/or instructions from one entity to another. It involves the transmission of an intended message and the reception and translation of that message into action. This can be accomplished through the use of words, signals, symbols, or illustrations. From an organizational management sense, personal computers can be effectively used as a tool to improve communications and thus increase the chances for organizational (and personal) success.

In the world of computer technology, communications means "connectivity", i.e., the ability of a system to link up with the "outside world" rather than being entirely self-contained. This requires compatible terminals, communications-enabling software, comphone modems, and a transmission medium such as direct cabling, telephone lines, and/or microwave systems. 2/ Due to the limited time allowed for this study; the author did not review the myriad of new features, operating systems, peripheral equipment, or application products that are available to today's users.

The utilization of PC's to improve interoffice and interorganizational communications can be categorized into the broad categories described below.

A. Electronic Mail

Electronic mail is essentially electronic messaging whereby a stored text is converted to electronic pulses and sent asynchronously or synchronously to the receiving terminal, where it can be scrolled to a screen, stored on a disc, or sent directly to a printer.

The use of this technique has increased three-fold since 1985, according to International Resource Development in the October 1987 issue of Personal Computing, from an estimated 8 million messages to over 22 million in 1987. Another key indicator is the number of receivers, or "mailboxes", which are estimated to increase from 450,000 to over 1.4 million during the same period. The principal source of electronic mail is word processing systems.

B. Expanded PC Capabilities/ Fax Transmission

State-of-the-art PC capabilities such as spreadsheets and data files, calendars and group scheduling, business and technical graphics, file browsing, directory services, and desktop publishing will increasingly be used for organizational communications. The "trigger" for increased use is the coupling of a PC or PC network with facsimile (fax) transmission; the transmittance and reception of a digitized image.

Its popularity is growing because, unlike electronic mail, it allows transmission of letters on letterhead stationery, signatures, marginal notes, blueprints, pictures, and typeset documents. By 1990, it is estimated that there will be over 500,000 fax machines in the United States. A recent breakthrough in its application was not technical, rather was institutional. After decades of non-standardization of fax boards and interfaces, the International Telegraphy and Telephone Consultative Committee approved, in late 1986, Group III standards. This removed incompatibility problems and allowed for manufacturing uniformity and hardware and software interchangeability to a much higher degree.[3/]

C. Local Area Networks (LAN's)

Local Area Networks are networks of PC users interconnected for the purpose of sharing a common data base and achieve a high level of system support and technical assistance. LAN's are build around four kinds of components; the network operating system, network boards, the network server, and the PC workstations. The key element, although all are essential in constructing a workable system, is the LAN server program. This program enables facilities for sharing disks, printers, and serially attached devices on a PC network, as well as the ability for workstations to process applications remotely. To some, the advantage is that a LAN offers reliability, i.e., high resistance to single point failures. [4/]

A recent advance was the marketing of the OS/2 Local Area Network Server version 1.0. This version provides basic networking services for DOS and OS/2 PC's running together on IBM's Token Ring and PC networks, a common network arrangement.

D. Bulletin Boards

An active bulletin board is a relatively inexpensive message center for sales staffs, administration or customer service, production displays, and other similar needs. Anyone with access to a bulletin board's multiple directories can read whatever messages they contain.

The principal advantage is that it can cut communications costs by replacing phones and the need for personal exchanges of information.

These tools are important to management because of the increased capacity for information gathering and information management that they provide. Their increased growth testifies to the fact that small and large users alike seek and value these attributes.

Accuracy: The received message or document is a perfect representation of the original.

Timeliness: The time delay from a courier service, mail, or standard telegram is removed. The advantage is magnified several times when international transmission is compared with cross-town transmission.

Convenience: The sender does not have to try to convey a message accurately through verbal means (telephone conversation), although sometimes the latter method is the most preferred. However, since verbal communications are often sent through an intermediary, a mistranslation often occurs causing waste in terms of time and/or money, and even organizational credibility. In addition, it is often difficult to get the parties together due to uncoordinated appointments and differences in time zones. New computer programs allow delayed transmission and/or automatic reception.

Cost-Effectiveness: A properly designed system can provide access to other sources of information at a lower cost than through a resident data base. Costs can also be reduced through the coordinated use of shared terminals and peripheral equipment. 5/

Multiple Transmission: An important sub-set of convenience is a networked system's capability to access several terminals simultaneously, sequentially, or a preprogrammed schedule.

III. Inhibitors to Optimal Utilization

The combined experience of the Project Team in computer systems and information received from current literature, internal automated data processing specialists and other sources indicate that the following reasons are frequently identified as reasons why PC communications techniques are not requested, and if requested and available, are not fully utilized.

A. System Related:

1. The initial cost of the desired system may be higher than expected and/or difficult for the organization to justify in comparison to other capital needs. This can place an air of skepticism on the system even before it is installed.

2. A history of high maintenance requirements (cost, downtime, reduced staff productivity) can reduce their desirability of a system. 6/

3. A lengthy phase-in time before achieving expected performance levels can lead to impatience and frustration. 7/

4. Systems that have limited enhancement/expansion capability can cause users to seek other systems to accomplish their work.

5. Since much of the work performed on PC's is of a confidential or proprietary nature, the lack of system security, such as password protection, can lead to non-use. 8/

6. A system that is perceived to be prematurely obsolete in the eyes of the user is less useful.

7. Poor on-line real-time performance results in increased labor requirements and communications system changes. 9/

8. Noise or disruption caused by inadequate transmission media can lead to loss of data and reduced interactive capability of the system.

9. The continued cost and disruption of enhancements, training, hardware changes, and software, if unanticipated by the organization, can lead to discontent in the system. 10/ 11/

10. There is frustration in attempts to interconnect incompatible systems. 12/

B. Organizationally Related:

1. The system cannot perform up to its intended use if there is a lack of adequate data base sources to serve the need. 13/

2. The lack of management/organizational commitment to use and support the system in terms of staff resources, system funding, and the willingness to tolerate some inefficiency while it is "burned in" can stifle utilization. This may be present in an organization that supports another computer system, such as a mainframe. 14/

3. Frustration can build up if there is inadequate training provided to operate the system. 15/ 16/

4. Some managers and staff simply don't like a new PC system based on poor past experiences.

5. Sometimes systems are provided when the need is unconvincing to the users.

6. Over-enthusiastic computer sales personnel or staff can create unrealistic performance expectations for the effort and cost required to implement its use.

7. The lack of defined uses can lead to the purchase of a system that is misdesigned to true organizational needs.

8. The lack of space and adequate facilities to site and operate the system can create disruption and distraction in its use.

9. More users than terminals or system capability can cause a situation where there is difficult access to the system. 17/

10. If a system requires time or terminal sharing, employees can become discontented if there is poor user coordination. 18/

11. Poor utilization can occur if there is an attitudinal conflict such as "computers cannot replace human intuition and leadership."

12. Some employees are intimidated by the new technology and unwilling to learn to use it.

13. Even enthusiastic users can lose productive time if there is a lack of supplies such as paper and disks.

14. A system will not be used if there is a lack of useful applications within the organization in which the equipment is assigned.

This list is an attempt to describe the most prevalent reasons why PC's often sit unused, are misused, or become the focus of staff discontent. It may not be complete because of the time constraints in this report's preparation. Future studies in this area will incorporate additional inhibitors deemed to be uniquely different and meaningful.

IV. Recommendations to Management

PC introductions in the work environment seems analogous to the introduction of any type of equipment, such as solid-state communications equipment, jet airplanes, microwave ovens, digital watches, laser-guided missiles, robotics or electric typewriters. However, amazingly so, the lessons of the past seem to be forgotten and PC introduction is often considered as precedential, somehow much different than anything previously encountered. Consequently, problems recur, even within the same organization.

The key to a cost effective and smooth acquisition and utilization of PC's for an interactive communications system is described below in brief terms:

- Be a visionary and clearly define the present uses and potential expansion requirements desired to meet organizational growth needs. [17]

- Obtain expert advice from within or outside of the organization to assist in selecting the components, siting the system, establishing training requirements, and identifying all sources of support needed to keep the system running smoothly. Involve the users so their needs will be considered and to create an enthusiastic expectation. Fully consider, but challenge the expert's and staff's claims and recommendations frequently to ensure acquiring a system designed to match your needs.

- Even though your needs will be different than your staffs', be a role model by either using the system personally, and relying confidently in the products derived from its use. [18] Set the example in a corporate culture that recognizes the importance of information to the success of the firm. [19]

- Acknowledge problems users are having and take responsive action.

- Pay special attention to the "other end(s)." They must function as well as the terminal(s) you are installing in the "home location" to have a functioning system.

- Establish a relationship with your system's dealer. This will maintain the dealer's interest in your business, possibly making it easier for them to meet your future needs.

And especially,

- Recognize the "inhibitors" listed in Section III and prepare to eliminate them. One of a manager's duties is to enable the employees to accomplish the job we're paying them to do. Therefore, it is important that managers acknowledge that overall success is contingent on "Productivity through people," one of Thomas Peters and Robert Waterman's eight attributes of America's best-run companies, as described in their 1982 book In Search of Excellence. 20/

    - Reward good performance; i.e., productivity, creativity, and consistent quality and highlight good examples of achievement as positive reinforcement.

    - Provide users with a portable machine or system access so that they can practice and improve their proficiency and perform work outside of their office.

    - Provide additional opportunities for education and training so your employees will attain and maintain a high level of competency. Education programs may have to be customized to meet the knowledge level of the employee(s) and their learning capacity. 21/ 22/

V. Summary

Personal computers can help organizations to achieve the potential necessary to anticipate and solve today's challenging managerial and production problems. In today's corporate systems, this means cross-system connectivity and the improved communications capability that this provides.

Whether it is electronic mail, expanded PC capabilities tied to FAX systems, local area networks, or bulletin boards, numerous problems face the organizations as a new system is conceived, designed, placed in operation, and maintained. The organizational manager must anticipate these problems and move systematically to mitigate and eliminate them. The theme of chapter 8, Attitudes and Attention from Robert Waterman's new book The Renewal Factor is that visible management attention, rather than exhortation, gets things done. Since it's important to pay attention to quality in all areas of the business, managers should plan on dedicating periods of total attention to issues of PC integration.

By making this commitment through direct personal involvement and knowledge, PC introduction and use will become the successful (and profitable) venture that was intended.

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OPTIMIZING THE UTILIZATION OF PERSONAL COMPUTERS

A Research Project

EAS 541

Portland State University

Masters Program in Engineering Management

Research Area: Project Management

Fall 1987

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PROJECT MANAGEMENT
AND
MICROCOMPUTER APPLICATIONS

Introduction

Successful engineering project management requires the blending of art and management science in order to balance three major elements of a successful project: time, cost, and performance. To achieve this success, a project manager must undertake and fulfill some specific roles:

Planning. The purpose of planning is to divide the overall project requirements into elements that can be effectively managed. Effective planning can help avoid unnecessary crises and anticipate unavoidable crises, making them easier to control.

Organizing. The project manager should be involved in the selection of the project team. The project manager also has the responsibility to provide feedback on each project team members's performance on a project.

Directing. After the project is planned and organized, the project manager must spend considerable effort directing the activities of everyone involved on the project. This effort can include coordinating project team members, senior managers, principals, outside services, clients, or other third party members. This role is essentially one of effective communication, making sure that project work is done efficiently and that nothing falls through the cracks.

Controlling. The project manager's control functions can generally be divided into four categories: technical quality, budget, schedule and client satisfaction. The control function can be successfully accomplished by using various control techniques, such as design or process reviews, formal progress reports, and informal milestone reviews. The ability to delegate work to other team members also calls for adequate control measures.

Used effectively, project management software available on the market today can assist the project manager in fulfilling the roles as a planner, organizer, director, and controller. Project management software can be used as a valuable tool by the project manager for the successful completion of the project; however, it cannot take the place of practical experience, basic common sense or active, participative, project management practices. Being employed by a large, private, project-oriented consulting engineering firm, serving as a task leader or project manager, project management and ways to become a more effective manager are of particular interest to this author.

Applications

There are many brands and types of project management software for microcomputer applications. Some software, such as Lotus 1 2 3, Symphony, Supercalc and others, are commonly used to produce electronic spreadsheets for general purpose needs. This software is not designed specifically for project management and their use will not be addressed in this report. Some brands of software specifically designated for project management applications are listed below:

Timeline	Microsoft Project
Superproject Plus	Superproject Expert
Harvard Total Project Manager	MacProject
Harvard Project Manager 2	Micro Planner
Primavera Project Planner	Workbench

Most of these software packages are used in workplan-type applications. They work on the basis of tasks required and the resources available to accomplish those tasks. They also require the input of the time schedule available and the time required to accomplish each task. These software packages can be used to assist in the roles of planning, organizing and controlling.

Planning and associated project organizing can be achieved through scheduling features in the software programs. CPM scheduling and the relationships of lead and lag times, early and late start and finish, as well as critical path and critical resources of a project can be reviewed through the use of charts. Most software available today can be used to create both bar and PERT charts. Bar charts allow the project manager to plan for the resources required to successfully complete the project. PERT charts can be used to assist with the planning of critical path activities. Both can help the project manager with short- and long-range project forecasting.

Ongoing project monitoring is also possible with most project management software. Project monitoring can be done by using some of the common resource managing features, which can be usually be reported in both preformatted or unformatted forms. Resource profiles and costs, calendar activities, activity overviews and duration variances, as well as activity listings are common types of reports available to help the project manager with project monitoring. Changes in schedules are common to most projects; therefore, the ability to update charts and change schedules to "real time" in order to identify available lag and float time or the new critical path is essential for achieving project goals. In addition, the ability to monitor "planned versus actual" dollars, days, or resources is invaluable to a project manager so that, if necessary, appropriate steps can be taken in a timely manner

to help get a project back on track.

Inhibitors and Obstacles

Inhibitors and obstacles in the application of project management microcomputer software can be divided into two categories: business and personal.

Although the cost of personal computers has dropped over the years, if the computer system cannot be used effectively, its purchase can become a poor business decision. Also, the prospect of continually upgrading both the hardware system and software packages can deter some potential users. In addition, some organizations may have a limited amount of space available for a microcomputer work station or may not be able to afford enough systems required for project management needs.

When looking at some of the personal issues hindering project management software applications, one of the basic issues may be simple fear of the computer system. Many managers have practiced for years without the benefit of computers or software. These people may have a fear of trying to learn a new way. Some managers may have difficulty in seeing practical applications of the computer and software. These people may see the computer merely as a sophisticated calculator.

On the other hand, there is always the possibility that the project manager may get so wrapped up in data collection and processing that appropriate actions necessary for the successful completion of the project may not take place. Other inhibitors for project management software applications may be the lack of education or understanding of the benefits of the software available, or even the lack of understanding of the essentials of good project management.

Leadership actions

The most important action necessary for implementing microcomputer software for project management is to require and encourage training and education in the very basic elements of project management for all managers. The manager must become aware of the necessity of balancing time, cost, and performance for successful project execution. Once the project manager has a well-established management background, the use of software as a tool to assist in the planning and monitoring of the project will become more apparent. Similarly, with a better understanding of project management issues, increased creativity in the software application is likely to occur. The basic skills of successful project management can be taught through formal programs, such as in

universities or community colleges, or informal programs in the workplace, such as short courses, seminars, and brown bag lunches.

After basic project management concepts are understood, education programs on the use of microcomputer systems and available project management software can be effectively implemented. Once the use of management software takes place, support and encouragement for its use are required to emphasize the benefits of successful project management, as well as to reinforce the users' positive outlook on the computer system. Also, care must be taken to upgrade the microcomputer system, both hardware and software, as necessary, to encourage continued and consistent use of the system. Upgrading may also prevent frustration that the project manager may experience from using an inadequate system or insufficient project management software.

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OPTIMIZING THE UTILIZATION OF PERSONAL COMPUTERS

A RESEARCH PROJECT

EAS 541

Portland State University

Masters Program in Engineering Management

Research Area: Manufacturing Support

Fall 1987

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INTRODUCTION:

Engineers perform manufacturing support functions in essentially all manufacturing processes. In many cases the actual tasks might not be performed by engineers, but by trained technicians who receive guidance from or follow procedures designed by engineers.

Manufacturing support functions include tasks like: providing instructions, monitoring process parameters, regulating work flow, testing, troubleshooting, controlling automated machinery, and inspection. This is a huge field of engineering activities spanning many types of industry. Rather than limiting the nature of the applications being considered in this study, I feel that it is appropriate instead, to let the function remain general and focus on the management issues that apply to the use of computers in this field.

Information in this report comes from current literature (see bibliography), personal experience (as an engineer in a large manufacturing facility), and discussions with individuals working in the fields of engineering management and computer support.

APPLICATIONS

PC utility for manufacturing support can be separated into applications for individual stand-alone units, terminals linked to a network, and terminals with access to a plant-wide data base.

In addition to these functional attributes, the use of computers can have significant motivational value. Engineers appreciate having the best tools available to do their work. It is also important for creative technical individuals to have the opportunity to continuously learn new skills.

I. STAND-ALONE PERSONAL COMPUTER

The personal computer is a powerful tool, with applications including the following:

Word processing: writing of reports and instructions can be done more efficiently and quickly, engineers being able to proof read their work and revise immediately, rather than writing things out by hand and then revising secretaries' typed versions. The need to cut and paste is eliminated.

Spread sheets: calculations, record-keeping, and formats for special applications.

Specialized software: project management, statistical analysis, standardized reports, experimental design, etc. Powerful tools to save time, increase accuracy, and increase level of engineering analysis, can be available at the engineers' fingertips through software that is currently available on the market or can be created as needed for special applications.

II. NETWORKS...On-line system application possibilities include:

Automated generation, revision and distribution of technical instructions for the manufacturing floor.

Paperwork processing automation (such as a limited access system for "signature" approvals).

Tracking of critical activities with the benefit that information can be input and received at multiple locations.

III. DATA BASE ACCESS applications:

Production process data access and analysis. Computers have become standard equipment in many process control systems. Frequency of use of the data available can often be increased by simply educating engineers who don't deal with the system on a daily basis.

Cost data access and analysis. Same as above.

Consistency of reporting is obtained through the use of a common data base.

Plant production schedule data access. "The use of a good materials resource planning system can be very beneficial in improving teamwork by providing an agreed-upon, attainable production plan."(1)

Group Technology (GT) is a data base application in which information about related manufactured items is stored and retrieved. The number of new parts created can be reduced by using existing or minor modifications

of existing parts in a new application. Data is also useful in other functions such as sales, purchasing, and manufacturing method decision making.(2)

INHIBITORS

Three types of inhibitors to the efficient use of computers will be considered here:

I. PRAGMATIC PHYSICAL INHIBITORS:
Lack of any of the following: funding, terminal space availability, availability of effective user training, and user knowledge of programs or facilities available. Scattered efforts of different individuals to set up systems for different uses can easily result in difficulties in hardware compatibility, lack of common software knowledge, and difficulties in obtaining effective user assistance.

II. HUMAN FACTOR INHIBITORS:
Management or co-worker acceptance of the computerized work mode. Learning to use computers is very time consuming. Individuals who have no interest in computers often feel (and communicate the feeling) that anyone sitting at a computer terminal is wasting time. The result is that computer learning and usage can be inhibited, or completely stifled by social pressure.

III. LACK OF MANAGEMENT SUPPORT:
This is the most serious inhibitor. If an organization's leader(s) considers computers an unreliable source of data, a waste of time and money, etc, then that is exactly what they are likely to be in that organization.

LEADERSHIP ACTIONS

Leadership actions necessary to overcome the inhibitors listed in the previous section are detailed in three separate groupings: personal; organizational; and hardware and software selection.

I. PERSONAL

-Understand at least the basics of working with computers. Personal use by the manager is highly recommended.

-Be aware of computer developments and potential. Be able to imagine or understand advanced applications of the available technology.

-Recognize that users will be terribly frustrated by a poor computer/information system, just as with any other inadequate tools.

-Know what your computer system is capable of and push engineers and managers to become familiar with it by asking for information or specific report formats that they will have to use the computer to produce. Once started, individuals will continue to learn more about the system and take advantage of its' capabilities. Without an initial push, it will be the tendency of many busy individuals to continue to do things the ways they have been over the preceding years.

II. ORGANIZATIONAL

-Be sure that your people are aware of the facilities, capabilities, software, and other resources that are made available to them and support their use.

-See that the organization is moving toward information literacy at a reasonable rate.

-Establish a centralized assistance group.(3)

-Provide generous access to computers for all engineers. Computer literacy can be encouraged by company sponsored low cost loans for individuals who want to purchase personal computers, availability of portable loaner systems for take-home use, and frequent classes (either on-site or outside).

III. HARDWARE AND SOFTWARE SELECTION

-Select standard software to be used throughout the organization (with possible exceptions) for common uses like word processing and spread sheets.(4)

-Make systems, where possible, compatible with other existing systems. Industry wide standards are being developed for connecting intelligent shop floor devices.(5)

-Deal with reliable established vendors that will provide the support that will be needed throughout the years.(4)

-Systems, to be used effectively, must be understood by the users. Operation of a system such as inventory control, process control, etc. should be set up so the user is aware of what the data he is receiving represents, where it comes from, not just that the box said to do a certain thing at a certain time.(1)

CONCLUSION

Personal computers are becoming an integral part of the engineering workplace. Their use warrants managerial attention because substantial manpower and financial resources are involved. Particularly with complex interconnected systems, there are many pitfalls to watch out for, things that could be overlooked that could result in considerable reduction of the organization's productivity.

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CONCLUSION

APPLICATIONS

The preceding sections give some details on applications of personal computers in the fields of engineering and engineering management. Applications are numerous and are discussed as background information for this study.

INHIBITORS AND LEADERSHIP ACTIONS

The findings of the contributors to this project have been compiled and condensed into seven general types of inhibitors. These are the major potential problem areas to be considered in managing the engineering use of personal computers. They are discussed briefly below, along with specific leadership actions applicable to each:

1. COST

Included are the costs of the initial system; maintenance and support; improvements; and training (time, expertise, hardware and software).

LEADERSHIP ACTION: Ensure that system meets appropriate cost/benefit criteria.

2. LIMITS OF SYSTEM CAPABILITIES

For personal computers connected in a network or to other of the organizations computing facilities the following may be causes of problems: excessive down time (low mean time between failures, high mean time to repair); poor on-line real-time performance; inadequate transmission media; incompatibility of hardware or software; inadequate user coordination; and excessive time required for phase-in of new system.

In addition, difficulties for stand-alone personal computers (as well as interconnected PC's) may result from: lack of space; inadequate facilities; difficult access; and lack of sufficient supplies (discs and paper).

LEADERSHIP ACTION: Upgrade systems to meet user needs. Develop a good working relationship with computer hardware/software dealer. Be sure planned use matches purchased hardware and software.

3. OBSOLESCENCE

There is risk involved in implementing a new computer system because technology is still improving so fast that whatever is purchased today will have a cheaper, more powerful counterpart in the months to come. Upgrades will be expensive and implementation of any upgrades is an added change for users to deal with.

LEADERSHIP ACTION: Keep informed on current developments in computer technology.

4. INADEQUATE TRAINING AND SUPPORT

Effective training is a critical part of any computer application. Training is complicated by the wide range of differences in individual's computer experience, which makes it hard to produce training programs that will address the needs of a group.

It is important that the software packages used in an organization be standardized as much as possible so that individuals will share common working knowledge and needs to learn new software as people move from group to group will be eliminated.

Software that is difficult to learn should not be chosen if possible as fewer individuals will make the effort to integrate use of the software into their repertoire of work skills.

Training takes on an even greater dimension when the implementation of a new system involves modifications to the ways many employees think about their work.

A centralized support group can fill an essential role in providing general information, software and hardware use assistance, and functions such as programming to implement changes in systems or develop new applications for existing data bases.

LEADERSHIP ACTION: Provide for adequate training. Establish a centralized support group. Select easy to learn software to be used commonly throughout the organization (with exceptions as needed). Purchase some portable PC's so that employees can take them home with them. Company sponsored loans to employees who wish to purchase their own systems are a good way of promoting computer literacy, as is easy access to company owned systems.

5. HUMAN NATURE

Because the use of computers is still relatively new in most engineering and engineering management environments, several human attributes need to be considered. Some individuals are intimidated by computer technology, which interferes with effective learning and use. Some may have unrealistic expectations of computer performance while others will have difficulty overcoming distrust of computer output. In all cases where new work methods are involved in computer implementation, the basic human resistance to change will have to be dealt with.

LEADERSHIP ACTION: Understand the benefits of PC's and inspire usage. Establish incentives and recognition for use. Create visibility for examples of others' past successes and tie benefits to the actual situation. Structure the phase-in of new applications.

6. INADEQUATE APPLICATION DESIGN

All systems must be carefully designed to meet the organization's needs. Use of software that is inappropriate for the task at hand or lack of applications can contribute to poor performance. Inadequate data base or sources may also be a problem.

LEADERSHIP ACTION: Give careful attention to the complete system functional design while in the planning stages. Plan for periodic review and adjustments.

7. LACK OF MANAGEMENT SUPPORT

Lack of management support in overcoming any of the above obstacles can result in ineffective use of computers in the organization.

LEADERSHIP ACTION: Develop personal knowledge and use.

The following pages indicate in which of the researched application areas specific inhibitors were considered to be significant. It is interesting to note that the inhibitors were not universal, and likely that many of the differences are a result of the physical complexity of the system (interconnected PC's versus stand-alone). Leadership actions identified, conversely, were considered significant for all of the researched application types.

INHIBITORS TO PC USAGE

1. COST
   - o Initial system cost
   - o Maintenance and support
   - o Improvements
   - o Cost of training (time, expertise, hardware, software

2. LIMITS OF SYSTEM CAPABILITIES
   - o Excessive downtime (low MTBF, high MTTR)
   - o Poor online real-time performance
   - o Inadequate transmission media for interconnected systems
   - o Incompatibility of hardware and software for interconnection
   - o Lack of space/adequate facilities
   - o Difficult access
   - o Inadequate user coordination (interconnected system)
   - o Lack of sufficient supplies (disks, paper)
   - o Excessive time required for phase-in of new system

3. OBSOLESCENCE
   - o Investment risk:
     - Technology is improving so fast that whatever is purchased today, will have a cheaper, better counterpart tomorrow. Upgrades will be expensive and implementation an added change for users to deal with.

4. INADEQUATE TRAINING AND SUPPORT
   - o Use of different but similar software for similar tasks within an organization
   - o Use of software that is difficult to learn to use
   - o Insufficient/inadequate training available
   - o Lack of convenient expert help availability
   - o Lack of needed programmers to develop new uses for existing data bases

5. HUMAN NATURE
   - o Technological intimidation
   - o Resistance to change
   - o Unrealistic expectations
   - o Distrust of output

6. INADEQUATE APPLICATION DESIGN
   - o Use of inappropriate software for task
   - o Lack of adequate data base/sources
   - o Systems misdesigned for organizations' needs
   - o Lack of useful application

7. LACK OF MANAGEMENT SUPPORT
   - o Lack of management support in overcoming any of the above obstacles can result in ineffective use of computers in the organization.

INHIBITORS VERSUS FUNCTIONAL AREA

INHIBITORS	System Planning	Communi-cations	Project Management	Mfg. Support
COST				
Initial system	X	X	X	X
Maintenance and support		X		X
Improvements				X
Training	X	X	X	X
LIMITS OF SYSTEMS				
Excessive downtime		X		X
Poor performance		X	X	X
Inadequate trans. media		X		X
Hardware/software incompatibility		X		X
Lack of space				X
Phase-in time		X		X
OBSOLESCENCE				
Investment risk		X		X
INADEQUATE TRAINING				
Incompatible software	X		X	X
Difficult software	X	X	X	X
Inadequate training	X	X	X	X
Lack of experts		X	X	X
Programming needs				X
HUMAN NATURE				
Intimidation	X	X	X	X
Resistance to change	X	X	X	X
High expectations	X	X	X	X
Output distrust		X		X
INADEQUATE APPLICATIONS				
Inappropriate software	X			X
Inadequate data		X		X
System misdesign		X		X
Lack of applications				X
LACK OF MANAGEMENT SUPPORT	X	X	X	X

LEADERSHIP/MANAGEMENT ACTIONS

Action	Management Function*				
	P	O	M	D	C
Training/Education	X	X	X	X	X
Personal knowledge and use	X	X	X	X	X
User friendly hardware/software	X		X		
Examples of past success	X		X		
Benefits to actual situation	X		X		
Structured phase-in	X	X		X	X
Followup support	X		X		X
Periodic adjustment to plans		X	X	X	X
Incentives			X		
Recognition for use			X		
Easy system access	X	X	X		
Portable loaners			X		
Company-assisted financing			X		
Develop user/dealer relationship	X				
Understanding system benefits; inspire use	X		X	X	
Provide expert advice	X	X	X	X	X
Ensure system meets cost/benefit criteria	X				X
Encourage software compatibility	X	X	X	X	
	72%	39%	83%	39%	44%

*Planning, Organizing, Motivating, Directing, and Controlling
Engineering Management, Cleland and Kocaoglu