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ABSTRACT

Trends affecting information systems and decisions of college administrators are traced, and specific types of technologies currently available are reviewed. Information systems support routine operations decisions or planning and policy decisions. The primary advantage of computerized information systems is rapid access to data and rapid manipulation and comparison of data. In addition, computerized systems can perform many different applications or functions, such as automated spreadsheet programs and financial modeling and planning programs. Examples are provided of how the new technologies can be used to achieve financial savings and greater efficiencies, and of the three sizes of computers commonly used in academic administration: large-scale or mainframe computers, minicomputers, and small business or microcomputers. Attention is also directed to word processing, copying machines, micrographics, and three major forms of equipment communication (electronic mail, telecommunications, and networks). Cost benefits of computing equipment include the application of computer logic to the gathering of primary information and the usefulness of computers to professional staff. Computerized systems are especially efficient for registration and transcripts operations. Types of computer crimes are noted. An extensive bibliography is included. (SW)

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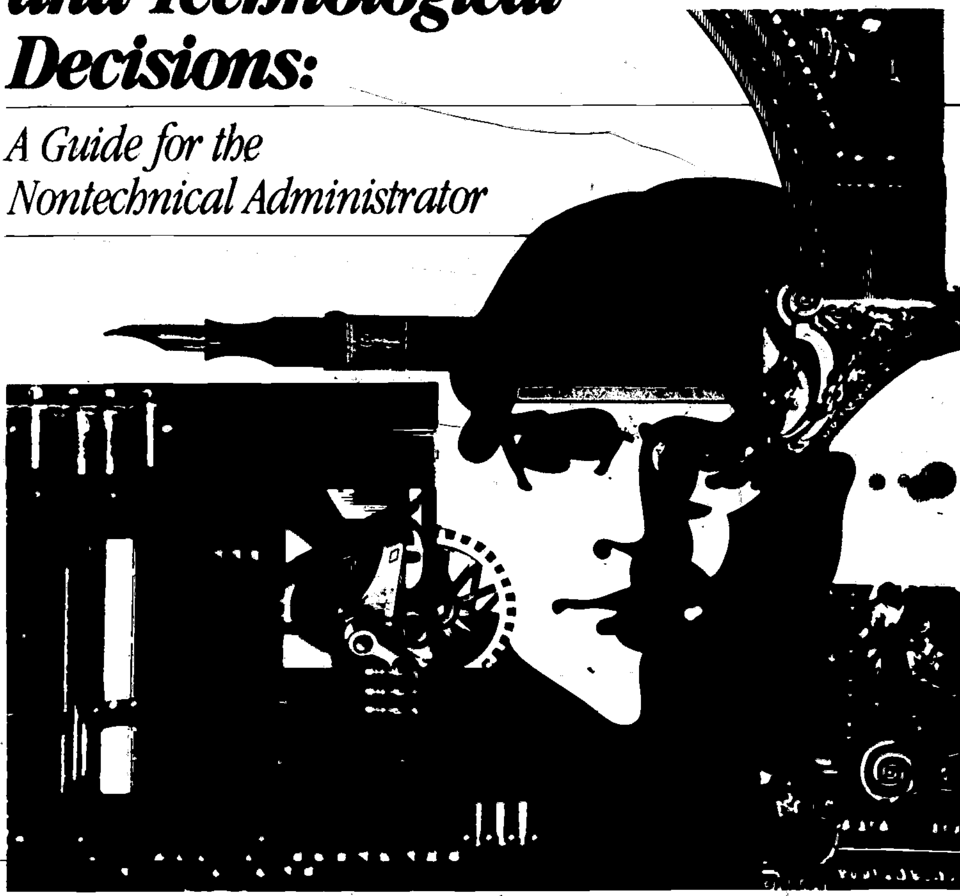
Information Systems and Technological Decisions:

A Guide for the Nontechnical Administrator

Robert L. Bailey



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Contents

Foreword

It is an irony that while many of today's readily available "high tech" equipment and systems were discovered or developed at higher education institutions, the technology is not being used widely to administer these institutions. The reasons for this are many. In a time of fiscal constraints, it is difficult for institutions to develop a rationale for investing a large amount of capital in equipment and software when they are laying off personnel. Related to this is the problem of the absence of "institutional slack." Because most faculty and administrators need to be trained before they can fully comprehend and appreciate the advantages of the new technologies and before the systems can be put into operation, a great deal of training is needed. Training takes time. If an institution does not provide slack or free time for this training, it is unlikely that these technologies will be utilized.

Another real but more subtle condition is that decision making concerning new technologies has been centralized in the offices of those few people on campus who have expertise in this area. When computer technology was dependent upon expensive mainframe hardware, this was reasonable. However, the development of inexpensive yet powerful microcomputers and "user-friendly" software has changed the situation. Centralized decision making now presents a threat to the status quo.

The more knowledgeable administrators at all levels become about the new technologies and their potential for increased efficiency, the more likely it is that these technologies will be utilized. Academe's leadership would do well to encourage administrators and faculty members to become technologically literate. In this Research Report by Robert L. Bailey, director of the Office of Admissions and Records at University of California, Berkeley, there is a careful review of this new technology area. Bailey sets the stage in a discussion of the trends affecting information systems and decisions of administrators. This is followed by a review of the specific types of technologies currently available. In the concluding chapters examples are given of how the new technologies can be used to promote financial savings and greater efficiencies. This report should be an excellent primer for those administrators who feel uninformed about the new technologies, yet realize that in order to compete they must become informed.

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Overview

The tasks of an administrator are very complex, and decision making is a fundamental aspect of administrative work. Good decision making depends upon good information. Yet historically, academic institutions have been slower than both government and industry in implementing the use of computers for administrative support (Wise 1979). In this era of decreasing resources, efficient information systems—employing new, computer-based technologies—can be effective and even indispensable tools for the academic administrator (Wise 1979).

An information system is a process that includes the data or information; the equipment and methods for collecting, compiling, retrieving and evaluating the information; and the people who use the equipment and the information (Wise 1979; Peterson 1975). The primary purpose of an administrative information system (AIS) is to provide specific and general support for decision making. Specific information systems support routine "operations decisions," while general or comprehensive administrative information systems—drawing on any number of specific systems—support "planning and policy" decisions (Wise 1979, p. 90).

Creating or finding information in a paper-based system can take days. In a computer-based system, in contrast, information is literally only a few keystrokes away. It takes only seconds to create, locate, gain access to, manipulate, change, and compare information. Also, administrators can enter new information into the system as it develops, ensuring that decisions by other administrators also will be based on the most recent data. The primary advantage of computerized information systems, then, is that they provide rapid access to data and permit rapid manipulation and comparison of that data. In addition, computerized information systems can perform many different applications or functions, such as automated spreadsheet programs and financial modeling and planning programs.

Unfortunately, most of the top administrators currently in higher education have had little exposure to computers. Traditionally, the college's computer operations were peripheral to the general administration of the institution, and during the '60s and '70s this division of expertise served very well. However, this will not be the case in the '80s. Technology is changing almost daily; computer hardware is becoming less and less expensive. And perhaps more important, the technology offers new opportunities for improving the functioning of many campus offices. Yet the integration of computer technology into the mainstream of campus operations cannot be left to the computer specialists alone. User responsibility is vital for implementing the office technologies that support a campus information system. The first problem is to persuade the users who work in offices, from the president on down, to accept the changes. Second, it is necessary to develop expertise and an overall campus plan for making intelligent purchasing decisions. This is especially difficult for the nontechnical administrator, who will continue to be in the majority for some time to come. Because of reductions in funding, some campuses have had to cut back or postpone plans for acquiring information systems and technical equipment. Some administrators see the allocation uncertainty as an opportunity to push ahead with plans to apply technology in their support units and elsewhere, reasoning that they cannot afford to delay (Brown 1982).

It takes a considerable amount of time to implement an effective institutional system and to persuade the system users to change their basic image of office technology. Successful implementation depends upon user involvement. The nontechnical administrator must accept responsibility for establishing the objectives of the system and must participate in the design, purchasing decisions, and implementation of the system. Only with administrative support, from the top administrator on down, can administrative information systems in turn provide support to the administrators they are designed to serve.

Trends Affecting Information Systems and Administrative Decisions

Enrollments. There is an old saying in higher education: "If you don't register the students and pay the faculty, nothing else matters." Administrators in higher education are entering a challenging period in at least one of these areas because, for the last five years, most of the popular press and some of the nation's prominent demographers have predicted a significant drop in college enrollment due to the declining number of high school graduates projected for the period 1980 through 1995. The Census Bureau estimates there are 1.4 percent fewer high school graduates in America in 1982 than there were in 1981, and 4.7 percent fewer than in the peak of 1979 (Magarrell 1982). The federal government has estimated that there will be a 13 percent drop in high school graduates in the United States by 1990 (*Chronicle of Higher Education* 1979). In addition, there are "doomsday" predictions that hundreds of institutions might close with the drop in the traditional pool of available students. Because of this dismal news, most institutions of higher education have mounted sophisticated marketing and recruitment plans (Grabowski 1981). While some of these programs have worked well for individual institutions or campuses, others may have only delayed the inevitable.

However, this 15-year period, 1980 to 1995, should be interesting because of the large group of people born in the late '40s and '50s who will be in the over-25 age group. Those institutions that will be recruiting students expect to offset some of the rapid enrollment decline with these older students. So far, the enrollment patterns of the older students show that they more often enroll part time, so it will take a greater head count to maintain the equivalent of full-time enrollment.

Enrollment of older students is projected to increase through 1988, as will the percentage of part-time students. Enrollment for men, which has declined for the past 10 years, will probably level off, particularly if the economic situation remains in a decline. Enrollment rates for women, which have increased in recent years, will continue to do so but at a reduced rate. As might be expected, not all categories of institutions are likely to be affected equally. If an institution is able to attract older students it will not be as adversely affected by the projected decline in traditional college-age students. However, the change from full-time to part-time enrollment will be difficult to track. It is likely that increases in part-time enrollments, as converted to full-time equivalents, will not be large enough to offset the decline in traditional enrollments. Given this situation, it is important to have institutional information systems that accurately identify the types of applicants currently in the recruitment pool and the yield of students enrolled.

The problem of maintaining enrollment has changed the needs of academic administrators. This shift in needs has resulted in a corresponding shift in administrative attitudes toward information systems, computers, and other office technology. Some view it as the way to increase productivity or create savings. The majority are attempting to use information systems as a means of improving administrative decisions relating to faculty, facilities, and students. Unfortunately, the switch to technological support for administrative decision making is not happening quickly enough, nor do the people such support is meant to help regard it with a desirable level of confidence. In addition, the cost of complexity involved in implementing an information system and the degree of user confidence in the system are not predictable and appear uncontrollable.

Student profile. Another dimension of the changes that will affect information systems and administrative technological decisions in the '80s is the student profile. The historic idea that college is essentially the privilege of the academically gifted or financially well off has been largely replaced by the view that opportunity must be available to all who might profit from it. Significant groups of the American population that historically never attended college are now doing so—more women, ethnic minorities, representatives from low-income families, foreign students from third world nations, and older adults, to mention just a few groups. Each quarter, large numbers of students transfer from institution to institution. Students drop out for short periods of time. Adults and students who changed their mind about their career patterns are going back to college to obtain supplemental or different degrees. These types of changes in higher education will put a tremendous strain on teaching. In this environment, timely and changing information about students, courses, degree requirements, financial aid, housing, instructional space, and many other items will have to be known and known quickly.

Steady-state funding. The term "steady-state" was coined in California in the late '60s when Governor Reagan froze the annual funding for the University of California. Since then, the best that could be expected fiscally was price-increase money and partial cost of living adjustments. This pattern has held for most of the years since the first action. A significant number of other states have the same type of funding patterns. Because of the faltering or uncertain economy and the anti-tax views of the citizenry, the current and future budgets for institutions of higher education could be in greater jeopardy. In fact, some states—Washington and California in particular—were asked to reduce spending mid-year in their last budget cycles and to make decisions based on a declaration of emergency (Magarrell 1982).

Annual expenditures of institutions of higher education are expected to increase to $57.6 billion by 1988–89. This will require increased fees and tuitions. For the most part, expenditures in higher education are determined by the number and type of students enrolled. However, many higher education institutions play diverse roles, providing not only education but also research and public services for and to the community. Noninstructional expenditures seem to be only minimally related to the level of enrollment (National Center for Education Statistics 1980). It would be misleading, therefore, to attribute the projected rise in expenditures solely to increases in the cost of education.

Another area of cost is annual capital outlay, which has declined $4.5 billion since 1968–69 and is expected to decrease another $2 billion by 1988. Although there may be little need for new campuses, there could be substantial need to renovate worn facilities and to change buildings to accommodate different programs and new types of students.

Although not directly hit by legislative cutbacks, independent colleges and universities also are suffering. High interest rates, inflation, and reduced enrollments caused by high tuition and the reduction of the financial aid funding have all forced private administrations to delay expenditures or cancel marginal programs. Unfortunately, higher education has never been very good at developing workable administrative plans and certainly not ones that include emergency options for limited or reduced funding.

Few campuses have administrative plans for developing long-range information systems and purchasing or leasing expensive equipment. Historically, institutions of higher education were not administratively organized to be as efficient or cost-effective as private enterprise; in fact, in many ways such a pattern would be detrimental to the collegiate atmosphere and the learning process. What was good for the departments, faculty, and students spilled over to the administrative units, but it was not effective for them. During the growth years, when there seemed to be ample funding, this lack of planning, efficiency, and cost effectiveness was not very important. One of the first indications of change was the energy crisis. With fuel costs accelerating rapidly, campus administrators sought to identify quickly all of the energy users and methods of consolidating and reducing energy needs. For most campuses, this was a costly effort. However, large and small institutions now maintain and monitor energy needs information systems. Because energy costs had risen so dramatically, the cost of technical support for this problem seemed small in comparison.

Many of the decisions that nontechnical administrators are considering today—including those about instructional programs, teaching loads, classroom utilization, student retention, graduation rates, and alumni support—are not as clear-cut. These activities generate essential information that all administrators need to know, but this information is hard to acquire because it is decentralized and is often in the form of paper documents. This information is seldom quickly accessible, and it is almost always impossible to merge or reconcile information from different units. More than ever before administrators must establish priorities. This effort requires timely and accurate information provided by information systems and modern technology; although needed, information systems are not inexpensive to establish or maintain. Other types of technology, such as printing technologies, also are essential.

New technical applications. Social factors affect the rate at which electronic administrative information systems overtake paper-based systems. This is true of American society in general and private enterprise in particular; in higher education this is doubly true. Reduced enrollment, reduced funding, faculty reductions, fears about the loss of privacy and the idea that "people take preference over paper" will cause colleges to be slower than other agencies in adopting new technology. Nevertheless, the changes will come.

Much of this new technology and change results from development of semiconductor chips and large-scale integrated circuits. An assembly of these devices enables users to carry out extremely complex data processing and control functions at high speed. yet the system occupies a very small space and consumes little power (Cawkell 1981).

The Association of Computer Users recently asked a panel of experts what can be expected in the near future. These forecasts will affect campus information systems and the administrative use of technology. The experts said:

1. Information systems will have to include better communication between data processing and word processing; they will have to be able to "talk" to each other.
2. Although few institutions currently are using computer networks, except for remote job entry, in the next decade institutions will work toward tying together all their equipment, including mainframes, minicomputers, terminals, word processors, intelligent copiers, and automated microfilms.
3. IBM Systems Network Architecture (SNA) will become an industry standard for software. Major microcomputer manufacturers will support it.
4. The goal of office automation is more than speed and accuracy for clerical tasks; it is also to help managers make decisions.
5. Word processing units, in addition to communicating, will be more sophisticated. Terminals will provide instantaneous images, enhanced text formatting, sophisticated cross-references, and more imaginative use of the video screens. Some will perform sophisticated financial calculations (such as automated spreadsheets), convert those figures into charts, produce a letter including the chart and then send it electronically to selected names without reentering information.
6. For certain applications, such as accounting functions, small computers will replace time sharing or large computers. Off-the-shelf personal computers such as Tandy and Apple already are in use in the academic areas. It is only a matter of time before the nontechnical administrator catches up.
7. Time sharing will continue to be valuable, but its main function will shift from interactive computing to storing and forwarding information. It is also applicable for data bases that need central information accessible by all of the small computers in the system.
8. Digital Research's CP/M operating system (internal software) will establish itself as the standard for microcomputers. Vendors are now making products to convert other microcomputers, such as the Apple II and the Radio Shack Model I/III, to CP/M.

9. Institutional technical staff must be concerned with human issues as well as technical ones. Social skills, such as the ability to communicate well and the ability to work with people, are increasingly important (Berst 1982a, pp. 36–41).

In addition, the price of electronic memories will continue to decrease but they will remain as much as 30 times more costly than micrographic storage. In the near future, then, microforms will be less expensive than electronic storage and retrieval (Avedon 1982). For this reason micrographics, computer output microfilm (COM), and computer-assisted retrieval (CAR) systems will be important parts of institutional information systems. In addition to its costliness, electronic memories must be backed up with duplicate files of important information, such as student academic records. Because micrographics is less costly and archival, it is unquestionably the best medium for providing security for vital university records.

The only thing certain about higher education in the '80s is that it will change. Consequently, the information systems and administrative technologies of the '80s must be easily and inexpensively changeable. Nontechnical administrators should be able to make direct academic information inquiries, and the clerical staff should be able to make program changes to the software (the computer's operating instructions) of information systems from their offices. It will be an exceptional nontechnical administrator who can understand this need and make the necessary management decisions required to "pull it off."

Effects of These Trends on Staff

Faculty and administrators. Although the number of faculty and administrative positions available in the '80s might be expected to decline at the same rate as the declining enrollments, on many campuses the rate could accelerate, for a number of reasons. There was a large increase in faculty hiring in the years 1945–55; many of these faculty members will be retiring or entering their last years of teaching. A small percentage of tenured faculty positions will remain filled because of increased life expectancy and good health, but many faculty positions will become open. Because of the current financial situation, however, these vacancies will not be filled or they will be divided into several temporary or part-time positions. This pattern has already been set by the institutions that attract working adults. At these schools, working professionals are employed to teach evenings and weekends. Part-time faculty are willing to work for lower salaries and often do not require fringe benefits because they view teaching as a secondary interest or job.

Another development that will affect the profile of the faculty, making them more unlike their students than was typical in previous generations, is the decline predicted in graduate enrollment. High school graduation projections for the next 15 years suggest that as undergraduate enrollment declines, overall graduate enrollments also will decline, since graduate programs recruit students who have earned a bachelor's degree. In addition, in periods of economic recession more students are attracted to professional degrees than to the liberal arts. Furthermore, it is difficult to attract people for academic or teaching positions that do not and will not exist. With fewer graduate students, new and remaining faculty will be directly teaching, with less assistance, the bulk of the undergraduates attending their institutions—undergraduates who are less prepared than were previous generations of college students.

Most of the faculty who will be hired in the immediate future are not part of the technical information systems generation. Those who are trying to come up to speed are only a step ahead of their students. Even in these cases, it is an awkward relationship and the faculty does not seem responsive to the necessary technical changes. The University of California-Berkeley campus, for example, does not possess an optical scanning machine for grading tests because so few professors will use one. How can antitechnical faculty members relate to the new breed of technically oriented students who are difficult to approach, even for a person trained in technical applications and schooled in the terminology of systems and technology development? In addition, if fiscal constraints require a higher student/teacher ratio and heavier teaching loads, when will faculty have time for the research essential to success in the academic world?

For administrators, the circumstances are slightly different; the terms used are "cost effective" and "priority programs." This is a difficult time for administrators to justify large, expensive systems changes, to compete in a very competitive market for technically skilled personnel, and to enhance campus computer hardware. Administrative information systems (AIS) have been available in most colleges and universities for over 20 years. The registrar's office was the first unit interested in using automated equipment to solve the age-old problem of effectively matching student enrollment needs with instructors and classes offered. As with any new, technologically sound product that users have not yet approved, the promised benefits of AIS often ran far ahead of the actual performance. The most recent illustration of this is the heavy emphasis on word processing and telecommunications in various forms, including electronic mail and information networking. Kalthoff and Lee (1981) point out that with word processing systems the benefits are 80 percent operator and 20 percent innovation. In addition, because the average secretary spends only 20 percent of his or her time typing, a 25 percent efficiency improvement would free only an additional 5 percent of the worker's time.

Given these facts, university nontechnical administrators no longer are willing to buy equipment just because it is the largest or most recent. The gamesmanship between campuses has taken a different twist. Just as most Americans are fixing their cars and driving them longer, university nontechnical administrators are making fewer purchases and are "making do." The nontechnical administrator (user) of the '80s must decide not only what computerized information system equipment to purchase, but also when and how to purchase it.

"Rank and file" employees. In general, the clerical persons, groundskeepers, custodial staff, and nonacademic employees will offer a mixed reaction to information systems development and computerization. One extreme might be illustrated by employees who protest that such development is an effort by management to "speed up" work and eliminate positions. Another objection is that cathode ray tubes (CRTs) generate harmful radiation or that constant viewing of the terminal is harmful to an employee's health.

At the other end of the spectrum are those employees who view computerization as an opportunity to learn new skills and as a way to make their jobs more interesting. For these employees, computerization offers additional opportunities: Their jobs can be reclassified upward and they can demand higher salaries because it will be increasingly difficult to hire skilled or trained employees. For those employees with children attending elementary school the motivation might be different. Their children may be taking computer classes or using computers in their math and science classes. In some schools, students can now check out microcomputers from the library, much like their parents used to check out books. These parents may want to share their children's educational experiences. This type of employee will be highly motivated and very receptive to the new technologies.

Older employees may be threatened by the new technologies and will be quick to say "I told you so" if there are problems or delays with the initial installation. It takes well-planned and well-executed inservice training, a strong public relations program, and a significant amount of time to gain these employees' acceptance and confidence. Frequently, the old work areas do not support the new systems procedures as well as they did the old. Seldom does a college have the funds to make significant structural changes or to replace all the furniture. This means that clerical and professional employees have to "make do." However, if the physical environment does not facilitate the use of new equipment, the problem of employee acceptance of computerization is exacerbated.

Seldom can an institution give every department its own computer or each employee a video terminal. The normal process is to begin small and evolve. It could take eight to ten years to equip a large administrative unit with on-line computer access and support, even though the increased use of mini- and microcomputers is reducing the hardware (equipment) costs. Some institutions are responding to these technological developments by remaining in a constant state of transition or change. Although academic personnel may expect this, the accounting and payroll personnel do not. Rapid change is not part of their historical professional role and is likely to alienate them from the systems and technologies causing the change. This is especially true if those technologies do not do the one thing they should do best: deliver speed and accuracy.

Notice that cost reduction is not mentioned. Experience has shown that whatever savings might be generated are used up rather quickly by expanded demands on the information systems or enhancements to the current system (Kaufman 1974, p. 38). In fact, users rapidly generate applications that fill all the "free" time on the computer; most of these applications are suggested under the label of progress or improvements. Nevertheless, filling the computer's "free" time with applications can limit the system's ability to handle peak workloads quickly and effectively.

The key to persuading the nontechnical institutional employees to accept and use automated systems and equipment is to use a success story by one of their own nontechnical colleagues, in combination with a strong, continuing inservice training program. Technical staff should not be used to train the majority of nontechnical staff because they lack the trust of the nontechnical staff. In addition, the volume of "buzz words" that they normally use will alienate the trainees. Since a good system has a five- to eight-year life expectancy, nontechnical administrators should take the time to carefully design and implement not only the new information system and the associated technologies but also the staff training program. Do it right the first time, even if this requires more time or a slower development pace.

In a recent survey of higher education institutions, Charles Thomas (1981) reports an average of 51 administrative applications per institution. Admissions and records applications were the most frequent, with financial management second, and planning, management, and institutional research third. The first two of these areas have had large numbers of clerical staff, the type of staff that would be most intimidated by the new technology. It certainly will do more harm than good to force change on these employees rather than trying to win over the majority with gentle persuasion.

Evolution of Institutional Information Systems and Administrative Technology

There has been little research and even less published recently about the total needs and goals of the nontechnical administrator with regard to institutional information systems and administrative technology in higher education. The assumption is that almost every administrator and management function could benefit from the proper application of state-of-the-art administrative information systems and modern office technology. Even with this assumption, higher education administration has lagged significantly behind government and industry in using computers and other support technology. The challenge in having a computer rests with managing it as a resource and influencing the nontechnical administrator as a user (Wise 1979).

Technological applications normally pass through several phases related directly to the sophistication of the nontechnical manager and, to a lesser degree, to the size and complexity of the campus. In the initial computer phase, the target for administrative data processing is in manual, labor-intensive areas such as admissions, registration, academic records, payroll, and accounting. Word processing is used to replace form letters. Micrographics applications are used more for security and historical purposes. As the administration acquires confidence and experience, other, more specialized applications are implemented; these applications usually are identified one at a time and completed sequentially. Rarely does an administration compile a total inventory of institutional needs and develop a priority list based on the time and resources available.

System users are in competition, and nontechnical administrators with sufficient independent funds often go their own way—with varying degrees of success. This phase is reappearing now on many campuses as each administrative unit buys its own microcomputer. Most campuses went through this with stand-alone word processing equipment and duplicating machine purchases. Some campuses countered this proliferation of equipment by establishing campuswide reprographic committees that reviewed and approved all applications and equipment purchases. Although the committees provided learning opportunties for their members, technology changed so fast that the original committee goals often were not met and, in fact, only served as stumbling blocks to good applications. An additional problem with equipment purchases is that, instead of using the application for which the equipment is needed as the criterion for determining which equipment to purchase, equipment purchases frequently are determined by the personality of the sales representative or the unit price.

Most institutional managers have moved on to the second phase: Maximum efficiency or savings has been reached or is perceived as having been reached, and any further progress can be gained only by coordinating the systems and consolidating the data files. In many cases the earlier systems must be replaced because they were not designed to communicate with other administrative systems. This phase costs a significant amount of money and requires the involvement of the highest level of management—the level that usually is the least technical; as a result, decisions may be based on inappropriate criteria. At best, top administrators have to work with criteria that are incomplete. Furthermore, they must rely on technical staff recommendations about information systems. With top management involvement, decisions normally happen more slowly. In fact, decisions relating to word processing, duplicating, and microforms equipment rarely are elevated to the highest levels of management unless they are part of a bigger or total system review.

The last, or simulation, phase is likely to start in the academic computing area and spill over into administrative information systems (Wise 1979). Simulation models allow the administrator to ask sophisticated "what if?" questions, enabling the user to see the effects of different variables and, in essence, explore various alternatives (Wise 1979). In this period of fiscal cutbacks and projected enrollment reductions, simulation can be very beneficial when plans or decisions involving many variables must be made in the face of uncertainties (Wise 1979). The key to realizing benefits from simulation is to ensure ongoing use of such models and broad-based participation in their use. Simulation models are only as good as the administrators involved, the amount of information known, and the level of logic included. Although computer costs are decreasing, the investment in simulation programs is not inexpensive; simulation models involve analysis, software, and programs. Furthermore, these costs are increasing at a rate that often exceeds the decrease in hardware (equipment) costs. Therefore, these expenditures make sense only if the institution has a long-range, dynamic information systems plan.

The planning process provides the nontechnical administrator with an excellent opportunity to develop literacy about computing technology, institutional information systems, and the relationship of specific technologies such as word processing, duplication, and micrographics to the total process. Campuswide planning eliminates the need for every unit on campus to relearn the hard initial lessons of the automation process.

Current Status of Administrative Information Systems

Although very few up-to-date sources of information about administrative information systems in higher education are available, there is one very good one: *Administrative Information Systems: The 1980 Profile* by Charles R. Thomas, executive director of CAUSE (College and University Systems Exchange), the professional association for development, use, and management of information in higher education (1981). Another good source for the nontechnical administrator is a group of publications by the Association of Computer Users, including their bimonthly magazine, *Interactive Computing*.

Thomas reports that the larger the institution, the more likely it is to have separate administrative and academic computing installations. Slightly less than half the large institutions have separate administrative computing installations, and only 10 percent of the community colleges have separate installations. The smaller the institution, the more likely it is that the administrative information system organization reports to the president or vice president. In the large, complex institution the reporting lines may be at a level lower than vice president.

In public and private institutions of the same size, the public institutions possess the larger staff. Those institutions with separate installations also report a larger staff in comparison to institutions of similar size without a separate installation. The percentage among the staffing categories remains amazingly equal: managers—11 percent, analysts/programmers—38 percent, systems programmers—7 percent, operators—34 percent, and clerical workers—10 percent. This percentage breakdown of staff probably will not change as more institutions use distributed processing (mini- and microcomputers). What will change is that administrators will do more of their own hands-on development and programming. Computing budgets for administrative information systems run between 1 and 4 percent of the institution's annual operating budget. In the last few years, there has been a major change in how the money is spent: The current trend is to spend more on staff and less on computer hardware.

IBM is the most popular hardware on campuses, accounting for 37 percent of the computers reported. Digital Equipment Corporation is second, with 17 percent. The other top eight manufactures are Burroughs, Univax, Honeywell, Hewlett-Packard, Control Data, Harris, Amdahl, and Prime. Certainly one company that will appear on the list next time is Tandem.

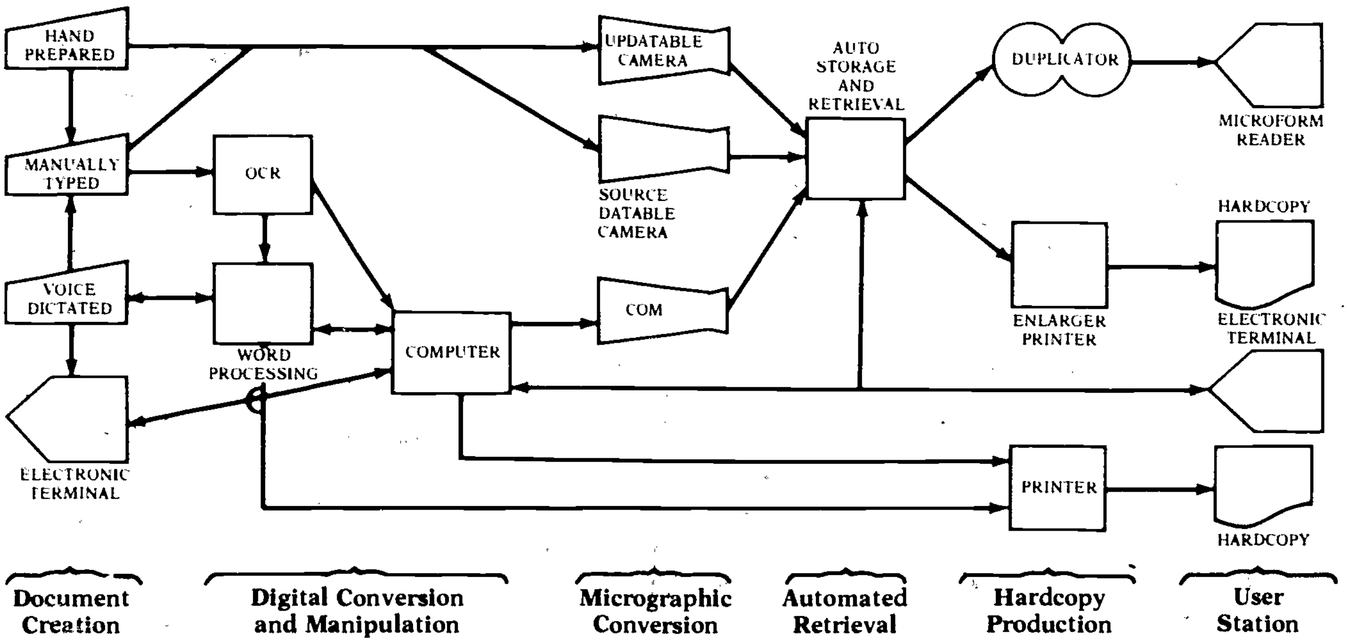
In the software area the use of multiple-application proprietory packages, such as automated spreadsheets, is increasing. The majority of these are general use, utility programs, programming languages, statistical packages, text editors, and similar packages.

As indicated earlier, admissions and records and fiscal management areas account for 55 percent of all applications. The other areas are: plant/management/institutional research—11 percent, general administration—7 percent, auxiliary service—5 percent, logistics—5 percent, financial aid—4 percent, library—4 percent, physical place—2 percent, and hospital—1 percent.

Administrative information systems have a number of problems. First, as noted at a recent information systems seminar in San Francisco, there is a significant shortage of administrative data processing specialists. Second, it was estimated that most campuses have a three- to five-year real backlog in systems work, plus an invisible backlog. Third, one of the major criticisms of AIS was the amount of time spent on maintenance—estimated at 50–60 percent of work time. Two additional problems with AIS have been suggested: Too much of the new code being written is redundant, and many information systems are limited in both control and access.

Although not included in the CAUSE survey, the areas of word processing, microforms, and duplication must be mentioned when considring institutional information systems. In many ways these functions are technical support systems to the institutional information system. Systems combining all these areas have spawned the term "Office of the Future." The flowchart on page 14 depicts a model of "The Nontechnical Administrator's Office of the Near Future" and shows the ways in which institutional information systems and administrative technology will complement one another (Canning 1982).

Information Flow in the Paperless Office for the Non-Technical Administrator



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Types of Information That Should Be Available

American higher education prides itself on the individuality of each campus and attempts to recruit prospective students with the "goodness of fit" idea—that what the institution has to offer meets the specific needs of particular students. Each institution has its own character, but there are real similarities among institutions of higher education, including similarities in both the availability and use of various types of data in their information systems.

Certainly the federal government, through the Higher Education General Information Survey (HEGIS) reporting, has attempted to develop uniformity in data definitions. The National Center for Education Statistics and various state agencies have tried to build on this effort and establish consistency among the different institutional information systems. However, the process of acquiring common definitions, with the goal of sharing systems and technology, often runs counter to an institution's desire to simplify its procedures or reduce its costs.

Most colleges and universities have considerable data available from operating systems and other sources, but nontechnical administrators' use of such data has been both limited and fragmented. Probably the one exception to this is grade record data. Grade records are used to study grading practices, retention patterns, and the accuracy of the recording process. Other areas—such as class registration data, expenditure data, and personnel data—are not used nearly as much by the institution. In some cases the data are collected and maintained only for outside users. One study identified 11 categories of information in which higher education administrators indicated that significantly more data were needed (Adams, Kellogg, and Schroeder 1976): unit costs data, personnel needs, community needs, enrollment projections, effects on enrollment, comparative data, faculty performance, staff performance, administrative performance, program evaluation, and institutional outcome. How this additional data would significantly improve the decision-making process was not identified. Other categories reviewed but considered adequate were: student demographic characteristics, faculty interests, faculty competence, expenditure patterns, student demand for courses, alumni concerns, student satisfaction, faculty research interests, grading practices, placement data, census data, faculty satisfaction, staff satisfaction, and institutional and salary data.

As most administrators know, much of the decision-making process involves political, interpersonal, or environmental influences. Given this, administrators must define realistically the limits on the development of and expenditures on institutional information systems. These limits should be developed in relation to both the potential use and the potential worth of such systems. In addition, the potential use and ultimate value of hardware such as computer terminals, duplicating equipment, word processors, and micrographics equipment should be considered. The need for effectiveness and efficiency should be a primary value in developing an information system and acquiring the associated technologies.

Suitable Kinds of Technology

Many questions arise with regard to implementing technological information systems, such as how much computing power to acquire, how many cathode ray tubes or word processors to purchase, and whether microfilming should be done on or off campus. These questions and similar ones are continuing topics of analysis, discussion, and debate among non-technical administrators, faculty, and technical staff. Many top administrators are suspicious (as they should be) of technology budgets that increase year after year. Ongoing review of the technical equipment and its application to institutional administration needs is a proper process, particularly compared to alternative approaches such as permitting every unit to develop individually, to the detriment of an eventual campuswide communications network; permitting the technical staff to make all the decisions centrally; and, worst of all, permitting a few top financial and technical staff people to meet with the equipment vendor to determine the equipment required by the whole institution. Such isolated purchasing processes simply do not work well, particularly in institutions where almost every administrative unit needs, uses, and expects a wide range of technical services. Therefore all users, especially administrative users, must understand the technical problems of institutional information systems and management (Rickman 1979).

Some institutions address this problem by expanding the duties of their computer lay advisory committee to include reviewing other technology. Large campuses may have a subcommittee that reviews a specific category of equipment proposals. These committees need to be heterogeneous in technical expertise, administrative experience and responsibility, and information systems applications and interests. In such a process, campus users or purchasers must convince the committee of the value of the proposed purchase. In addition, users must ensure that all the appropriate reviews have taken place. Although such committees normally lack the authority to approve or deny resource allocations, they can nevertheless help administrators avoid some significant errors. This type of review procedure encourages communication among users and the sharing of technical resources. In addition, this method improves technological planning and decision making by generating an awareness of the enormous amounts of money spent on technological support and equipment; in turn, this awareness further stimulates the planning and review process (Mann 1979).

Information systems and the associated technologies can be ineffective if users do not understand them. They can provide inaccurate or late data, demand unusual precision and attention, and be difficult to modify in terms of both the kind of information a system manipulates and the application it performs. This potential for ineffectiveness is as true for hardware as it is software. When changes are necessary in either the hardware or software, the best course of action is to adjust or modify the original equipment—assuming, of course, that it is suitable for modification. If it is not, the next best alternative is to rely on its trade-in value. Problems such as these can lessen the effectiveness of institutional information systems and equipment applications even when the users are receptive and supportive of technology (Kling 1980). When users are lukewarm or opposed to new technology and the application does not work or is more difficult than originally presented, staff resistance will increase and have an even greater negative impact on the use than do the sheer technical qualities.

Kling (1980) describes several characteristics of a user-centered environment that nontechnical administrators should strive for when designing institutional information systems and making technological decisions:

- applications that increase personal competence and pride in work are valued.
- users are accepted as normal people who can make errors.
- user jobs are designed to be personally satisfying, and the technical applications are designed to fit job needs.
- the burden of precision is placed on the machine/equipment.
- application designs and assumptions are intelligible to users through appropriate techniques and clear documentation.
- users easily obtain, create, and change systems that meet their needs.
- users can initiate, veto, and collaborate in systems design and technology selection.

To summarize briefly, all the current technology could have a place in the administration of higher education if the appropriate user participation and approval processes are used. The technologies with the greatest potential for academic administrative uses are: computers, word processors, duplication equipment; micrographic equipment and systems; and communication equipment and systems.

Computers. Three sizes of computers commonly are used in academic administration: large-scale or mainframe computers, minicomputers, and small business or microcomputers. All these basic types are fully functioning computers, but they differ in many areas—for example, in amount of computing power, speed of data processing, equipment costs, expansion capabilities, types of input and output, and storage capacity (Quible 1980).

Mainframes. Mainframe computers are the large-scale, "traditional" computers. A mainframe system is composed of the mainframe itself, which is the processor for the system, and any number of peripheral devices, including multiple terminals; typewriter-like keyboards for entering and manipulating data; CRTs for displaying data; storage devices, such as disk drives for reading, storing, locating, and gaining access to data files; and output devices, such as printers (Forester 1981, p. 579).

Mainframe computers are sophisticated machines capable of generating massive amounts of computing power—more power, in fact, than any other computer. In addition, mainframes have more storage capability than other computers. Because of their computing power and storage capability, mainframe computers have certain advantages over other computer systems: They can perform more simultaneous tasks and more complex computations than other systems and can process data at faster rates than other systems (Quible 1980; Good 1981). In addition, because of their large storage capacity, mainframe computers also have larger data bases than other systems (Good 1981). Another advantage of mainframes is the large amount of readily available, well-tested software or computer programs for them (Kull and Brown 1982).

Price is the major drawback of mainframe computers. The least expensive mainframes cost $250,000, and the most expensive can cost millions of dollars to purchase or lease. In addition, mainframes are more difficult for the user to operate than either minicomputers or microcomputers. In fact, they are quite complicated to use (Kull and Brown 1982).

When these disadvantages are considered in tandem with the increased capabilities and lower price of minicomputers, a recurring question arises as to whether or not large-scale, mainframe systems are obsolete. Although some experts counsel that the best way to handle large computational needs is with more small computers rather than with a larger computer, the mainframe is best suited for applications such as batch processing of academic records or payrolls (Good 1981).

Minicomputers. Minicomputers are difficult to define, since top-of-the-line microcomputers now perform many of the functions that were once the province of minicomputers. In addition, top-level minicomputers now offer many of the capabilities that were previously available only from mainframe computers. Since capabilities alone no longer offer a reliable method of defining minicomputers, price can be used as the defining characteristic. Most minicomputers range in price from $40,000 to $80,000, although super minisystems may cost as much as $250,000 for the basic system and $1,000,000 for the total system complete with peripheral devices (Berst 1982, p. 39; Seaman 1981, p.93).

The basic components of a minicomputer system include the minicomputer itself for processing power; multiple terminals; keyboards for data entry and manipulation; visual display screens or CRTs; storage devices, such as disk drives for reading, storing, locating, and retrieving magnetic data files; and output devices such as printers.

Minicomputers offer less computation power than mainframe computers but more than microcomputers. Because of their relatively large processing power minicomputers can operate very quickly and can control many different kinds of terminals (Seaman 1981). Like mainframe computers, minicomputers provide multiple terminal hook-ups so that more than one person can use the system at a time. In addition, like mainframes, minicomputers can run multiple applications simultaneously.

Among the applications minicomputers can handle are data processing (data entry, manipulation, storage, and retrieval); data base inquiry; electronic filing; word processing (creating, gaining access to, and manipulating documents or text); data communication; electronic mail; and facsimile entry, storage, and retrieval (Kull and Brown 1982).

Minicomputers have numerous advantages. First, with their fast processors and fast memory, they operate very quickly, offering almost immediate input/output response time. Second, because minicomputer software is efficient and well tested, users have access to a large software capability and a wide selection of software tools. Minicomputers are easier to operate than mainframes, making software development easier also. Furthermore, minicomputer software offers another important advantage: expansion capability. Generally, minicomputer software can be used on larger systems, allowing for future expansion of administrative needs and a corresponding expansion of the microcomputer system (Seaman 1981).

Service is another major advantage of minicomputers. Minicomputer manufacturers offer extensive maintenance programs that include such features as onsite diagnostic and repair visits by systems engineers (Seaman 1981).

Minicomputers store and process less data and fewer simultaneous applications than mainframes, but they store and process more data and more simultaneous applications than microcomputers. However, although minicomputers are inexpensive compared to mainframe computers, they are expensive compared to microcomputers.

Microcomputers. The intelligence of a microcomputer, also known as a personal or small business computer, is located in its silicon chip, which is, in essence, a small low-cost "computer-on-a-chip" (Good 1982, p. 139). As a result of the small size and low cost of its intelligence source, the microcomputer is correspondingly small and relatively inexpensive. Sized to fit on a desk top or even in a lap, microcomputers range in price from $3,500 to $6,000 (Willmott 1982, p. 52). Its combination of low price and flexibility has made the microcomputer one of the fastest growing sellers on today's computer market (Berst 1982a).

The basic components of a microcomputer are a terminal with a typewriter-like keyboard and a video display screen (a CRT), main memory, disk storage, and a printer. The main memory contains the micro's basic capabilities, which can be greatly expanded by the thousands of software programs available from the manufacturer, independent software providers, individual custom programmers, and the individual university administrator with programming skills. New software instructions (adding new capabilities) and data files are stored on magnetic disks, either floppy or hard, and read into the micro by the disk drive. A printer produces hard-copy (paper) output.

With these components and the appropriate software, the microcomputer is capable of multiple functions. It can perform word processing and text editing, it can send and receive electronic mail, it can gain access to a database, and, perhaps most important, it can provide university administrative support. In fact, many of the microcomputers purchased in this country currently are used for "desktop decision support" (Berst 1982b, p. 130).

This support takes many forms, the most common of which are:

1. Automated Spreadsheets. Such packages provide a format for analyzing financial data and calculating allocations, expenses, and other budget projections (Willmott 1982, p. 52). Spreadsheet software performs accounting functions that previously were performed manually. For example, the user sets up a balance sheet, labels the rows and columns on the screen/CRT, and defines their mathematical relationships. Once the relationships are explained, the computer does all of the mathematical calculations. Furthermore, once a format is designed the microcomputer "remembers" it for future use. "Spreadsheet programs save . . . days over manual methods" and are "in daily use" by administrators for "financial reporting, cash flow forecasting, investment analysis, budgeting, planning, engineering analysis and more" (Berst 1982b, p. 136). All the major microcomputer vendors sell versions of automated spreadsheet software.

2. Financial Modeling and Planning Programs. These programs allow the university administrator to simulate and plan for the future. Although some of these programs use the spreadsheet approach, many employ an alternate format: "They ask questions or provide a form to fill in, then process and display the results" (Berst 1982b, p. 137). The simplest programs handle one type of financial model, such as cash flow forecasting, allocation tracking and planning, program start-up planning, lease versus purchase, and expenditure planning. The administrator puts in the correct values and the computer does the calculations, allowing the administrator to see numerous alternatives quickly. Other programs are designed for administrators without financial expertise. The computer asks questions or provides a fill-in-the-blank format. By responding to the computer, the administrator can "apply sophisticated financial modeling tools to questions about investments . . . inventory purchasing," funding cycles, and more (p. 137). The most advanced programs help the administrator predict future expenditures and "the impact of different alternatives" (p. 137).

3. Graphics Programs. Built-in graphics are a feature of many decision support programs. Graphics can facilitate decision making by putting important information in easy-to-understand formats, such as "graphs, pie charts, bar graphs and area plots" (Berst 1982b, pp. 137, 153). Some graphics programs forecast trends. For administrators "who understand such things as moving averages, multiple regressions, trend line forecasting and so on, these programs offer sophisticated decision-making tools" (p. 153).

These types of administrative support programs permit quick access to, manipulation, and comparison of data. This facilitates decision making by helping administrators "do the work they are really paid to do": plan educational programs, "spot trends, make projections, etc." (Berst 1982b, p. 130). Consequently, use of personal computers by executives can improve their productivity and performance (Panko 1982).

Despite these advantageous capabilities, microcomputers do have disadvantages. Because they have lower processing speeds than time-sharing systems, computations can take considerably longer. In fact, "it can take as long as several hours to complete the calculations for some applications" (Berst 1982b, p. 133). Microcomputers also have limited memory and storage capacity. Most institutions cannot afford to purchase large-capacity Winchester disk drives, so they purchase the less expensive, more limited floppy disk drives. (A disk drive "reads software instructions into the word processor," reads "stored information into the word processor for editing or printing" and "writes newly entered text onto a disk for storage" [Theakston 1982, p. 104]. A floppy disk drive ranges in price from $500 to $1,500, while a hard disk drive system ranges from $3,000 to $25,000.) This limitation on data storage can be a serious problem for many administrative applications (Willmott 1982, p. 53). With lower processing speeds and limited memory and storage capacity, microcomputers are a bit slow and inefficient (Good 1982, p. 139). Furthermore, given this slowness, the low initial cost of microcomputers can be deceptive: "a $500 computer can tie up a $5,000 printer and a $10,000 mass storage device" (p. 139). Most of these problems, however, can be addressed and overcome with a microcomputer network.

Another problem with microcomputers is their communications capability. "Most personal computers do not now have access to mainframe data bases," isolating the administrator who needs to track institutional data (Willmott 1982, p. 53). The inverse of this problem is that information developed on a personal computer is not stored on the main computer, making it unavailable to other administrators; this can lead to duplication of effort throughout an institution. The solution to these problems is found in the growing field of communications software that allows the personal microcomputer to gain access to the files of the main computer (p. 53).

The final problem with microcomputers is that to extract their decision-making capabilities, university administrators must gain computer proficiency. Thus, busy administrators must find the time to read the owner's manual and to gain hands-on experience (Willmott 1982). In fact, it can take days or even weeks to become proficient with decision support software. Furthermore, with each new program the administrative user must relearn the program, commands, procedures, and protocols (Berst 1982b, p. 132). Given the potential benefits of decision support programs, many administrators have solved this problem by setting aside learning time and making it a priority (Flanagan 1982).

Word processing. Unlike a typewriter, a word processor is not a familiar machine to most university administrators. In a pinch, most administrators could type a memo on a typewriter, but not on a word processing machine. A word processor is a machine that can rearrange text prior to printing it—adding or deleting text or changing the text format. The basic hardware of a word processor consists of a terminal, a keyboard, and a video display screen. The terminal can contain its own computing power or it can be attached to a separate computer. The keyboard, which resembles a typewriter keyboard, often includes keys for special functions and a calculator-like numerical keypad. The video screen is used for displaying the text under consideration. Material typed on the keyboard appears on the screen. The screen is known by several interchangeable names, including the CRT, the monitor, and the visual display. The screen and the terminal combined are often referred to as a video terminal (Theakston 1982; "Word Processing—A Link" 1982).

In addition to the video terminal and the keyboad, "all word processors also have memory," that is, the ability to retain data and store information (Theakston 1982, p. 103). Internal memory, also known as "main memory," is a permanent part of the word processor. "It 'remembers' the instructions on how to operate," and it also remembers the text in current use. "The larger the main memory, the more complex the programs" the word processor can manage (p. 103).

Word processors can also have external memory, also known as magnetic storage or mass storage. In essence, documents and information are "stored on magnetic media, then called up again when needed" (Theakston 1982, p. 103). In the recent past, magnetic tape or cards were the preferred medium of storage. Today, in part because information access time is longer for tape and more limited for cards than for disk, magnetic disks are preferred. The thin, flexible, floppy disk system is both more popular and less expensive than the hard disk system, although the latter can store considerably more information. An eight-inch floppy disk can store up to 30 pages of typed material, while a hard disk can store up to 75,000 pages. Both systems employ a disk drive, which can be either an integral part of the terminal or a separate component.

An optical character reader, known as an OCR, provides a third way of entering information on a word processor, in addition to keyboard entry and magnetic retrieval of stored data. An OCR is a device that reads written material, translates it into electronic signals, and then enters it onto a word processor. The material to be entered can be handwritten, printed, or typed; since "the most modern OCR devices can read almost any material" (Eddy 1981, p. 15). An OCR allows the entry of new text onto a word processor without requiring that the text be retyped on the word processor keyboard. Since keyboarding is labor-intensive, OCR devices can offer considerable labor savings (Eddy 1981, p. 13). Furthermore, "using the word/text processor for editing and output can maximize productivity. It makes no economic sense to tie up a $15,000 machine for rough drafts when these could be done on a $700 typewriter" and then entered by OCR "into a word/text processor for editing and output" (Eddy 1981, p. 15).

Output requires a printer, regardless of the method used to enter the text. There are two general categories of printers. Letter-quality printers produce typewriter-quality print. They have more than one typeface and additional features such as upper and lower case and subscripts and bold type. Draft printers are generally faster but the print they produce is not typewriter quality ("Word Processing—A Link" 1982, p. 22).

The hardware and software components of word processing can be combined into four basic types of systems:

1. A *stand-alone system* is "a work station that is independent or can function by itself" (Stultz 1982, p. 13). A stand-alone system possesses "all of the basic components—a terminal, a processor, storage devices, and a printer" ("Word Processing—A Link" 1982, p. 22).

2. In a *shared-logic system* a central computer (also known as central processing unit or CPU) contains all the intelligence and processing power. This power is shared with components such as terminals and printers, which may be quite distant physically from the CPU but cannot function without it. In other words, if the central computer goes down (ceases to function), so does the rest of the shared-logic system (Stultz 1982; Theakston 1982; "Word Processing—A Link" 1982).

3. In a *distributed-logic system* multiple terminals, including stand-alone and shared-logic systems, share peripheral equipment (such as disk drives and printers) while possessing their own individual computing power. In effect, they form one large system, but instead of centralizing the computing power in one CPU it is distributed throughout the system. Frequently one of the component systems manages or controls the entire network. Given this distribution of intelligence, the malfunction of one terminal, even of the controlling or "host" terminal, in no way affects the remaining terminals on the system (Theakston 1982, p. 22). The advantage of distributed systems is that they "grant independence to the individual user while also granting centralized system control. They also permit the user to "maintain and control a centralized information 'bank' which the component systems can reference and contribute to" ("Word Procesing—A Link" 1982, p. 23).

4. A *hybrid distributed system* is composed of both word processing and data processing systems. "It can give . . . the computing power and centralized storage facilities of a large computer and the convenience and text editing capabilities of the word processor or office management system" ("Word Processing—A Link" 1982, p. 23). For example, the university office management system might perform basic functions, such as text editing, and send more complex functions, such as advanced financial calculations, to the main computer, which will calculate and return the results. Hybrid distributed systems permit word processors to "share in one or more large centralized databases" (p. 23).

Given the available components and system options, what can word processors do? Their most generally known function is to assist in performing secretarial tasks. Features such as automatic return, automatic format control, and text editing allow the word processor operator to focus on keyboard speed and content rather than on format, margins, and corrections (Stultz 1982, p. 87). This secretarial assistance can produce remarkable increases in productivity; "display based word processor systems are from four to five times more producive" than standard typewriters (p. 86). Word processors also offer "cost savings, versatility and adaptability" in secretarial support (Pomerantz and Williams 1982, p. 33). Because word processing can take over and reduce production time in tasks such as creating a large quantity of form letters with variables, word processing may prove "a reasonable cost alternative to the trouble and expense of hiring a person" (p. 33).

However, word processing will not benefit every office. Before making a decision on whether to purchase word processing equipment, potential consumers should undertake a basic feasibility analysis to determine whether a word processor is genuinely needed, and if so, which type is best suited to the consumer's needs. Furthermore, a company may also need to perform a cost-benefit analysis (Krasen 1980a; 1981).

Increasing secretarial productivity is only one function of word processors. Word processors also can perform important support services for management. Many current word processors,

> *with the appropriate software and storage media, can function not only as text editors, but also as computer terminals, message centers, electronic file cabinets, electronic mail stations, notebooks and telex stations. . . . Word processors have evolved into multi-function workstations, . . . information management systems . . . which interface and integrate most major office functions ("Word Processing—A Link" 1982, p. 24).*

Multifunctioning word processors used for administrative support often have special features that can aid in university decision making. For example, many administrative support systems provide access to the information on file in the university's central system. Some systems perform simulation modeling, permitting administrators to view important fiscal information, "change certain financial indices, and view the results" (Stultz 1982, p. 66); in this way administrative support systems assist administrators with important resource decisions. Administrators also can enter new financial data as it develops, ensuring that decisions by any other administrator are based on the most recent data.

Administrative support systems can improve administrative communications. The teleconferencing feature "allows two or more administrators to view documents simultaneously on their own video display screens and to discuss them via telephone or office intercom" (Stultz 1982, p. 51). Similarly, in an administrative support system, both the administrator and the secretary have terminals at their desks, allowing them to view documents simultaneously. Keyboard work can be performed during dictation and changes can be made as the document develops (Stultz 1982, p. 65).

Stultz maintains that the primary purposes of administrative support systems are to improve administrative productivity and communications. However, Flanagan claims that "performance, projections, and planning are the main uses and better decision-making is the primary benefit" of management work stations/administrative support systems (1982, p. 26). Flanagan says that increased productivity—dramatic time savings—is not the major purpose for administration work stations; instead, the maior goal is to improve the quality of an administrator's work by allowing the development of improved strategies and plans based on more complete, up-to-the-minute information.

The technology used in modern word processing systems is actually an adaptation of data processing technology. The major differences are in the information handled and tasks performed. Where word processing and computer systems have been organized to exchange information, the systems frequently take advantage of each other's capabilities. Combining the two systems so that they have access to each other greatly expands the capabilities of both. The extent to which this has been done on university campuses and the types of equipment involved have not been surveyed, and only a few cases have been reported in the literature.

Digital Equipment Corporation, in their newly published "Practical Guide to Word Processing and Office Management Systems," ("Word Processing" 1982) states that the trend toward personal work stations will continue, partly because word processors will become increasingly easy for the user—even the nontechnical university user—to operate. In fact, they predict the development of word processors that will comprehend and respond to the human voice ("Word Processing—A Link" 1982, p. 24).

Considered in total, the features of multifunction word processor systems make them similar in function to microcomputers. The Association of Computer Users' annual predictions suggest that in the future single-use, stand-alone word processors will give way to multipurpose microcomputers. These microcomputers will perform word processing, financial planning, graphics, accounting, electronic mail, and so on. One factor in this predicted trend is that it now "costs more to buy a dedicated (single-use) word processor than it does to purchase a multi-use microcomputer with word processing software. Often the difference is as much as $5,000" (Berst 1982a, p. 49). There are problems with microcomputers, however: "Most of them do not offer the high quality training, the ease of use or the hand-holding support that come with dedicated machines" (p. 40). Nevertheless, university administrators are "realizing that microcomputers give them more versatility for less money" (p. 40).

Copying machines. Most copying machines sold today are plain paper copiers, known as PPCs, rather than coated paper copiers, CPCs, because plain paper copies closely resemble the original document and are easy to write on. As they become an integral part of every office, copiers are becoming less expensive. Modern copiers include reduction and enlargement capabilities that allow the machine to reproduce the original document at a smaller or larger size. Reduction can reduce filing space and make it possible to include such items as computer print-outs in files. Most PPCs, but no CPCs, are capable of two-sided copying (duplexing), but this function is generally performed manually. Many manufacturers offer feeder devices that "feed a document to the exposure glass, position it properly and eject the original" (Wirth 1982, p. 132). Some machines feature automatic document feeding that can automatically handle stacks of documents to be copied. Stream feeders also are available that automatically process continuous documents such as computer print-outs (p. 132). All of these features increase productivity by reducing manual operation (Montross 1982, p. 41).

Today's machines use microprocessors to "control and monitor copying functions" (Wirth 1982, p. 129). Microprocessors increase both copy quality and speed of copying and reduce manufacturing costs by replacing many mechanical parts. Among the functions microprocessors facilitate are copy count, countdown, and self-diagnosis. This last feature permits the copier to communicate its problems or malfunctions to the user or the service technician. For example, the copier might tell the user to add paper or toner (Montross 1982, p. 41). Microprocessors also permit the monitoring of copier use with systems that use coded cards, keys, key-counters or keyboards to prevent unauthorized access to copiers. This can reduce operation costs ("Copier Control Systems" 1982, p. 154).

As advanced as these machines are over early manual copiers, the technological breakthroughs are just beginning, and "intelligent, sophisticated machines . . . are slowly" emerging (Montross 1982, p. 42). Intelligent copiers already are in use at some institutions, "offered by some word processing system manufacturers as a way to copy documents stored on the word processing system's storage media" (Stultz 1982, p. 130). These copiers can be either permanently connected or temporarily connected, via telecommunication, to the word processing system. The system transmits documents to the copier in the form of data bits that the copier's intelligence translates into character images. These character images are then "transferred to paper by a xerography process . . . . This process saves labor and takes only a few seconds per page" (p. 130).

Integration of the copier with the word processing system is a trend that will continue. Future copiers will perform several tasks, including "memory retention and high quality data scan with print-out capabilities" (Montross 1982, p. 42). In addition, this multifunctional equipment will interface with other university office equipment, receiving information not only from word processors but also from small computers, facsimile terminals, electronic typewriters, other intelligent copiers, and electronic mail systems. Intelligent copiers also will be able to merge data from more than one source into one report, which the copier will then "print, duplex, collate and staple" (p. 42).

Micrographics: Micrographics offers alternative, automated methods for the traditional manual filing and retrieval of documents and records. The alternatives to paper-based filing systems are magnetic and microform systems. In magnetic systems, documents are stored on magnetic media, including drums, disks, disk packs, and floppy disks. Microform systems employ microfilm and microfiche as alternatives to paper document storage. Each system has certain characteristics and requires its own equipment (Eddy 1981, p. 16; "Micrographics and Computers Merge" 1982, p. 39).

Magnetic Systems. In magnetic systems, documents and information are "stored on magnetic media, then called up again when needed" (Theakston 1982, p. 103). The basic components of a magnetic storage system are an intelligence source (a computer terminal); a magnetic surface—for example, a floppy disk; a read/write head or disk drive; and an index (Eddy 1981; Theakston 1982). To store data, text is submitted via the terminal to the "memory controlling the storage device" (Eddy 1981, p. 16). The memory assigns a space to the text and, using the disk drive, records and reads back the original text, comparing it to the original. If they are identical, the location, or "address," of the text is recorded in a directory. To retrieve magnetically stored data, the user consults the directory to find the address of the desired document/text and then goes to the address to obtain the text. The storage capacity of the various magnetic media ranges from 80,000 to 80,000,000 characters. Since the average double-spaced, typed page contains approximately 2,000 characters, magnetic storage capacity ranges from 40 to 40,000 pages. Because the storage media themselves are relatively small (for example, a floppy disk is smaller than a record album), magnetic storage requires considerably less space than paper storage.

In addition to saving space, magnetic-based filing systems save time and labor. Copies of text are available within seconds, offering a considerable reduction in the time and labor required to retrieve text from a paper-based filing system. Further, "most text originators or editors will file the text directly . . . because the same keyboard and CRT used . . . to create text will be used to file and distribute" it (Eddy 1981, p. 16). The direct, hands-on access to magnetic files and the "almost instantaneous" quality of this system provide the information needed for effective management decisions, financial reports, and so on much more quickly and easily than does a paper-based filing system. Also, for information that must be updated frequently, magnetic filing is "more cost effective than paper, microfilm or microfiche" (p. 16).

The major disadvantage of magnetic storage stems from the nature of the medium itself. Magnetic media sometimes are unable to play back stored information because of old age (the media wears out), static electricity, poor electrical contact, a power failure, or damage to the media (Gilgore 1982, p. 79). "Fingerprints, spilled soda, excess heat, folds and bends, scratches or dents all can destroy . . . important information" (p. 79). The solution to this problem is redundancy: Backup copies should be available for all files (p. 79). One final disadvantage of magnetic filing systems is that "magnetically recorded information is not presently admissible in courts of law" (Eddy 1981, p. 16).

Microform Systems. In microform systems, documents and information are stored on microfilm or microfiche. Microfilm is a roll of film, while microfiche is a series of four-by-four-inch pieces of film, often linked in magazines that are four-by-four-by-one-inch ("Micrographics and Computers Merge" 1982, p. 39). The basic components of a microform system are: "a microfilmer capable of encoding image-location marks under each document image; a micro-image terminal for automated retrieval and a computer for storing index information" (p. 39).

To store and code the text, documents are "fed into a microfilmer which automatically imprints a sequential number on each document, microfilms it, and encodes a three-level image mark under the document image" ("Micrographics and Computers Merge" 1982, p. 40). Computer output microfilming (COM) provides a second method of originating microfilm files. COM allows documents created and stored on the computer, such as text written on a word processor, to join the microfilm process, so that microfilm files include this information as well as that originated on paper. Next, a directory or index is prepared by entering on the computer key information about each document, including its roll and frame numbers. After the entry of this data, the original documents can be discarded. The coded microform images, contained in microfilm magazines, are then placed in a small (two square feet) rotating access file. From this point on, an operator at a retrieval station (consisting of an access file of microfilm magazines, a computer terminal, and an intelligent microimage terminal) has hands-on access to any document within seconds.

To retrieve stored text, relevant access data is keyed into the computer terminal. The information that was input during data entry, including the roll and frame numbers of the text, then appears on the terminal screen. Using the information on the screen, the operator locates the correct microfilm magazine and inserts it into the microimage terminal; the desired text then appears on the screen. Paper copies of the text are available at the push of a button. The entire process; from start to finish, takes only a few seconds.

This system of filing is also available without the use of a computer. In the computerless system, intelligent micrographics equipment performs all of the functions. For example, intelligent microimage terminals scan microfilm and automatically locate a specific document.

As with magnetic filing systems, advantages of microform filing include savings of space, time, and labor. Microform filing systems can reduce the space requirements of paper-based systems by "up to 98 percent because a small rotating access file can hold up to 360 microfilm magazines, or the equivalent of nine million document images" ("Micrographics and Computers Merge" 1982, p. 40). Files available within seconds save labor and time not only for the secretarial or clerical staff but also for the administrative staff, since "an estimated 25% of top managers' time is spent waiting for information" ("OA Comments" 1982, p. 4). Quick delivery makes information readily available for administrative decisions and reports.

Security is another advantage of microfilm filing: "microfilm is a secure medium which is difficult for an unauthorized person to access" ("Micrographics and Computers Merge" 1982, p. 40). In addition, unlike magnetically stored documents, microfilmed documents are considered admissible in courts of law (Eddy 1981, p. 16).

Cost is the final advantage of microform systems, particularly in comparison to magnetic storage systems. Currently, the typical cost for storing the image of a document on magnetic disk for one year is one dollar. In contrast, the typical cost for storing that same document for one year on microfilm is approximately one-tenth of one cent ("Micrographics and Computers Merge" 1982, p. 40).

Microform and magnetic filing systems both offer considerable savings in time, labor, and space compared to a paper-based filing system. These savings can result in improved productivity and performance for administrators as well as for clerical staff. The extent to which micrographic systems are in use in academic administration has not been surveyed. Except for large campuses and library science departments, most institutions of higher education seem to buy these services rather than have their own on-campus capability.

Communication. Users and vendors of automated office equipment agree that communication is the key issue of the next decade. A panel of members of the Association of Computer Users predicts that the '80s will be "dominated by communication regardless of what type or size equipment you use" (Berst 1982a, p. 36). The current emphasis is on establishing lines of communication among various separate pieces of equipment, resulting in the integration of two or more separate devices into one whole system. Such a system often is referred to as the Office of the Future. To a large extent that is precisely what it remains—an idealized vision of the future—because communication capabilities among various machines are still in their infancy. This disparity between projected and actual capabilities partially stems from the absence of industrywide manufacturing standards. Sophisticated ideas for integrating equipment are difficult to implement because two pieces of the same type of equipment, produced by two different manufacturers, may not be capable of communicating with each other. This incompatibility has resulted in consumer pressure for and gradual provision of industrywide standards that will allow the integration of equipment by any number of manufacturers.

Currently there are three major forms of equipment communication: electronic mail, telecommunications, and networks.

Electronic Mail. Electronic mail is a method of sending and receiving inter- and intraoffice communications. It can be defined as " 'the electronic transmission of messages, text and graphics between two or more individuals' " (Pomerantz 1982, p. 42). Electronic mail is a substitute for traditional, paper-based mail carriers, including the United States Postal Service, private courier services, and inter- or intraoffice company mail. Based on the transmission of electronic signals rather than the transportation of paper documents, electronic mail offers same-day or, in some systems, instantaneous delivery of information.

Electronic mail takes a number of forms, including TWX and Telex, facsimile, computer-based message systems (CBMS), and communicating word processors. TWX and Telex, both currently in wide use, are terminal-to-terminal systems. Messages are entered by keyboard at one terminal and sent via telephone lines to another terminal, which can be located anywhere in the world. The receiving terminal prints out a hard (paper) copy of the message. The advantages of TWX and Telex include their "relatively low cost" and their "worldwide acceptance" (Pomerantz 1982, p. 42). Both systems can send messages immediately or store the messages for later forwarding and delivery. The drawbacks of Telex and TWX systems include "relatively slow transmission rates; congestion of Telex lines; transmission that is limited to upper-case lettering; and print quality that is often poor" (p. 42).

Facsimile, extensively used in business, electronically transmits exact copies of the original document over distances. Facsimile transmission works by scanning a document and converting its printed text or graphics into electronic signals. The signals then are transmitted over standard telephone lines to geographically remote receivers, where they are reconverted into prints (Pomerantz 1982, p. 45). Facsimile systems consist of separate transmitters and receivers or transceivers that perform both functions. Receivers with full duplex capability can send and receive signals simultaneously ("Facsimile Grows to Meet the Future" 1982, p. 72).

Facsimile has several advantages. First, it is low in cost; it is less expensive to install facsimile equipment than computer terminals throughout an organization ("Q & A" 1982, p. 8). Facsimile's ability to reproduce anything, including graphics, is another advantage. That information does not have to be rekeyboarded increases speed and decreases the opportunity to introduce errors. Furthermore, "transmission accuracy is high, operator training is minimal and the machines are fairly portable" (Facsimile Grows" 1982, p. 72). One final advantage of facsimile is its status as "an acceptable legal document" (Eddy 1981, p. 20).

A disadvantage is that facsimile copies often are of poor quality, especially in comparison with standard photocopies (Pomerantz 1982, p. 45). More serious is the lack of "interaction capability between broader computer data bases and information reproduced by a facsimile" (p. 45). In other words, facsimile equipment can only copy existing documents; it cannot locate information on a computer and create new documents. This communication gap between facsimile and other automated office equipment can be solved by digital facsimile equipment, with its potential for integration based on compatible bit streams; this equipment is replacing analogous facsimile machines.

Another major problem with facsimile is that the equipment from various manufacturers is incompatible because of the different compression ratios of their signals and different speeds of signal transmission. As a result, it is often impossible to transmit information between facsimile machines manufactured by different vendors. Even when possible, such transmissions often are defective. Consumer pressure, however, has led to the establishment of "world wide standards that allow equipment from different manufacturers to communicate" (Eddy 1981, p. 20).

According to a study by International Resource Development Inc., "Facsimile Markets," graphic message transmission will increase greatly in the '80s. But new, intelligent copiers/printers and high speed scanners, linked into local networks—which in turn are linked nationally and internationally by satellites—will absorb much of the work now done by facsimile equipment. In the future, "facsimile capability will be a feature or function of a copier" ("Facsimile Grows" 1982, pp. 72, 75).

Computer-based message systems (CBMS) transmit communications electronically from one computer terminal to another. CBMS capabilities can be incorporated into existing computer systems through the use of electronic mail software or programs (Pomerantz 1982). In CBMS the terminal can be used to compose, edit, store and send, retrieve, read, answer, and file messages. Messages can be forwarded to other members of the CBM system and to other users of compatible systems. Some systems also permit the user to set up distribution lists of people who regularly receive specific types of correspondence ("Q & A" 1981; Pomerantz 1982).

Speed is one of the primary advantages of computer-based mail systems: Message delivery is instantaneous or same-day. Convenience is another important advantage: CBMS gives users access to messages at any time. Additional advantages include "the computer's ability to assist in text input, storage and retrieval, and distribution to other terminals in the network (Pomerantz 1982, pp. 43–44).

The drawbacks of CBMS include the lack of image transmission ("Q & A" 1982, p. 8). In addition, because CBMS is a relatively new technology it is not yet widely used, limiting the number of recipients accessible to a sender. Furthermore, there are no currently available directories listing the companies that have CBMS and which systems they have (Pomerantz 1982, p. 44).

Another problem with CBMS is the lack of compatibility among the systems produced by different manufacturers. Consequently, even if both the sender and receiver have CBMS, they may not be able to communicate via those systems. This incompatibility may be solved by a format standard recently developed by the National Bureau of Standards. A variety of companies, including "software suppliers, minicomputer companies, timesharing firms and value-added carriers, have embraced the standard," offering the possibility that in the future CBMS will have the "same universal access as the telephone and the mail" (Pomerantz 1982, p. 44).

Information security and confidentiality poses another serious problem with CBMS. There is a small chance of the message becoming lost in the computer system or being sent to the wrong person. For this reason, some users prefer not to send classified or confidential information via CBMS, although other users regard it as "quite secure for routine correspondence, especially when compared with letters . . . which can be opened, or phone calls, which can be overheard" (Pomerantz 1982, p. 44). In spite of these disadvantages, computer-based message systems are gaining in popularity. According to International Resource Development, although "about one hundred and sixty thousand workers currently use some form of CBMS, . . . by 1991, almost fifty percent of white-collar workers . . . may be using such systems" (p. 44).

Like CBMS, communicating word processors provide a method of electronically transmitting textual information on a campus or between campuses. This method of communication depends on the establishment of local networks of word processing work stations in which several machines are linked together, sharing databases (resources and data files), and communicating with one another (Good 1982, p. 139; Pomerantz 1982, p. 44). Other equipment, including OCR equipment, photocomposition machines, and Telex/TWX terminals, may also be linked to this network (Pomerantz 1982, p. 44).

Terminal-based communicating word processors can perform all the functions of CBMS: Messages can be composed, edited, stored, transmitted, received, read, answered, and filed. As with CBMS, speed and convenience are the major advantages of communicating word processors.

Just as they share the benefits of CBMS, communicating word processors also share the drawbacks, including the major problem of incompatibility between different brands of word processors. Communication "is often limited to the most elementary messages" (Pomerantz 1982, p. 44). Furthermore, communicating word processors have an additional, unique problem: Because word processing is, at this time, primarily a secretarial function, "there is a reluctance on the part of executives and professionals to use the equipment to directly communicate with one another" (p. 44). Despite this image problem, communicating word processors are a sensible method of electronic mail given the large number of word processors in use today.

To summarize, communicating word processors, computer-based message systems, facsimile, and TWX/Telex are all forms of electronic mail. In spite of their individual drawbacks, including the key problem of compatability, each method provides rapid, electronic transmission of data and messages.

Telecommunications. Telecommunications is the use of telephone lines to establish communications between two separate and often distant computers. This method of communication relies on costly digital telephone lines or, more commonly, on an interface device known as a modem (Eddy 1981, p. 21). The modem converts the digital computer data into analog data to transmit it over ordinary telephone lines; at the receiving end another modem converts the analog transmission back into digital data for the receiving computer.

There are three major advantages of telecommunications. First, machines produced by different manufacturers can communicate with one another via a modem and a telephone line (Cruikshank 1982). Second, this method allows remote users to be a part of a whole system. For example, users on several campuses can transmit data to one another and thus form an intercampus network or system. Third, telecommunications offers an inexpensive and quick way to move information.

The major problem with telecommunications is that response time for remote terminals is much slower than for close terminals. The difference can be as much as 20 seconds (Cruikshank 1982). Since telecommunications relies on telephone lines, this time lag in transmitting data can increase telephone expenses. Incompatibility between modems can also be a problem. To ensure compatibility and transmission capability, modems with the same speed and the same options should be used at both the transmission and reception ends of a telecommunications system.

Networks. Networks are the third major form of equipment communication. There are several kinds of networks: communicating word processing systems, telecommunications systems, database networks, local area networks, and microcomputer networks. All networks have one major advantage in common: By permitting a number of users at different locations to share resources, such as computing power and data files, networks increase the capability of the information system as a whole. Increased capability can, in turn, increase productivity and efficiency.

Although most networks are permanently connected by cables and consequently require a certain degree of proximity, telecommunications equipment allows users to establish networks between geographically remote terminals.

Database networks permit the sharing of dissimilar databases or data files. The major advantage of this type of network is that it is unnecessary to duplicate all the information in every data file on campus. For example, although financial information can be stored in the data file of the business office, that information is readily available to other offices without the costly and time-consuming replication of files.

Local area networks are, as the name implies, networks that link separate but geographically close computer equipment. The equipment may be in the same building or in several buildings on the same campus. The total distance encompassed by a local area network may range from a few hundred meters to several kilometers. Separate information systems within local area networks can share resources, including computational power, data files, and peripheral devices.

In microcomputer networks two or more microcomputer systems are linked together, permitting them to share resources or files. The size of the network is determined by the type of equipment used; depending on the manufacturer, the number of terminals in a network may be unlimited or limited to 32, 64, or 128 terminals. The geographic size of the network is also determined by the manufacturer, generally ranging from 50 to 20,000 feet. The larger networks "can embrace a campus or scale a tall building" (Good 1982, p. 141). Even larger is a network recently completed by Tandem Computers, Inc., which runs from the East to the West Coast of the United States.

Microcomputer networks offer computational advantages over a single processor—that is, mainframe or minicomputer—system. First, networks combine the low cost of the microprocessor, ranging from $500 to $1,700, with greater job throughput, which is the amount of data going through a computer in a given time (Gilgore 1982, p. 79; Good 1982, p. 139). In a network all of the tasks to be done and programs to be run are placed in a single, systemwide queue and assigned to processors as they become available. The system thus can run continuously, without stopping to await the completion of a single task (Good 1982, p. 140). Furthermore, a network saves the time spent moving programs "in and out between mass storage and central memory" in a single processor system (p. 140).

Networks provide more efficient use of peripheral devices. A number of users at separate terminals can share the use of peripheral devices such as "a single, expensive, high-speed printer or a high-density hard disk drive" (Good 1982, p. 139). Networks also reduce system vulnerability. A decentralized system with multiple processors is less vulnerable to breakdown than a centralized, single processor system. In a network, if one processor malfunctions, its work can be redirected to other processors.

Incompatibility can be one of the drawbacks of microcomputer networks. Hardware incompatibility between the network and existing office equipment may result from the lack of compatibility among the products of different manufacturers. Since different microprocessors have different capabilities and strengths, incompatibility may prevent access to the best machine for the job. In addition, the software for existing stand-alone microcomputers may be incompatible with the software for the network, particularly because some software (such as the popular VisiCalc spreadsheet package) is available only on a floppy disk, while networks are likely to use the larger-capacity hard disk systems.

Cost can be another problem with microcomputer networks. Although microprocessors are relatively inexpensive, the total price for the initial installation of a network can be quite high, largely because of the cost of interfacing or connecting the separate processors into a network. The price of interfacing ranges from $500 to $2,200 per processor (Good 1982, p. 142).

Limited functions are another drawback of computer networks. Some networks transmit and share information but not files, and others share peripheral devices but not information. Consequently, users may need more than one network to completely serve their needs.

Despite the disadvantages, microcomputer networks can offer substantial advantages over single processor, mainframe, or minicomputer systems: lower overall cost, greater throughput, reduced vulnerability, and more efficient use of peripheral devices. Given these advantages, the use of microcomputer networks is expected to expand greatly in the next decade (Berst 1982, p. 36).

Software Options

Since the advent of computers on campuses, nontechnical administrators have had to inform the technical analyst or programmer of what they were doing or wanted to do. The technical staff, in turn, wrote programs in languages such as PL-1 or COBOL in which they would tell the computer how to perform the job required by nontechnical administrators. More often than not, something was lost in this interchange. In essence, there has been a communication problem between nontechnical administrative computer users and their computers—a problem in the area of software (that is, the user's instructions to the computer). Today, new capabilities might provide the long-needed resolution to this communication problem or "software crisis" (McCracken 1978). One new capability enables a nontechnical administrator to tell the computer directly only what he or she needs to know; the computer then figures out for itself how to provide what the administrator requires. Direct communication between the administrator and the computer removes the need for a technical staff person to serve as interpreter between the administrator and the computer. This may, in turn, reduce or control expenditures, since higher education allocates a significant amount of resources for technical staff salaries.

Nontechnical administrators need more advances in software in order to keep up with today's fast, cheap, and disbursed hardware and tough applications of institutional information systems. As administrators learn how to solve some applications, management tackles harder ones. Nontechnical administrators should not expect the technical personnel to force the changeover to direct communication between the computer and the nontechnical user. Those experienced in procedure-oriented software are no less resistant to change than other higher education employees. The current method of employing technical staff as liaison between nontechnical users and computers will have to be superseded, and it may be the nontechnical administrator who makes the decision to do so. The true cost of software development is usually drastically underestimated, and during the '80s higher education dollars will be hard to obtain and therefore will have to be spent carefully. This is not to say that nontechnical administrators will replace the technical staff in the computer area, but in the future most technical staff will be developing software tools, not actual application programs.

Until administrative users have acquired more hands-on capability they need to ask themselves several questions about the computer affairs unit with which they do business:

1. How frequently do I participate as a member of a design team?
2. How frequently do I perform systematic analysis of benefits and costs anticipated from a proposed computer application?
3. How frequently do I review designs for a new application?
4. How frequently do I provide test data for an application?
5. How frequently do I sign off on accepting an application?
6. How frequently do I provide feedback on problems with the data processing unit? (Kling 1977)

Financial Savings
Administrators are entering a world of combination word-data processors, voice-activated computers, desk-top and hand-held computers; intelligent copiers; computer output microfilm; and sophisticated facsimile equipment that accepts text from word processors and terminals. Administrators now face the fifth generation of computers in America—computers that are vastly more powerful than those of earlier generations. The fifth-wave machines are less expensive because of substantial reductions in the hardware costs of silicon chips. Electronic computing power that just a generation ago would have filled an entire room and cost hundreds of thousands of dollars now fits on a small desk top and costs as little as $2,000. Furthermore, experts predict that hand-held, portable computers in the $200 price range will be available by the end of the '80s.

Of course, approving enormous expenditures for computing equipment will not, in and of itself, guarantee financial savings. Nor does the key lie in the age-old concept of replacing human workers with automated equipment. The myth of machines replacing people is easily laid to rest by simple examination of the figures. According to the Department of Labor's Bureau of Labor Statistics, job displacement of people by computers over the past three decades has been more than offset by jobs created in new industries, as well as by accelerated productivity. Whereas there were 10 million clerical workers in 1960, by 1980 that figure had risen to 18 million—an 85 percent increase in clerical employment. Buying computers, then, does not automatically ensure that administrators will be able to cut costs by reducing staff. Instead, computerization may require that institutions hire more employees, grant overtime during the conversion process, and even pay for additional training costs to ensure efficient use of the equipment.

Where then, are the financial savings? Cost benefits can come from a number of sources, almost all of which are long-range: specially designed computer-compatible forms for information; the reduction of "information float"; intelligent computer buying; the retraining of administrators and other nonclerical personnel; and electronic mail.

Computer-compatible information forms may be expensive to produce in the short run; a whole new class of professionals specializes in such tasks. In the long run, however, the application of computer logic to the gathering of primary information will result in greater efficiency. And with each new generation of computers, becoming more efficient by various strategies, forms for institutional information gathering should be updated to reflect new computing abilities.

"Information float" refers to the period of time between requesting and receiving information. A higher education administrator who wants information on a number of students, perhaps for verification of attendance, offers a good example of information float. In the traditional, noncomputerized office, it might take a week of searching by a number of employees to gather the proper information. Compare the economics of that scenario with one in which a single employee keys names into a computer and, in perhaps half a day, receives a print-out of student status for all those names.

Intelligent computer buying can be quite tricky even for the technical person. One of the problems concerns the question of when to buy rather than lease equipment. As new types of equipment are introduced, with each generation doubling or trebling the memory capacity and speed of its predecessors, the potential for savings and greater efficiency increases correspondingly. Given this, when does the cost-conscious, nontechnical administrator stop waiting for new developments and buy? Of course, no quick and ready answers apply to every campus. Because they lack knowledge about computers and have less sophisticated needs and little expertise in computer applications, administrators tend to lease equipment during the initial implementation of computerized information systems. Even when they gain knowledge and expertise, they may prefer to lease equipment in order to stay current with state-of-the-art equipment. However, long-term leasing can be more expensive than purchasing equipment because of the rapid decline in hardware prices. In addition, purchased equipment can be traded in, thus reducing the total cost of future equipment. Furthermore, academic administrators may not really need state-of-the-art equipment; in fact, given the time that transition to a new system takes, leasing state-of-the-art equipment may be very costly for an institution. Technology will continue to improve, but this should not deter administrators from purchasing equipment.

One of the most overlooked sources of financial savings in office automation is the involvement of nonclerical personnel in the use of computers. There was a time when office automation meant a word processor for the typist; certain time-consuming but invariant details of forms could be automated so that only relevant details had to be typed in for any document desired. Thus, word processing in its infancy merely replaced or supplemented ordinary typing. This is no longer the case. It is now estimated that at least 45 percent of office personnel, from clerical staff to management, must be trained to operate the new computer systems efficiently if financial savings are to be realized. The days of strict separation between the creation of words by administrators and the physical output of those words by a word-processing secretary are nearly over. On progressive campuses, administrators who choose to create their own documents directly on a computer-based work station can do so without the assistance of an intermediary; final output decisions (such as typeface, typesize, and spacing) are left to those with more experience in output formatting, which saves retyping time and allows for more specialization and creativity for the clerical staff. Retraining nontechnical management and administrative personnel to use computers efficiently is an important element of cost reduction.

Finally, unless the institution can store every conceivable bit of information it needs in the same place, computers should be able to communicate with other computers containing supplementary information. Whether the other computers are next door, in the next building, across the country, or elsewhere in the world, telecommunications is the key to obtaining the information administrators need quickly and cheaply. Institutional computer systems cannot possibly contain every database they will ever need; therefore, systems should be purchased with an eye toward their communication capabilities.

Increase in Efficiency

Persuading management and staff to use the available technology efficiently and effectively is a significant problem nontechnical administrators will face in the 1980s more than ever before. In fact, the majority of problems in office automation may involve the acceptance of modern technology by office personnel.

Much of the resistance results from fear of losing the collegial community and creating clerical, assembly-line working conditions. Such fears can cause increased employee turnover and absenteeism, decreased job satisfaction and even employee strikes. This grim scenario, however, can be avoided if nontechnical administrators are directly involved in the implementation of office automation. It is possible to design and create working conditions in which human needs are the top priority and serve the employees, rather than vice-versa. When administrators are secure in their own position and convinced that computers will save them from drudgery as well as aid in their decision making, they will use these labor-saving devices to full efficiency.

Additional resistance stems from the fact that computer literacy requires keyboad (i.e., typing) skills of all users, even administrators. Although systems are available that leave the typing to secretaries, these systems inherently lack the efficiency required in the new office. In a world of databases accessible by telecommunications, administrators cannot afford to leave keyboarding knowledge to secretaries.

Territorial disputes on campus also hinder efficiency by deflecting attention from institutional business to individual power struggles. Such disputes often revolve around the question of who is in charge of the sophisticated technology. This is a dismaying but increasingly evident problem wherever prestige or salary is determined by the proximity of nontechnical and technical staff to the institutional "seat of power."

What specifically does computerization offer higher education nontechnical administrators? Two obvious areas for computerization are course registrations and transcript preparation.

A registration process that requires students to fill out completely new forms each term, even though most of the information requested remains unchanged, wastes time for both students and the employees processing these forms. The best kind of computerized registration system can retain the old, unchanged information while accepting updates.

With computerized systems that are less than optimal (batch-processed), registration information is not available for at least a week, separated from the administrator by a number of employees. With on-line registration, up-to-date information is a few keystrokes away at any time.

It is no longer necessary to wait weeks for the required registration numbers to complete the latest government form.

There are many instances where an institutional information system would result in quicker service for administrators, staff, and students. For example, the ordinary transcripts operation of a nonautomated office requires a few days to a few weeks to process a request for a transcript, depending on the current workload. What happens when the workload is upset by, say, a flu epidemic sweeping the office? When this happened a few years ago at the University of California at Berkeley, transcripts were delayed a month or more. Taking this example to an extreme, a student could be denied a scholarship or admittance to graduate school by an institution's failure to send transcripts within a reasonable amount of time. Could the institution be held legally liable in such a case? Consider this fact: Physicians and hospitals that fail to acquire or use computer-based technology to diagnose and treat patients may well be subject to liability, based on recent court rulings that have gone against doctors whose failure to use available technology resulted in serious injury to the patient. Is it beyond the realm possibility for a student to sue a college for transcript negligence?

Coordination with Other Offices

The problem of acquiring up-to-date information from one office is compounded when the information required "belongs" to another office or even another campus. Perhaps a financial aid officer needs to know whether a certain student is registered this quarter. The computerized alternative to work orders and backlogs lies in centralized records, accessible via a few keystrokes at the closest terminal. If the information needed is at another campus, a quick telephone call will clear the way for one computer to talk to another computer, store the information so gained, and print it on paper.

Another example is a student's change of residence: How many forms is the student required to fill out to register that new information? How many departments or offices must that student visit in order to make sure that everyone who is supposed to know about the address change gets the information? How many employee hours will be required to place that information in all of the right files? With centralized data files the address change is entered just once into the student's information file, which is then accessible within moments to other departments.

Flexible Working Hours for Staff

Are 8-to-5 working hours going the way of the keypunch machine? Offices around the country today are taking advantage of the benefits that accrue from flextime, a system of flexible scheduling of working hours that can be applied to machines as well as people.

It is easy to see how people benefit from flextime. Employees who elect to come to work early or stay a few hours later can avoid the ordeal of rush hour traffic and reduce the attendant frustrations that can affect their work. In addition, the staff time lost to dentist and doctor appointments during the working day could be regained if employees could make appointments early in the morning or late in the afternoon, before or after their work hours.

Flextime also works well for machines. Consider all the dead hours, at night and on weekends, when machines are not in use. Flexible scheduling can add 50 to 100 percent more hours to the efficient use of computers and other office automation equipment. It also cuts down on overworking computers during daily prime time. Spreading out the jobs over a longer number of hours is one very good way to realize the long-range benefits of office automation.

Information as Power on the Campus

In an age in which over 50 percent of the American work force is in the business of creating and moving information, we are all becoming part of a new information economy. As with any economic system, those who control large shares of the economy also possess large shares of power. In essence, power accrues to the new information brokers.

However, computerization brings with it a certain sense of informational democracy as more users gain access to the information. To some extent, this is as it should be. After all, automated typing and filing leave secretaries with more time to handle information that is more administrative in nature. Correspondingly, executives no longer need to rely on their secretaries' skills in order to obtain information.

With increasing user access, security of information emerges as a greater problem. Crime by computer is a serious and fast-growing problem; according to criminologists, it is the fastest growing form of crime. There are at least five major and many minor categories of computer crime.

1. Theft of valuable data. This area leads the list of computer crimes, in part because there are so many ways of doing it. Methods include wiretapping; piggyback entries (unauthorized plugging in between the user and the system, thereby enabling modification of information); trapdoor entry (finding weak points in security); electromagnetic pickup; and browsing, accomplished by connecting an untraceable, unauthorized terminal to a computer system. Common sense dictates the importance of identifying and protecting sensitive information.

2. Theft of services. Every decision maker must maintain strict vigilance in order to realize long-range cost savings. Have your clerical workers figured out how to access the computer games that were put there solely for the recreational use of executives? Or perhaps some employees are using the computer to write personal letters. In the past, with typewriters, they wasted only their own time, but now this involves the computer's valuable time as well.

3. Theft of valuable property. Acquisition of expensive office automation equipment carries with it the responsibility for its security—everything from terminals to diskettes. Lax security procedures work against the realization of maximum long-range financial savings.

4. Financial fraud. Unauthorized entry could change the information to show that certain students had paid certain fees when, in fact, they had not.

5. Sabotage. Remember the draft protests of the '60s, when file cabinets full of information were burned or saturated with red paint? That's nothing compared to the destruction and havoc that could be wreaked today by unauthorized entry into centralized computer files. On a less dramatic scale, computer-literate students could alter their grades.

All these potentially hazardous situations of computer crime can be planned for and, to a large degree, prevented with the proper forethought. Computer security consultants are available to help identify potential problems and offer solutions.

Summary

For nontechnical institutional administrators, the decisions relating to information systems and administrative technologies are complex and involve great sums of money. Nontechnical does not mean uninformed or nonparticipatory; in fact, institutional administrators cannot leave systems design and technical equipment purchases to the systems specialist. These decisions are vital to the management of an institution. Cooperation and communication are necessary, but the final decisions must be made by the administrative user. For the users there is no substitute for experience in this type of development.

Although automation offers significant opportunities and benefits, it also requires that nontechnical administrators make many complex decisions in the '80s (Henderson 1982). These decisions should be guided by the following observations:

1. Implementing systems and managing change are posing unanticipated challenges for nontechnical administrators.
2. Determining user requirements has proven to be more complex than ever before.
3. Administrative technology, although beneficial in its current form, is still embryonic and evolving.
4. There is still a knowledge gap between nontechnical administrative users and technical staff. There is another gap between campus systems and technical staff and private enterprise. Currently, systems designs tend to be "technology driven." The "user driven" design approach is necessary.
5. In the final analysis, technology or hardware should never be the deciding factor. In making decisions regarding technological equipment and purchases, the first deciding factor must be the administrative application—for what is the machine needed, and can it perform that function? The second deciding factor is fiscal.
6. Flexibility is another critical factor in large-scale, institutional information systems and administrative technological decisions.
7. New or expensive products should not be purchased unless the product has had the full experience of multicampus administrative use.
8. Although users of institutional information systems and administrative technology should be mainly interested in the end result, they should not leave the "how" to the technical specialist. It is a mistake to assume that the "how" is evident in the end result.
9. The integration of office systems is an evolutionary process. Efforts to build integrated office systems must focus on the users of the systems and not on their technology.
10. It is increasingly difficult to measure the impact of these systems on productivity and to present solid cost justifications.
11. New administrative organization and innovative methods of making decisions are needed to oversee the design, technical implementation, and evolution of institutional information systems.

At most institutions of higher education, a significant number of non-technical administrators are still on the fringe of information systems and administrative technology. During the '80s, campus management will move from the hands of a select group of innovators into the hands of a large percentage of the administrative population. Ten years from now university administrators will look back on the "old days" before office automation in the same way we now look back on the days of the hand-lettered transcript.

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