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ABSTRACT

In an effort to shed light on the advent of the computer and its applications at small, two-year colleges, this report describes a national survey and case studies of five small colleges to determine their current use of computer services, the role and method of governance of computer-based information systems, and the policies affecting them. The first section of the report reviews literature and research to provide background for the study, tracing changes in the status of computers from luxuries to necessities, the development of computers and information systems, and other current problems and issues related to computer use. After describing the study design, the report presents study findings, based on survey responses from 165 two-year colleges with fall 1979 enrollments of 2,000 students or less. Results are provided in terms of planning and procurement of computers and information systems, governance and administration, hardware and software systems, administrative information systems, instructional applications, costs, educational vs. technical perspectives, and problems. The next section projects future directions in computer applications, considering new technological possibilities, new economies, and trends in information systems and instructional capacities. Finally, the implications of the study findings for policy, hardware, software, and personnel are summarized. (AYC)

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COMPUTERS AND INFORMATION SYSTEMS IN THE SMALL TWO-YEAR COLLEGE

By:

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and

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PREFACE

We are happy to introduce the first in a series of monographs by the Institute. The previous publications have been Research Reports growing out of the Fellows Program. The monograph series will reflect projects in which the higher education faculty are directly involved whether in collaboration with other researchers or independently.

ABOUT THE STUDY.

This study was initiated under the auspices of the State and Regional Higher Education Center which was established in 1972 and funded by a grant from the W. K. Kellogg Foundation. Of the 35 monographs published by the Center since that time, 14 have focused upon the two-year college. The Center, an affiliate of the Institute, funded this monograph publication.

This study combined case study and survey research methods. The investigators sought evidence of past, present, and future practice against which policy implications might be identified. Dr. Conrad's expertise and extensive experience with computers in the private sector as well as higher education also is reflected in the study through the added dimension of contrast/comparison of the literatures of higher education and the private sector. By looking at the problems, applications, and developments of the technology in the private sector, it is possible to anticipate what will evolve or emerge in the collegiate sector. This is a reflection of the "lag" in adoption/application by the educational institution as well as a reflection of the economics and rapidity of change involved.

ABOUT THE INSTITUTE

The Institute was established by the higher education faculty to provide a focus for studies in educational policy. It extends the emphasis on the policy sciences at The Florida State University to the discipline of Education.

The Institute is dedicated to a mission of research and service at the state, national, and international levels. Four purposes have been identified, including: (1) To focus upon institutional, state, regional, and national issues of management, governance, finance, educational programs and educational services through descriptive and analytic studies or through synthesizing analytic or evaluative aspects of postsecondary education; (2) To serve Florida State University as well as the State of Florida as a resource for policy analysis and research on issues of postsecondary education within the scope of the Institute's mission; (3) To complement the scholarly activities of the graduate program in higher education of the Department of Educational Leadership; and, (4) To serve as an initiator of activities and services intended to assist practitioners to deal better with problems and issues confronting immediate and future dimensions of institutional operation and vitality.

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INTRODUCTION

Computer knowledge is now the new literacy. The nation has spent millions of dollars on adult education to overcome illiteracy in reading, writing, arithmetic and other basic skills for living; yet, almost overnight we have a new illiteracy affecting the majority of the adult population--computer illiteracy. Colleges, too, are faced with this problem as they seek computer applications to instruction and administration.

A decade ago, small colleges could legitimately point to the high cost of hardware as their reason for not applying computers. However, declining costs of minicomputers, their availability in the used market, and now the revolution in computing prices brought about by microcomputer technology have brought the costs of computing hardware down until even the smallest college can find computing power affordable.

The change in status of computers from luxury to basic literacy for college applications has happened so fast that relatively little is known about the impact, especially on small colleges. This lack of knowledge, as well as that regarding information systems, has been noted by various authors including Adams, Kellog, and Schroeder (1976), Richman and Farmer (1974) and St. John (1979).

The purpose of this study was to shed some light on the advent of the computer and its applications in the small two-year college.

BACKGROUND

Luxury to Literacy

In 1961, there were only about 5,000 electronic data processing systems throughout the United States. By 1970, almost all colleges with over 5,000 students had begun to use computers in administration while only 28 percent of those with 1,000 or less students were utilizing computers (Mosmann: 1973: 137) and only a few secondary school systems were utilizing computers. Even in 1973, Mosmann noted: "No matter how much a system does, the price tag may be too high (138)." Yet by 1974, the vision of some was changing. Richman and Farmer projected: "Shortly, it will be too expensive not to compute and universities and colleges will join other complex organizations in obtaining all the information they need to operate reasonably efficiently" (1974: 297).

Few anticipated the magnitude of the computer's invasion of industry, the office, education at all levels, and even the home, made possible by the introduction of the microcomputer to the market in the late 1970's. Estimates are that 235,000 schools across the nation now have one or more microcomputer in use with a projected 450,000 to 600,000 schools using microcomputers by 1985 (Walsh: 1982: 32).

Now, in 1982, there are over 100 microcomputer manufacturers, with several anticipating sales of over 1,000,000 computers in 1982 alone (Swaine: 1982: 35). These sales will be to businesses, educational institutions, and homes for every type of application imaginable. All this has been made possible by a technological revolution that has put more and more information on smaller and smaller and cheaper and cheaper components.

The small college is now caught between the larger institutions with their extensive experience in using large scale computer systems and information systems and secondary schools using thousands of microcomputers and sending eighteen year old computer-whiz kids to begin their college careers.

Computers then are no longer a luxury for a college of any size, but rather a basic necessity--as basic a tool for college survival as the telephone. Using computers effectively in the college environment and coping with computer literate students requires a computer literate faculty, staff, and administration, with access to adequate hardware and software.

What progress has been made to this end? What is the status of computers and information systems in the small college?

Evolution and Current Status of Computers and Information Systems

In 1963 there was a total of 400 computer systems in colleges and universities nationwide (Kaimann and Marker: 1967) primarily in large universities, and used for research with some records processing. The number of systems, applications, and options available grew rapidly, but primarily at larger institutions. By 1970 virtually all universities or colleges with over 5,000 students had a computer center. The general tone of the literature of that era, even through the early 1970s, was that use of computers in small colleges, especially for administrative applications, was impractical. However, by 1973-74 hardware manufacturers began to target smaller colleges in their advertising and national publications for two-year colleges like The Community and Junior College Journal began to include articles such as the one by Meyer in 1973 (Meyer: June/July 1973; 18-19) which discussed administrative access to on-line student data at a college of 3,000 students. Authors such as Mosmann (1973) began to define areas of computing applicable to the small college. These views of the needs of the small college were still fragmented, stressing either financial or student records, rarely more.

In less than ten years, both the Epsilon 1980 Survey (1981: 9) and the results of the national survey reported in this monograph document small colleges of less than 2,000 students now utilize computers extensively, especially for information systems. Both studies found about 65 percent of these colleges have computer support for student records processing and over 80 percent have a computerized and some administrative applications.

Computer systems are applied to the same type of problems in small colleges as in large, though the hardware used and the software designs used are often very different. This similar distribution of administrative applications regardless of size was confirmed by the CAUSE 1980 Profile (Thomas: 1981: 126-127) which listed the areas by rank as 1) Admissions and Records; 2) Financial Management; 3) Planning, Management, and Institutional Research; 4) General Administrative Applications such as Personnel; 5) Other Administrative functions such as Alumni Records; 6) Auxiliary Services and Logistics (tied); 7) Financial Aid and Library (tied); and 8) Physical Plant.

Small colleges, however, have a briefer history--only about ten years as compared to the twenty years of experience of the largest colleges and universities in computers and information systems. This is reflected in a lesser number of applications, in less sophisticated development of information systems, and a lesser degree of overall development of computing on campus. This can be seen in a number of studies in the literature. The FISCHE 1976 Survey (Hamblen and Landis: 1980) when compared to the CAUSE 1980 Profile (124-125) shows that the average number of applications at small colleges has almost tripled in four years, bringing the small colleges to almost the same number of applications as found in 'medium' sized colleges (2,000 to 6,999 students) in 1976 but still with only half the number of applications found in large institutions in 1980. The Epsilon 1980 survey (Epsilon: 1981: 9) reported that 96 percent of private universities and 90 percent of public universities had computer support for admissions but only 25 percent of two-year private colleges and 65 percent of two-year public colleges had such applications.

Assessment of level of sophistication is more indirect but can be roughly assessed using the classifications of Robbins, Dorn, and Skelton (1975: 5-13). They studied thirty different institutions and agencies using the case study method in 1975. However, the size and type of the institutions was not reported. They identified four stages of computing development typical of institutions studied--Initial, Basic, Operational, and Extended. Briefly, the Initial Stage has little or no use or knowledge of computers; the Basic Stage has access to a computer but few administrative applications or knowledge. The Operational Stage has computing used extensively for administrative operations and educational training, and a computer system managed by a separate center or department. In the Extended Stage, the computer impacts throughout the institution, multiple service types are available, and advanced administrative information systems are in use or under development.

Their 1975 study showed "many" institutions, mostly smaller ones, in the Initial Stage. Others were in the Basic Stage and many more in, or entering, the Operational Stage of "moderate sophistication." This Operational Stage seems a stable state; for, although the rate of growth into it is increasing, very few--"a handful"--are in, or are emerging into the Extended Stage.

Using the classifications described, experiences of the investigators of this national study would place most small colleges (fewer than 2,00 headcount) in the Basic Stage of development, with a large number now struggling to move from the Initial Stage to Basic. As Robbins, Dorn and Skelton found, the direction is toward the Operational Stage, but only a few small two-year public colleges have yet reached this plateau. Even fewer are in the Extended Stage of use. Baldridge and Tierney (1979) discussed two private colleges of 2,350 and 2,500 students each that are in the Extended Stage.

Judging by the literature available through hardware vendors and trade journals, small private colleges, when they have computing capability, are generally somewhat more advanced in their use of computer systems than small public colleges. Wesleyan Univesity participated in a highly successful EXXON funded project to implement an advanced MIS, with a planning and simulation model called SEARCH. Also, Clarkson College of Technology was funded by EXXON to revise their data base and install the NCHEMS resource allocation model. Clarkson has also become one of the first colleges to provide all incoming freshmen with a microcomputer (French: 1982: 21). IBM, in discussing smaller (enrollments of less than 4,000) colleges defined as in the 'mainstream' of education featured three private colleges and two public two-year colleges (IBM: September/October 1980). These are: Madonna College, Catholic, St Olaf College, private; Pierce Junior College, private; Ulster County Community College, public; and Anne Arundel Community College, public.

One major aspect of computing services for small public junior and community colleges is the state systems for computing that are being provided more and more frequently. Many states (including Texas, Virginia, West Virginia, Florida, Georgia, Illinois, Kentucky, North Carolina, South Carolina in the fourteen state southern region) provide some degree of computing support to all colleges within their systems. This service ranges from rudimentary accounting systems to full access to information systems available through large state universities.

The effect of these systems on the individual institutions is interesting. Due to lack of expertise on campus, or inadequate interface terminals, some colleges are still at the Initial to entering Basic Stage of development in their use of services though software at the Operational Stage (and, occasionally, the Extended Stage) is available. In other instances, where an individual of high expertise is affiliated with a small institution, the inadequacies of state support have prevented progress from the Basic to the Operational Stage of development.

People and Other Problems

Small colleges began shifting from manual to computer based information systems only a few years ago. The literature of the sixties regarding human problems in industry as a result of the introduction of computer based systems are now applicable to the small college. Kaimann (Kaimman and Marker: 1967: 16) described the magnitude of the personnel problems: "Without proper preparation, personnel will cause the failure of every system."

Personnel problems have been identified as the major source of difficulty in implementing information systems by many authors including Lucas (1976: 6), Diran (1978: 281), and Kanter (1977). These personnel problems in computing can be classified as problems with personnel already at the college (the users), problems with new data processing personnel, and problems with communications between the two groups.

One of the most basic problems involving user personnel is resistance to change. Resistance to change has a long history from the Luddites who destroyed labor-saving textile machines to those who thought the automobile would never last; resistance to computing technology is only one of the most recent. Resistance to change is an emotional attitude accompanied by fear and uncertainty--fear of loss of status because new skills must be learned and uncertainty of ones ability to master the new skills--these feelings can not be overcome by logic nor debate. They require a sophisicated plan of action that combines knowledge of both the human and organizational factors.

The data processing personnel are the 'change agents' in this process trained to proceed logically but perhaps lacking human understanding. As such, the systems analysts often find the slowness of acceptance or lack of cooperation by users frustrating and tend to return to their own department, thereby reducing communication. This perception is consistent with the research of Couger and associates (1979: 6) who assessed university computer managers as high in a factor known as 'growth need strength' but low in 'social need' (the need to interact with others). As a result of the charactistics that give them technical strength, they may lack interest, patience, and understanding of those very people--the users--on which the ultimate success of all information systems depends.

Another problem that may arise and result in slow information system development is that of computer systems analysts becoming more involved with technical purity and sophistication than the end result ... a successful system. Additional problems may result as perceived by those already at the college when a new group of people with significant status are introduced into the information power base of the college. This can disrupt both the formal organization and the informal power base.

The problems are basically the same between faculty and computer specialists when introducing computers into the classroom. The faculty view themselves and their world from the perspective of an educational system which has changed very little in centuries, where the techniques used and wisdom of teachers that lived over 2,000 years ago are still valued for what they can offer today. The computer specialists, however, view themselves and their world from the perspective of computing technology which spans only twenty-five years. The 'first', 'second', and much of the 'third' generation of hardware systems, and accompanying techniques fill the technological trash heaps while the latest technology, the microcomputer, is only a few years old. Almost total change every few years is a way of life to the computer specialist.

Between such different groups, reflecting the systems in which they developed and the personality traits that drew them to those separate systems, the resulting communications problems are no surprise. However, a high degree of communication between the user and implementer of information systems and between faculty member and computer specialist is essential for successful systems.

There are a variety of other problems facing the small college in establishing effective computer centers and information systems. One of these is obtaining and then keeping qualified technical personnel. Salary schedules, location, lack of the latest hardware, and job frustrations all contribute to high turnover of staff--higher even than the 27 percent annual turnover rate in industry. The turnover of key personnel can mean loss of essential knowledge, need for retraining, schedule delays, and increased costs. Where only one or two people constitute the programming/analyst staff, turnover is most serious.

Another problem area is the 'information glut' that can arise as documented by Kanter (1977) which makes acceptance and use of an information system by management even more difficult. This results because many people, especially computer analysts, define meeting the information needs of management as providing more information, rather than 'the right information.' This might be called the 'shotgun' approach to meeting information needs, where detailed data is presented rather than only the synthesized, summarized information that can be effectively applied to management decision making.

Policy and Administrative Issues

The experiences of business and industry regarding policy and management of data processing departments and management information systems are frequently analogous to those of small colleges. The generality of these experiences was cited by Amadio (1980: 27-33):

"No matter how different in size, industry, application requirements or geographic locations, data processing departments share the very same basic needs, problems, and concerns."

As early as 1963, Brandt and Hutchins stressed (Schoderbek: 1971: 274-283) that the placement within the organization, the internal organization of data processing and the level of managerial support were major factors in determining how successful a system would be. However, there is no optimum departmental organization nor single set of policies defining role and responsibility. When that article was written in 1963, many of the policy issues and problems now being faced by small colleges were already clearly defined for industry. These included a lack of policy, a lack of technical understanding, the organizational level at which the computer personnel should be placed, and the numerous personnel issues of personality, interest, and status. These issues had changed very little when Mosmann analyzed the policy needs of academic computing in 1973 (78-87), and stressed the philosophical, and often political, nature of the policy questions regarding the purpose and role of computing within the larger organization.

Lack of policy is cited as a problem more often than any other policy aspect. Computer operations call for new policies, for institutional change. Computer operations are often in conflict with or drastically different from established, traditional institutional policies (Robbins, Dorn, and Skelton: 1975: 71). Yet as Bearley (1978) noted, any organization needs organization wide policies, structures, and procedures for information management of which computer operations is a part. Mosmann (1973: 80-83) stresses the need for a basic policy document to address a lengthy set of questions that only begins with what is the function of the computing operation, whom does it serve, and who determines the policies. Robbins, Dorn, and Skelton (1975: 69-74) also delineate a lengthy set of policy issues that must be considered, and raise numerous questions concerning critical policy decisions for all types of computing options. In spite of the much discussed absence of policy statements, they wrote: "... when decisions about computing are made they appear very much related to institutional framework, objectives, and policies, whether they have been adequately articulated or not."

Whether a basic policy statement has been defined or not, there is some type of administrative structure. Management by a computer center director is most common. There is a growing tendency for this director to report directly to the President, especially in smaller colleges but he or she may now report to the chief administrative officer, business manager, or academic officer, depending primarily on where computer applications were first inititated within the college. Computing center directors will usually be the chief (or only) technical computing advisor to the administration in a small college. This approach provides for strong administrative control, fast response to needs, and a quick response to technological changes. However, much depends on the skills, personality, style, and sheer presence of the computer center director, who will become, in the frequent absence of written policy, a de facto policy maker (Robbins, Dorn, Skelton: 1975: 36). In small colleges, the computing center director must have both technical and managerial skills for he or she will often serve as a member of the management team of the college, have line responsibility for computer operations, and have technical responsibility for MIS design and implementation.

An advisory committee of representatives of user departments, the chief financial officer, and the computing center director is often effective to assure user involvement and support and an effective policy-review body. The value and role of user committees has been acknowledged by many authors. Smith (1980) described in detail the role of a user committee in the implementation of an information system at one large college. Robbins, Dorn, and Skelton (1975: 35) also cited the use of an advisory or users committee in small colleges to provide guidance for the computing center director.

Organization and staffing of the small college computer operation, whether a central computing center, network access, or other operation, are similar to that in any small business data processing center. There is a broad base of knowledge about small business centers as over 55 percent of all computer sites are classified as "small," having less than $10,000 per month total expenditures. In such sites, staffing is skewed toward clerical and operational personnel--they are about 65 percent of the staff; programmers, 25 percent; and management, 10 percent. The programming staff spend about 30 percent of their time for implementation of new systems, 60 percent for maintenance, and 10 percent for momentary needs (Amadio: 1980: 27-33).

The functions to be performed in a small college center are the same as those in a larger center and include management, communications (user interface), system design, applications development, maintenance, programming, operations, and data entry. Duties and responsibilities associated with each function are commonly documented in computer management and operations texts as well as trade journals. The primary difference is that in a small college center, a single person may perform several functions. The director of the computing center, for instance, often manages, handles communications issues, and provides systems design. One programmer may provide applications development, maintenance programming, and even some operations. Secretarial staff or computer science students frequently serve as computer operators and data entry operators, often on a part-time basis.

Computing Needs

Few small colleges have the foresight to seek or the good fortune to obtain support such as the EXXON Foundation has provided to a few colleges for systems development or to contract with a major corporation such as IBM to conduct a computing needs analysis as some universities have done. What, then, are the computing needs at a small college? Computing needs of colleges of all sizes were defined in five general categories by Robbin, Dorn, and Skelton (1975: 16-23). The five computing needs, each of which is discussed in the following paragraphs are:

- computing capability
- computing reliability
- computing access
- control over computing, and
- prestige derived from computing.

Computing capability is the computing need that comes first to mind in any discussion of computing on campus. Capability includes both hardware and software adequate for administrative and instructional applications. Administrative information systems to provide college management with information at all three functional levels--operational, control, and planning and decision are a major part of the computing capability needed.

The transactional or operational level is the most basic level of automation. It provides support for administrative functions such as payroll or student records; the day-to-day operational activities of an organization. Synthesis of this data provides control level information such as financial statements, inventory control, names of candidates for graduation, and other information needed to monitor, control, and analyze on-going operations at the "middle-management" level. The third level of information is that needed by top management to aid in long-range planning and policy making, for consideration of decision alternatives (Lawrence and Service: 1977: 27-28) (Kanter: 1977). Information systems have been only marginally effective at this third level, due to the different nature of the information needed--more external, more futuristic than historical.

Computing reliability means the ability of the system to function as expected. Users of several state systems find purchase of their own computer system looking more desirable due to reliability problems such as data loss and incorrect reports. Administrative systems, especially financial and student records, have a high need for such reliability.

Access or the ability to get computing done when needed by the user is also a significant issue. Administrative systems often can meet their access needs with an overnight response. However, when a small college is a user on a large system, either state or university operated, their user priority may be so low that during high use periods, access needs are not met satisfactorily. This is one of the most frequently cited reasons for obtaining the college's own computing facility, with up to two weeks cited as a turnaround on low priority jobs in some large systems.

Access is a major issue in instructional uses of computers. A microcomputer or out-of-date hardware that is on-campus and accessible to all students is usually preferred in instruction over a terminal to an off-campus system, even if more capability is available through the terminal, since access of the terminals to the mainframe is usually restricted.

The needs for control and prestige, though not technical issues, are significant factors both in the initial decision on how to meet computing requirements, and in the acceptance and future success of the computing facility, and its instructional and information systems. Control is frequently an issue in an individual institution seeking its own system versus being part of a state information system and computer network. Part of this is the issue of right of access to the information in a data base when both the information and the service are controlled by individuals outside the institution. The tradition of strong executive leadership among many small colleges contributes further to control as an issue, as information is readily available at the state level through the data base without presidential approval.

Control, more recently, has become an issue even between users and computer centers managers on campus. This is occurring more at large institutions but will be an issue at more and more small colleges. That is, the user may seek to gain control over his/her own needs through an in-office microcomputer separate from the mainframe or minicomputer elsewhere on campus. The root of this is frequently communication problems on campus--among the people--not the hardware. This control issue occurs often within the Student Records area which does not usually direct the computer center and which often feels that financial area processing obtains priority.

Prestige has been cited by numerous authors as a factor. Brown and Luedeke (Ryland and Thomas: 1975: 578) wrote:

> Many organizations wish to be absolutely up to date and to possess the symbols of ultra-contemporaneity. Large, complex computers have long been such a symbol. MIS may replace the number cruncher as the latest status symbol .... Some will go out and buy an MIS so as to be up to date without bothering to determine how to integrate the system within the institution.

Diran (1978: 274) wrote: "A president who wished to be thought of as innovative might well turn to MIS ... to build his or her public or professional 'image'."

In instructional applications, prestige looms as a major issue in the reputation of the instructional program in computer information systems or computer science. Satisfying this need often means having hardware that is more prestigous, ie., newer, more colorful, than the area high schools or competing institutions. Two-year colleges frequently cite large increases in enrollment in computer courses when newer hardware is installed.

Within these five areas of computing needs, each college defines its own specific needs and priorities. Hardware and software must then be selected or developed to meet all areas of computing need as defined if it is to be effective.

Meeting Computing Needs: Hardware and Software

A small college must consider ways of meeting its computing and information system needs through hardware and software that are appropriate to the size and unique characteristics of the institution in todays environment. The hardware and software options usually considered viable today are:

- Centralized computing on-campus via a minicomputer with:

  a) in-house developed software,
  b) vendor and in-house software,
  c) contractually developed software,
  d) proprietary software packages.

- Leasing computer services in a batch mode via an off-campus center that provides hardware, software, and service. The off-campus center might be a service bureau or a larger institution.

- A consortium of small colleges sharing a central system in either:

  a) batch mode, or
  b) interactive through on-campus terminals.

- Participation in a large, external time sharing network such as a state level or university sytem via input/output terminals or via computing terminals.

- A larger computing center operated on-campus as a service bureau for other schools or agencies and thereby making the system available to the host college.

- An internal network of microcomputers that may or may not link to a larger system but communicate amongst themselves.

Most of these options were explored by Robbins, Dorn, and Skelton in 1975 (33-61) and by Paul J. Plourde and others in 1978 (Schouest and Thomas: 1978). Vendor literature, conferences such as those of the Association for Educational Data Systems, CAUSE, and the National Education Computer Conference, popular microcomputer magazines, and other publications describe some or all of these options currently.

The application of microcomputers to the small college environment is the most recent development. The potential of the microcomputer to meet small college computing needs is undergoing rapid transformation.

from experimental to possible to almost practical as networking capability is enhanced, computing speeds increase, and disk capacity and reliability increase monthly.

Costs, Cost Effectiveness and Evaluation

The first question asked by most small college administrators about computers and information systems is "What will it cost?" The question should be "Will it be cost effective?" The financial resources of most small colleges are limited and many choices must be made among competitors for those funds, each with some rationale for support. The decisions which allocate those funds must be cost effective.... they must do the right things with the resources available. The cost of acquiring information, the use of resources to collect, process, and analyze data competes with the college instructional program for resources, as noted by Lawrence and Service (1977: 68). Yet the very scarcity of resources that causes this competition for funds is part of the increased need for information systems, as noted by Diran. He wrote (1978: 273)

> Increasingly scarce resources demand the most efficient and effective use of that which is available and there is real need for defensible, and even accurate, data when hard decisions must be made.

To consider the cost effectiveness of computers and information systems, the areas of potential benefit must be defined. Kanter (1977) categorized the benefits of such systems to business as both tangible and intangible, in a manner readily translatable to the small two-year college. The tangible benefits include:

- The ability to obtain information previously unavailable.
- More timely information.

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- Improvement in operational level information.
- Ability to perform analyses not previously available.
- Reduction in clerical load.
- Maintenance of a competitive position (ie., personalized recruiting correspondence).
- Aid in management decision making.

Intangible benefits Kanter identified, translated to the small college are:

- Image as perceived by the student/ applicant.
- Prestige.
- Improved student morale.
- Management confidence.

There is widespread agreement in the literature that computers and information systems provide the tangible benefits cited, though the clerical load reduction is more likely to be an alteration--a shift that may increase effectiveness but does not lower cost.

Just as educators have long argued over how and even if their student "outcomes" can be measured, information systems too are difficult to quantitatively measure, to "value" or evaluate. Lawrence and Service (1977: 65) addressed this issue

> Does use of these tools and techniques yield better decisions and more capably managed institutions? As of now there is no definitive answer to this question. No one has yet developed measures of "decision quality" and then proceeded to evaluate ....

They (68) did, however, indicate that there are "tentative indications" of better planning and management at colleges where information systems are applied.

There are, then, no definitive measures of cost effectiveness. Rather, cost effectiveness must be assessed for each institution, with the cost of the services provided being but one of the factors assessed. Robbins, Dorn, and Skelton (1975: 63) stated this very clearly:

> The economics of computing moreover, even if well understood at one institution, can not readily be translated to another. Computer costs are so specifically related to institutional size, character, objectives, that comparisons between institutions become almost meaningless.

In spite of this, comparative cost data are still sought, and do serve as a point of comparison among colleges.

Computing cost may be classified as capital and operating. Capital costs are one-time costs distributed over time; while operating costs are annual expenses. Often when "costs" are computed by inexperienced personnel, only the initial capital outlay is calculated, resulting in gross underestimation of computing costs. Sullivan (1980), in fact, estimated that the true annual cost of using equipment is double the equipment purchase price. The investigators' experiences with small colleges indicate to us that 150 percent rather than 200 percent is more typical for them.

Capital outlay may include--depending on the finance option selected and the vendor--hardware, software, and facilities. Facilities include not only the building and furniture but any terminal occupied space or necessitated changes such as transmission lines, energy sources, or air conditioning.

Operating expenses may include hardware, software, maintenance; personnel, utilities, supplies, and training expenses. Though hardly calculated as part of the direct expenses, college maintenance personnel, security, and clerical support are also part of the actual operating expenses.

Though surveys of computing costs abound, and hardware and software suppliers may be waiting in line with cost data on their services, literature on the evaluation of financing alternatives for colleges regarding the hardware and software components of capital outlay are few. Johnson and Gunther (1980: 249-259) give an excellent treatment of this issue, citing five funding alternatives that should be priced using a cash flow analysis of net present value. The alternatives are:

- Rental
- Lease
- Lease/Purchase
- Manufacturer Financed Purchase
- Externally Financed Purchase

New hardware is estimated as adequate for five years. Other sources use five to seven years, with the longest anticipated use being ten years. Based on current third party markets and past performances, a resale value of 10 to 20 percent maximum can be expected for the hardware. With continuing rapid technological advances and declining costs, resale values can not be expected to rise.

Hardware and maintenance costs in industry in 1977 (Kanter) were about 38 percent of the annual computer center budget. This was further sub-divided as 46 percent computer, 34 percent peripherals, 10 percent communications hardware, and 10 percent data entry. The hardware share of the budget is continuing to decline as reported in the CAUSE 1980 Profile (Thomas: 1981: 8) which reported hardware costs of only 28 percent of the administrative computing budget among its members.

Personnel costs are perhaps even more crucial to a small college where the expertise needed is lacking, but where the high salaries and high turnover of skilled data processing personnel is new. In 1977, personnel costs in industry were already about 52 percent of computer center annual expenditures and rising. This was confirmed for education in the CAUSE 1980 Profiles (Thomas: 1981: 8) which reported personnel costs of over 50 percent of the computing budget among its members. The 1980 INFOSYSTEMS salary survey (Keller: 1980: 42-54) revealed that the cost of all data processing personnel is still rising about 7 percent per year. Salaries for data processing managers industry wide averaged at $28,548, with information systems managers averaging $39,832. Such salaries are usually off-the-scale for small college faculty or administrators with comparable formal training who would earn an average of only about $20,000. As a result, small colleges face one of their major computing problems in attracting and retaining qualified top level data processing personnel with the salary restrictions they have.

What does all this add up to in terms of the institutional operating budget? Keller cited for large universities, data processing costs of 4.6 percent to 6.3 percent of the total operating budget; Kehl's (1979) data, when calculated gives 1.3 to 3.5 percent. Baldridge and Tierney (1979) reported that Mann found large institutions had computing expenditures of an average of 2.3 percent of their operating budgets in 1968. The CAUSE 1980 Profile (Thomas: 1981: 7) reported that about 75 percent of all CAUSE members spend between 1 percent and 4 percent of their total operating budget on administrative computing only. Over half of the two-year CAUSE institutions report expenditures

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of 4 percent or more. Robbins, Dorn, and Skelton (1975: 2) reported computing as 2 to 4 percent of a college's operating budget.

Part of the fluctuation in data is due not only to real differences, but to variations in what is or is not included in the cost figures, such as a share of the capital outlay, data entry costs, utilities and federal outlay. Individual institutions are highly variable in the way in which such costs are allocated, making comparison difficult. Thomas (1981: 49-50) gives an excellent analysis of the difficulties in comparing administrative information system budgets between colleges.

Reason he cited include:

- difficulty in apportioning cost between academic and administrative
- differences in department charged for services, whether computer department or user, including supplies
- differences in methods of hardware procurement
- differences in methods of software purchase and charge.

STUDY DESIGN

The Issues

To shed some light on the advent of the computer and its applications in the small two-year college, a series of questions for analysis were formulated and study methods defined to respond to those issues. The questions of inquiry which are addressed in the Results section that follows are:

- How have small colleges planned for and procured computers and information systems?
- How are computer centers and information systems governed and administered?
- What hardware and software are used and what are the policies and costs associated with the systems?
- What are the status and priorities of Administrative Information Systems?
- What are the current instructional applications of computers?
- What is the role of people in computer based information systems and what is their attitude about computers on campus and in the classroom?
- What future possibilities for computer information systems are practical for small colleges?
- What will be the role of computers in the small college in five years and what are some of the ramifications of that role?

To answer these questions and discuss issues relating to them, information was sought from a variety of sources, including educational literature, technical literature, a national survey of small colleges conducted to provide statistical information, a series of institutional case studies conducted to provide a deeper understanding of the issues, and the experiences of the investigators in over five years of working with colleges to introduce or improve their use of computers and information systems.

The National Survey

A survey was conducted of all accredited public, two-year colleges with membership in the American Association of Community and Junior Colleges (AACJC) with a headcount as of fall, 1979, of 2,000 or less. This survey was designed to respond statistically to many of the study questions listed, especially to determine the current status of computer services and information systems, the role and method of governance of computer based information systems in those colleges, and the policies affecting them. Using the AACJC Directory (1980) as the guide, a study set of 287 colleges was identified.

The procedures utilized in conducting the study were:

- Determined institutions to survey.
- Developed survey instrument.
- Evaluated survey by sending to a sample.
- Revised survey.
- Mailed survey to all colleges selected.
- Followed up on non-respondents.
- Tabulated results using a computer based procedure.
- Analyzed and reported results.

From the initial group of 287 small colleges, a total of 172 colleges or 60 percent responded. Of these, 165 or 57 percent of the initial group provided survey results suitable for analysis. Of this 165, 80 percent or 131 reported some type of computer services.

To respond to the questions of this study, the 131 were tabulated and analyzed as a total group, those declaring that the state provided computer services to them were analyzed as a group, and those describing their system as a "Management Information System" were also separately analyzed.

Institutional Case Studies

The second part of the study utilized the Case Study approach documented by Best (1977: 118-119) and Van Dalen (1966: 218-220) to investigate intensively the development and effectiveness of computer based information systems and other applications of computers at a carefully selected sample of colleges. The objective was to study several exemplary institutions to analyze and define those factors contributing to their success, as well as factors inhibiting computer applications, and to answer the study questions given previously.

Five institutions were selected from Southern Regional Education Board (SREB) states after contacting the office of each SREB state administrator of two-year colleges as listed in the AACJC Directory (1980: 69-71). Each office was requested to identify the colleges within their system from the set of small, two-year public institutions defined for the national survey that 1) had computer based information systems the longest time, 2) had computerized the most subsystems of a typical college information system, and 3) had the most comprehensive management information system. From the resulting subset, five colleges were selected for study to give broad geographic representation, varied approaches to meeting computing needs, size variation within the parameters specified, and varying degrees of state participation in the systems. The five selected were believed to provide a broad picture of computers and information systems effectively applied within the small public, two-year college.

RESULTS

Planning and Procurement for Computers and Information Systems

The need for planning for computer support and information systems is no less crucial in the small college than the large. Unfortunately, small colleges often do not formally plan for overall college development nor for computers and information systems. This fact is reflected in the literature and was evidenced even among the exemplary colleges identified for case study. Long-range, written plans for information systems, and computer center development were prepared in only two of the five case study institutions. Furthermore, in these two, state guidelines required their development and gave some guidance as to content; in other words, there was strong state leadership. Another startling fact was at the two colleges whose primary computer application was instruction, there was no documented plan, long- or short-term, for computer center or information systems development. Hence, planning among these most advanced institutions existed only where administrative applications were primary and where a strong state role was present.

When examining the planning prevalent at the case study college with the most effective information system and institutional program, it was found that the President and Computer Center Director had worked closely together to plan and softly "sell" the plan to the rest of the college as they progressed. The combination of strong state support and leadership, trust between the administrator and technician, and a concerted effort to develop valid plans produced a system effective both for instructional and administrative applications.

Appropriate planning requires a thorough understanding of state and/or local procurement policies and options available. The national survey attempted to determine the procurement policies and options used nationwide. The national survey showed that system procurement policies are to buy hardware in 62 percent of the colleges, lease or lease/purchase in 23 percent; lease time on a system at a separate location for 15 percent, and share a system with another college for 18 percent. A total of 28 percent use a combination of methods. States regulate hardware purchase in 44 percent of the colleges but only 14 percent have any regulation of software development. Bid laws and general purchasing guidelines are provided by 53 percent of the states.

Procurement includes many steps, requiring technical expertise, legal expertise, knowledge of the institution, and financial expertise. The small college operating alone faces many problems for which it may be lacking expertise. Many of these problems are removed when the small college works closely with a state two-year college office, with several other similar colleges, or has extensive assistance from other sources. In the case study colleges, four of five worked with state level offices in defining system specifications. One of these assisted the state in defining criteria that could be used throughout the state two-year college system for benchmark standards, bid evaluation criteria and procedures. In another, the study college and several other small two-year and four-year colleges worked together to develop hardware and system software specifications that they all shared. Local communities were involved in the hardware/software procurement process in two case study colleges because part or all of the funds for purchase or lease were provided by local sources. Two colleges sought outside consultant

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assistance (non-vendor) to review their needs and develop system specifications, including specific hardware suggestions.

There were a number of factors considered in selecting systems. As might be expected, all case study colleges considered hardware cost and conformity to bid specifications in selecting their systems. However, availability of administrative information systems on the hardware was considered by only two of five colleges. Yet all three colleges that replaced the hardware on which they had operational administrative systems rewrote and/or obtained new administrative software--none converted the major software systems previously in use! This and state regulations pertaining to software in only 14 percent of the national survey colleges show clearly that administrative software is not being considered in the initial procurement plans and decision in anything proportional to its cost and value. Software has already become the most expensive component of system acquistion; with still decreasing hardware costs, the software cost share, whether in development or acquisition costs, will continue to grow.

In three of the five case study colleges where the computer information systems or data processing curricula were the major reason for obtaining the system technologically up-to-date equipment was a major selection factor. Other factors considered in systems selection at the case study colleges included availability of similar installations in the area and the quality and accessiblity of maintenance support by the vendor.

According to the national survey results, the selection of systems typically is made by several people of varied backgrounds. This includes the head of computer services in at least 62 percent of the

35

colleges. Either a special committee or the college executive council make this choice in 55 percent. Presidents were directly involved in the choice in only 16 percent of the colleges.

Governance and Administration

Small colleges are only now facing the issues of the role and purpose of computing, its organizational level and responsibilities, and a variety of other issues that were clearly defined for industry twenty years ago. Computer operations are often in conflict with or drastically different from established, traditional institutional elements and policies. There are no departmental organization standards nor a definitive role and responsibility for the computer center and staff within the small college. Brandt and Hutchins, writing in 1963 about computers in industry (Schoderbek: 1971: 274-278), stressed that placement within the organization, the internal organization of data processing, and the level of managerial support were major factors in determining how successful a system would be. These issues are still crucial ones.

The national survey of small colleges showed that they are yet uncertain as to the most effective level within the organization for the head of computer services. Fully 37 percent regarded the position as head of computer services as only professional support, and 17 percent regarded the position as instructional. The position is considered administrative by 53 percent of the colleges. The total of over 100 percent results from the dual role--both administrative and instructional--assumed by 10 percent. In the case study colleges, a similar spread was found--one position was professional support, two were predominantly administrative with policy input in areas other than computer operations and instructional Division Chairperson responsibility and two positions were predominantly instructional.

According to the national survey results, computer services are placed within the administrative structure as shown in Figure A, with only 10 percent reporting directly to the President. The chief fiscal officer has the computer center under his/her control in 44 percent of the colleges. In the case study colleges, one reported directly to the President, the other four at the next lower administrative level. Of these, one reported to the Administrative Dean; one, the Financial Dean; two, the Occupational Instruction Dean. One college had an unusual split of responsibility, the instructional head was responsible for computer operations but did not officially supervise the administrative programmer. Rather, the programmer reported to the Business Manager in a staff position.

FIGURE A

The Administrator Over Computer Services

Percent of National Survey Respondents Reporting to Officer Noted

50
40
30
20
10
0

Business Officer	Student Services Officer	Academic Officer	President or CEO	Development or Administrative Officer	Other
44%	21%	13%	10%	6%	6%

CAUSE recently completed an information systems profile of its member institutions (Thomas, 1981). This profile included 11 "small," two-year colleges where small was defined almost identically with this study--that is, colleges with up to 1,999 enrollment. The CAUSE profile of small colleges differed in many respects with results of the national survey conducted for this report. CAUSE reported 18 percent of the heads of computer services reporting to the President, only 9 percent reporting to the Chief Business Officer, and 27 percent reporting to the Chief Academic Officer. Both the small sample size in the CAUSE report and the selective nature of that sample--membership in a "professional association for development, use, and management of information systems in higher education" ... contribute to the differences observed.

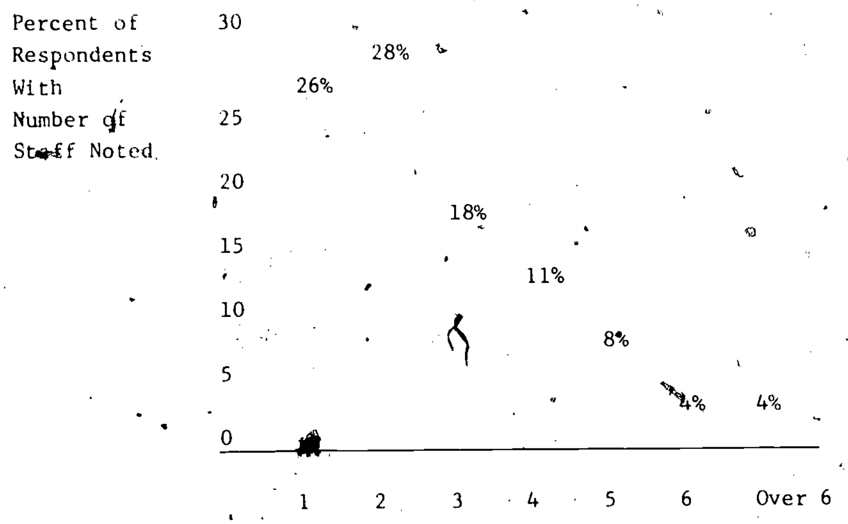
According to our national survey, the role of the head of computer services in policy making runs the gamut of 85 percent that participate in setting policy regarding computer services and 41 percent that participate in setting policy in areas other than computer services to 15 percent that do not even participate in establishing computer services policies. Within the case study colleges, the head of computer services tended to be more influential than the national survey results would indicate. Without regard to whom they reported, they acted with a high degree of autonomy in operating the computer center. In the judgement of the investigators, factors contributing to this include the frequent dual reporting channels which leave the head of computer services more autonomous than over-supervised, the technical nature of the position coupled with the high level of computer illiteracy among other administrators, the atypical personality of the director of computer services as compared to educators, and a proven record of performance in the position.

Staffing patterns naturally vary from college to college but at the same time they reflect the college's commitment to and understanding of computers and information systems. Total staff, including the head of computer services, working directly for that office in any capacity was reported in the national survey as 2.74 average full-time equivalent, varying from one to over six, as shown in Figure B. These are distributed over several different job categories, as shown in Figure C, with data entry operator the most commonly reported position. The CAUSE survey of staffing (Thomas: 1981: 33-40) covered similar but not identical job categories. Data entry was not one of the categories used so it is unclear where this position would have been reported. However, a much larger total staff size of 5.6 was reported by the 11 two-year CAUSE members, once again showing their more than usually supportive role toward information systems.

Small two-year colleges are attempting to operate their computer centers with primarily entry level people--computer and data entry operators, according to the national survey. There are an average of 1.32 operations personnel to .53 analysts/programmers whereas the total CAUSE profile of college and university administrative systems staff showed a slightly higher percentage of analysts/programmers than operations personnel. The investigators postulate a number of reasons for this situation in the small two-year colleges--including low salaries at the colleges, lack of understanding of the needs of data processing professionals, less than recent hardware, deliberate cost cutting strategies, and lack of understanding by the two-year college

FIGURE B

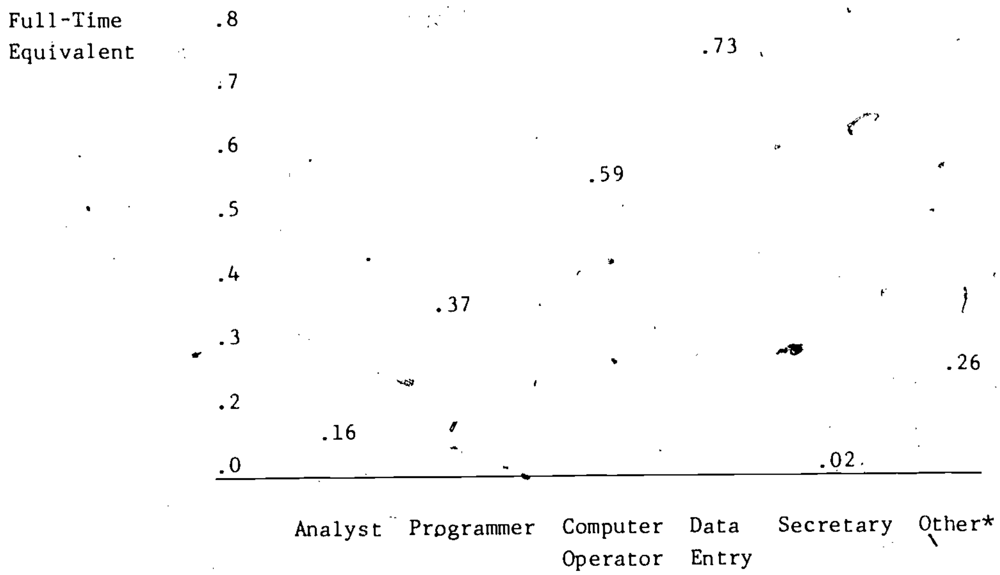
Total Number of Staff in the Small College Computer Center as Reported on the National Survey



Full-Time Equivalent Staff of all Types in the Computer Center

FIGURE C

Number of Full-Time Equivalent Staff in the Small College Computer Center by Specific Job Type



Average Number Reported by Computer Center in the National Survey
(* Instructors, Student Aides, combined positions).

administrators of what improvements analyst/programmers could bring to the systems. The implications include a) the college can anticipate a high turnover rate, b) the college is not likely to fully utilize its computer systems capabilities, c) the need for careful operations documentation is essential, and d) proprietary software packages could improve the viability of the current staffing patterns.

In the case study colleges, the heads of computer services spent only about 25 percent of their time in that role, the rest as instructor or college administrator. The more formally educated directors applied less time to the role than those with less formal education. All five had as many or more analysts or programmers as operations personnel, a ratio similar to the CAUSE profile. Three of the five used student aides as operators, especically data entry ~~operators~~.

The Systems: Hardware and Software

After planning for and procuring a system as described, what hardware and software is the small college likely to have?

Hardware. The national survey of small colleges requested the manufacturer and model of the computer system(s) used, to which 113 colleges responded. In addition, systems were identified as "batch", "on-line", or "both". Figure D depicts the distribution of hardware manufacturers. Some institutions have access to both large mainframes and local capability--all are included. Several items of note are:

- IBM is the major supplier of hardware at 26 percent of those reported, but this includes everything from the IBM 1130 to shared-access to IBM 370's and newer IBM mainframes. The IBM system most frequently identified was the IBM System 34 which accounted for almost 7 percent of all small college systems.

- DEC, with 19 percent of the market, has primarily PDP 11's of various models located at the colleges.

- DEC hardware was identified as part of the main system by only one of the multi-organization systems.

- No other vendors were uniformly distributed nationwide, but were selectively located, usually by state. This is primarily the result of state systems or state regulation. For example, all TI systems reported were in Georgia; all Olivetti's, in North Carolina; all MDS terminals in the South Carolina system.

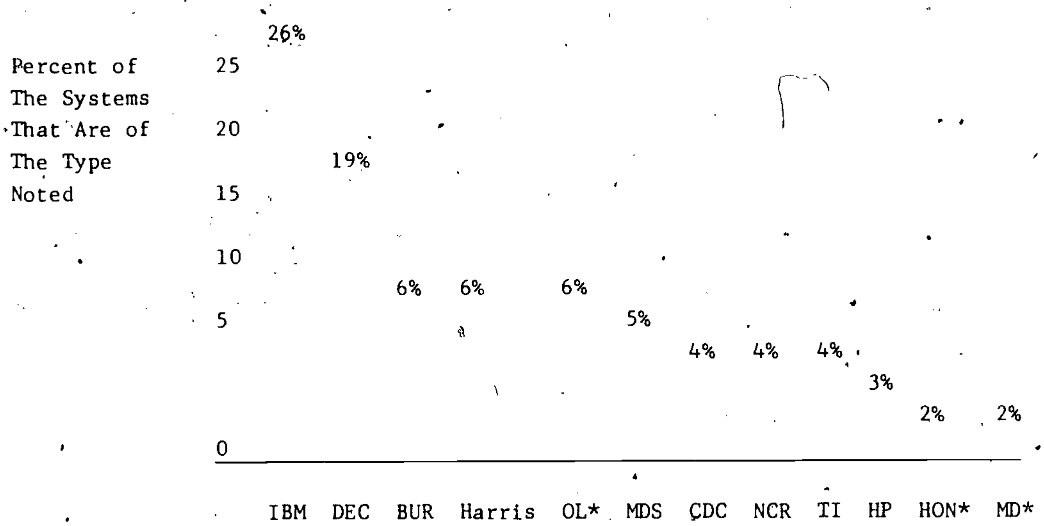
- Use of microcomputers in administrative information systems was being tested at three locations, but this number will increase rapidly.

- State or university systems shared by the small colleges included IBM, HARRIS, CDC, and Amdahl, with IBM systems reported most often.

- At least twenty different hardware manufacturers were represented among the 113 colleges providing this data.

FIGURE D

Types of Computer Systems to Which
Small College Have Access By Manufacturer



Manufacturers Reported with 2 percent or more of the Systems.

Note: Eight other companies were represented, each with less than 2 percent of the market.

(* OL=Olivette A-7, HON=Honeywell, MD=Microdata).

In comparing the results of this survey with other current literature, the following observations were made:

- CAUSE (Thomas: 1981: 89-118), in studying its membership of all different types of institutions, also found IBM the leading supplier with 37 percent and DEC second with 17 percent of the computers reported. DEC computers were reported most often by two-year (21 percent) and small colleges (23 percent), results that are very consistent with this study.

- CAUSE also found that small institutions reported the largest number of systems in the "other" category, ie., not among the top ten, as compared to larger institutions.

In analyzing these results, much consideration was given to the reasons for the large number of vendors represented at only one or two colleges nationwide. Some of the factors that contribute to this are:

- inexperience by small college personnel with computer systems when the choice is being made,

- lack of consideration of applications software in the procurement decision, and

- hardware bid winner selection based primarily on cost with little or no benchmark analysis.

Among the case study colleges, only major manufacturers were represented, with IBM systems at or available to three, DEC PDP 11's at two, and one of them also with a UNIVAC BC7/700 accessing an IBM mainframe. An interesting observation is that this UNIVAC system had recently replaced an IBM System 3 <u>for cost reasons only</u>. Hence, four of the five case study colleges had an inhouse minicomputer only. One had an inhouse minicomputer plus access to a state network system. Four of the five had both on-line and batch capability; one batch only.

Among the total national survey respondents, 34 percent reported batch, 27 percent on-line, and 45 percent have both capabilities (about 6 percent responded to all entries). The Epsilon survey (1981) of all colleges in the NCE Education Directory reported very similar results of 30 percent batch for two-year public colleges; 44 percent, on-line; 22 percent, both. Both studies show that about one-third of two-year colleges, all sizes, are still in the batch processing mode only. This means card or diskette entry without on-line terminals--older hardware. As the case studies show, better use will mean more on-line, interactive systems. This is occuring as hardware is replaced. Since the average number of years the national survey colleges had had their own computer services was almost six years, the 66 percent with on-line capability is most impressive as few could have afforded that capability six years ago. Use of the on-line capability may not yet be very sophisticated, as Epsilon reported (81: 7) that less than 20 percent of two-year colleges admissions offices could conduct "inquiry file maintenance." Observation by the investigators confirms that such capability is only now being developed at many two year colleges.

Software. Of the national survey colleges, 58 percent developed some or all of the applications used. Another 40 percent use applications developed in-state, either by other colleges or state systems; 19 percent purchased applications from the hardware vendor; and 22 percent purchased proprietary packages from software developers. Figure E lists in descending rank order the software sources identified.

FIGURE E

Common Applications Software Sources

Sources

Internal Development
Other Community Colleges In-State
Other Community College Out-of-State
University Systems
State Systems
Hardware Vendors
Proprietary Software

(In descending order of frequency referenced.)

Of the 44 colleges receiving computer services from the state, 75 percent reported using software developed by other in-state sources; only 38 percent had developed part or all of their own software. Software, then, is provided in most cases along with computer access by the state.

Similar results were observed among the case study colleges where the state provided some software assistance in two of five cases. One was a complete state system with software on a central mainframe accessed through the local minicomputer. In the other, the state coordinated financial system development, then provided the software to all state two-year colleges. Two colleges independently sought software--one purchased a proprietary package for student records; one obtained a financial package from another in-state college. Only one of the case study colleges used no software from outside sources, the case study college with the least administrative software available.

An interesting observation regarding software development is that all five case study colleges that had upgraded their hardware in the last few years had completely replaced their applications software at the same time ... none converted software they had on earlier hardware.

None of the case study colleges were yet utilizing true data base systems, except as part of the state system in one case. This is consistent with survey results and observation which indicate that few of the minicomputers used now have data base software available from the hardware vendor and that most of the personnel in small college computer centers do not have data base training. The languages used for in-house software development among the case study colleges were RPG II, COBOL, and BASIC.

Administrative Information Systems

The computer services provided at the national survey colleges were 61 percent administrative and 35 percent instructional, with 4 percent typically in leased services or community service. The functions were rated in priority among the categories specified in Figure F. Student Information Systems, Computer Information Systems Instruction, and Financial Systems were clear priorities. Surprisingly, over half the survey colleges considered instructional support and library systems of such low priority that these items were not ranked at all.

FIGURE F

Computing Priorities in Small Colleges

Priority	Application
1	Student Information Systems
2	Instruction in Computer Information Systems or Data Processing
3	Financial Information Systems
4	Other Administrative Support Systems
5	Instructional Support, including Computer Assisted and Computer Managed Instruction
6	Library Information Systems

The case study colleges had a somewhat different profile. Instructional applications varied from 0 percent on the state network system to a high of 70 to 75 percent in the two colleges for which instruction was the primary purpose of systems procurement. The one college on batch hardware applied 75 percent of its services to administrative applications. Two colleges had major activities in providing outside services--30 percent of computer time at one; 62 percent at another. These services were major factors in financing the systems. Administrative applications, then, at the case study colleges were 25 to 75 percent, for an average of 42 percent.

Major administrative systems (the next section will discuss instructional applications) were subdivided into applications areas that the investigators' experiences indicate are likely applications in the small public two-year college. Major areas were addressed rather than more detailed applications in the interest of survey brevity. Figure G presents the major systems and applications areas, listed by the percentage of survey respondents that have such computer applications available.

FIGURE G

Computerized Applications Available

System/Applications	Percentage of Respondents
Student Information System	
Student Registration and Add/ Drop Processing	80
Admissions Applications and Student Master File	72
Term Grade Analysis of Students (Records/Reports/Mailers)	69
Student Class Schedules/Locater	66
Student Transcript Records (Term or Total)	58
Alumni Records and Followup	25
Graduates Followup	24
Applicant Followup (Recruitment)	22
Dropout Followup	17
Financial Information System	
Payroll	62
Budget	57
Annual W-2's	53
Subsidiary and General Fund Ledgers	50
Encumberances/Accounts Payable	49
Social Security Reporting	48
Cash Receipts	44
Financial Audit Trail	44
Consolidated Balance Sheet	42

Complete Financial Reporting	36
Bank Account/Check Reconciliation	24
<u>Financial Aid Administration</u>	
Grant Recipients and Awards	41
Scholarship Records	32
<u>Academic Information System</u>	
Faculty Grade Distribution Analysis	40
Support for Preparation/Printing of Class Schedule	37
Academic Advisement	34
Catalog Course Records	25
<u>Management and Institutional Research</u>	
Instructor Class Load and Production Analyses	54
Enrollment Statistics--Students/Programs	53
Profiles of Student Characteristics	46
HEGIS Reporting	41
Facilities Utilization Analysis	29
Profiles of Dropouts	23
Program Analyses (and Costs)	13
<u>Auxiliary or Logistics Systems</u>	
Equipment Inventory	43
Facilities Inventory	30
Bookstore Inventory	12
<u>Library System</u>	
All Applications (less than)	10

The case study colleges, as would be expected, had a higher percentage of the applications computerized than the national survey population. While 80 percent of the national survey respondents had computerized the Student Records applications of Admissions, Registration, and Grades, all of the five case study colleges had such applications. Though four of the five colleges had on-line capability, only one had implemented on-line registration.

Also, all five case study colleges had implemented complete financial system reporting whereas only 36 percent of the national survey calleges had complete financial reporting. Again, however, only one case study college had on-line inquiry into these records. However, even the case study colleges had much more sporadic implementation of Academic, Research, Management, Financial Aid, Auxiliary, and Logistics systems than of Student Records or Financial Systems. Various applications from these systems were available though none has all applications considered in these system areas.

The national survey respondents were asked to assess the level of sophistication and completeness of their administrative systems as a whole. Almost 24 percent assessed their systems as an "integrated management information system," with another 25 percent assessing theirs as "comprehensive subsystems." Fully 47 percent considered their systems only "a collection of separate applications."

Though more sophisticated than the typical college in their information systems, the case study colleges all viewed their systems as still evolving--but comprehensive subsystems. One had access to a Management Information System (MIS) provided by the state community college system. One of the five had begun to implement a Data Base Management System with the objective of developing an integrated MIS. Also two or 40 percent already have word processing, with another college having word processing equipment on order. (Word processing was not assessed in the survey.)

The CAUSE Administrative Systems profile (Thomas: 1981: 126-128) ranked eleven independent application areas similar to those of this study, but for all two-year college members of CAUSE regardless of size. The applications distribution identified by CAUSE, though determined differently, was very similar to that of the national survey results; that is, 1) Admissions and Records (includes Student Information and Academic Information), 2) Financial Information, 3) Planning, Management, and Institutional Research, and 4) General Administrative Service. This ranking was found in the CAUSE study for all different college types studied and is consistent with the results of this national survey.

Though there are many different applications packages in use, both the national survey colleges and the case study colleges reported a need to develop or to replace existing software in some areas. Financial Aid Administration Systems lead with 46 percent planning or currently developing. Figure H presents the application areas (not systems) which one-third or more of the national survey colleges plan to upgrade.

FIGURE H

Application Areas Developing or Planning to Develop

Application	Respondents
Financial Aid Grant Records	46%
Graduation Followups	41%
Scholarship Records	42%
Dropout Followups	39%
Library Inventory	39%

Library Circulation	38%
Bookstore Inventory	38%
Applicant (Recruitment)	38%
Alumni Records and Followup	37%
Facility Utilization	34%
Enrollment Analyses	33%
HEGIS Reporting	33%
Facilities Inventory	33%
Library Periodicals	33%

In analyzing the survey results, those colleges classifying their systems as an "integrated MIS" were isolated and studied to see if any characteristics distinguish them from those with less sophisticated systems. Major differences included:

1) The state provides computer services (and software) to 57 percent of the MIS colleges but to only 33 percent of all other colleges. This reinforces the observation made at the case study colleges that strong state involvement, especially in obtaining inhouse minicomputer and software, was very positive.

2) Priorities were very different. Non-MIS colleges accorded instruction in computers and data processing the first priority where as in the MIS colleges, it ranked fourth--after Student Information, Financial Information, and other Administrative Support.

3) Hardware at the non-MIS colleges was not as up-to-date as at the MIS, as over twice as large a percentage of non-MIS colleges still use batch systems.

4) Due to extensive state support not billed at the college level, annual costs for hardware leases and software directly to the colleges were much lower at MIS colleges, though other expenses were about the same.

None of the case study colleges that had upgraded their hardware had converted their major administrative software. The reasons for this varied but included state support by providing some of the new software, dissatisfaction with earlier software, changes in hardware vendors, and the preference of the head of computer services for development rather than conversion. Rather than convert software, they either developed new systems or obtained different software from other sources. Since several years are usually required for implementation of complete software systems, complete information systems software was more a function of the length of time since the college had upgraded hardware than how long the college had possessed computing capability.

A major factor in having more sophisticated information systems at the case study colleges was the level of training, the background, and interests of the head of administrative computing. Though obvious, it is a factor often overlooked in the press to keep costs low at many small colleges, where the head of computing may be assigned only a professional staff position. At colleges with completely state provided information system services including an "integrated MIS" unsophisticated users employ only scattered applications.

Instructional Applications

Instructional applications include:

- Computer information systems or data processing curricula
- Computer literacy instruction, or teaching non-majors how to use and apply the computer,
- Computer assisted instruction (CAI) where the student uses the computer to learn other subjects,
- Computer managed instruction (CMI) where the instructor uses the computer to assist with material preparation and/or records,
- Word-processing instruction, which might also be considered a form of CAI.

Computer services to support any or all of these areas would be considered instructional.

Small two-year college computer centers utilize an average of 35 percent of their time for various instructional applications, according to the national survey. In almost all cases, the small college has only one computer center, which is used both for administrative and instructional purposes. The CAUSE study further comfirmed this, reporting that 90 percent of the two-year colleges studied used the same systems for both instructional and administrative applications. The cases studied showed this is both cost effective and workable.

The national survey results showed that 34 percent of the colleges had career programs in Computer Science or Information Systems with 29 percent having transfer programs. A total of 22 percent plan to add a career program; 23 percent plan to add a transfer program.

In the case study colleges, four provided an instructional program in computer information systems or data processing that used the same inhouse minicomputer as for administrative computing. In all four, the head of the computer center was also responsible for the computer instruction program, teaching at least one course per term.

Computer literacy was not addressed in the national survey but was only in the planning phase or not under consideration at the case study colleges. The investigators have witnessed recent concern for professional development in computer literacy for college personnel at an increasing number of small colleges visited. Such awareness level and user level training of faculty will be provided at most colleges in the near future.

The national survey found about 21 percent of the colleges had CAI in one or more disciplines. Seven separate areas account for most applications. These are listed, rank ordered, in Figure I, which shows math and business, the "traditional" CAI areas to be the leading fields of application, along with computer instruction itself.

FIGURE I

Computer Assisted Instruction
Applied in the Following Disciplines (Rank Ordered)

1. Math
2. Business
2. Computer Instruction
3. Social Science
3. English
4. Physics
4. Engineering Technology

Computer managed instruction (CMI) techniques including test grading, analysis, generation, and maintenance of question data banks were found to be in use at 10 percent of the national survey colleges. Another 25 percent of the colleges would like to add CMI. In the case study colleges, CMI was found at two of the five, though neither had broad based CMI applications.

The CAUSE survey included test scoring and analysis as part of "Other Administrative Applications." Out of 350 institutions, 191 reported this capability but no breakout of institution type nor size was provided.

Word processing was not included in the national survey. However, among the case study colleges, two already had strong word processing instructional programs using terminals on the in-house minicomputer, along with a letter quality printer. A third was in the process of adding word processing both for instructional and administrative applications. Though CAUSE did not specifically assess administrative word processing either, several colleges reported the use of proprietary word processing packages. It is clear that word processing is another area of importance to the small college as the information age continues to develop.

Costs

As was discussed in the Background section, costs are difficult to compare among institutions. However, cost data can present a valuable perspective especially to those colleges new to computers and information systems on campus. The national survey requested the annual budget for computer services, but not data on one-time capital expenditures. The average annual budget for 1980-81 was $59,957 for the 115 survey colleges that provided data. Though almost all reported hardware, personnel and supplies/support costs, only 42 survey colleges reported lease costs and 47 colleges reported software costs. The average hardware and maintenance cost was $24,764 whereas average personnel cost was $30,991. Supplies and support costs were reported as $6,358 per year. These data can be used only very generally in reviewing cost, however.

Among those 44 national survey colleges for which the state provides computer services, there was a dramatic drop in the average annual budget, as might be expected. The average in that case was only $35, 475 with the largest difference being the greatly reduced hardware costs and lower software costs to the college. These expenses are usually borne by the state system.

Among the case study colleges, slightly higher costs were found, as all had in-house system expenses even if state system services were provided. A detailed breakdown of annual computer operations costs of the case study colleges is presented in Figure J. The difficulty in comparing these data is more clearly seen in that Figure. An analysis or interpretation of these data results in an expected annual operating cost of an in-house minicomputer system of $75,000 to $100,000 with about 50 percent of the cost personnel salaries.

The low software costs reported (about $2,000 per year) can be attributed to the tendency of such colleges to develop their own software or to seek software from other sources in state rather than to lease software.

Cost allocation back to user departments is frequently reported for larger institutions. However, only one of five case study colleges allocated any costs back to the user; rather, computer services provides support to all aspects of the college as needed.

The 1980 CAUSE Profile (Thomas: 1981: 54-57) reports a much higher average annual budget for the nine small two-year CAUSE colleges reporting data. The average budget was $195,015 with 53 percent spent on personnel; 35 percent, hardware. Though this was by far the lowest average budget reported for any group of colleges in the CAUSE profile, public or private, it is almost twice that in the case study colleges and is three times the average figure of the over 100 colleges participating in the national survey. The range of costs reported in the national survey was a minimum of $1,000, for hardware only, to $255,000 for total costs. However, only 3 of 115 reported costs as high as those reported in the CAUSE survey.

FIGURE J

Computer Operations Cost Profiles (1980-81)
For Five Case Study Colleges

	College A	College B	College C	College D	College E
Ownership of CPU	Owned	Owned	Owned	Lease	Lease/Purchase
Initial Hardware Cost	$77,000	$83,466	$75,000	Not Applicable	Not Applicable
Capital Outlay:					
For New Purchases	$116,069	$25,000	$2,300	$0	$20,000
Hardware Lease/ Purchase Contract	$0	$0	$0	$21,930	$55,500
Operations:					
Maintenance	$33,375	$21,600	$17,000	Included With HW	$18,500
Software	$1,360		$2,208	Included With HW	$2,384
Personnel	$48,500	$37,000	$37,000	$50,345	$103,000
Benefits	$4,474	$53,000	$6,500	$6,041	$20,000
Personnel Include:					
Administration	Yes	Yes	Yes	Yes	Yes
Instructional	No	Yes	No	No	Yes
Supplies/Services	$8,064	$6,000	$2,900	$1;800	$6,350
Training/Travel	$800	$2,000	$300	$0	$2,400
Total Operations Cost (Not Including Capital Outlays	$96,573	$71,900	$65,908	$68,186	$152,634
Operations As A % of Educational and General Expenditures	6.4	2.5	4.6	Not Available	Not Available

Note: Costs include operation of facility for administrative and instructional use except for College D, which does not have an instructional program. Personnel included varies, as noted above. The state does not charge cost for state provided computer services to the institution for College D, therefore, no cost is identified for those services.

The People: The Educator Versus the Technical Perspective

The people--both users and providers--are the most crucial element in computer services whether instructional support or administrative information systems. As reported in the literature review earlier, numerous authors have discussed the crucial nature of human factors in the success of any information system--whether in industry or education. In fact, Diran (1978: 273-283) documents the total failure of an advanced information system at a large university--due to human factors.

The majority of information needs within the small college can often be met with less than the latest hardware and with unsophisticated software but they can not be met without communication and sharing of responsibility for the objectives among the users and providers of computer services. The provider and the user of computer services, whether educational or administrative information services, have been traditionally people of very different training, with divergant personalities and personal needs, and quite different job objectives. These factors mean that very different perspectives are brought to bear upon the definition, purpose, and priorities of the services provided.

The computer systems professional is often referred to as a 'technician'. As a technician, the typical profile that emerges is of an individual far more interested, and capable, of communicating with hardware and software than people. By training, background, and inclination, computer systems professionals have a higher need for personal growth and a lower need for social interaction than other groups (Couger, Zawacki, and Oppermann: 1979: 2-5). They tend to know less about the overall organization, its procedures, and priorities than do the users.

The user of computer services, on the other hand, is usually not sufficiently knowledgeable technically to understand what is required to accomplish new or modified systems, resulting often in uncertainty or fear of change. Educators especially are more accustomed to verbal communications that lack the precision needed for systems definition and are uncertain and uncomfortable with the potential impact of computer systems on their role and responsibilities. Out of these characteristics that are all too typical of users and providers, there often comes a lack of rapport, poor communication, little trust and a lack of willingness to understand and share responsibility for effective systems.

Since their application of computers is considered exemplary, the case study colleges were analyzed to identify characteristics that lead to effective user-provider communication. These include:

- realistic expectation of computer services by the users,
- user involvement in system design,
- an attitude on the part of the computer staff that their objective is service to the college,
- user responsibility for data validity,
- confidence, developed over time, in the reliability of the computer output by the user,
- a deliberate cultivation of communications among users and providers by one or more key personnel, and
- well defined scheduling procedures for development and production.

However, even those colleges with exemplary computer applications reported some attitudinal and communication problems.

Problems

The most crucial problem area in information systems is human communication, however, there are also other areas of concern in effective implementation of information systems. Initial costs and the 3 to 6 percent of the annual budget needed to sustain operations can still be prohibitive in the small college. However, this is viewed by fewer and fewer colleges as an optional expenditure. State support can remove this as a factor. Among the national survey colleges, 37 percent received part or all of their computer services directly from the state. For these institutions, the average annual cost of computer services was only $35,475, far less than the average for all the survey colleges of $59,957. The case study colleges all cited inadequate funding as a problem resulting in hardware inadequacies at three of the five; and in insufficient personnel at three of the five.

Technical personnel turnover is also a frequent problem area. Though this turnover is typical of any computer center, it is an especially difficult problem for the small college. The average staff size in the small college as reported on the national survey was 2.74 FTE, with no more than one analyst reported, and no more than two programmers at any institution. The loss, then, of even one such person may totally deplete the support staff to an entire area such as finance.

The environment in the computer centers at the case study colleges probably provides more growth opportunities and better working conditions than average, since computer staff turnover was not a major problem as it typically is. The case study colleges identified personnel turnover as more a problem with user personnel than computer staff. The loss of key user personnel through turnover is equally disruptive as the loss of computer staff. This is especially true in the small college where the business office staff or the student records staff may be only two or three people. Rarely do small colleges have complete office procedures manuals or adequately cross-trained office personnel. As a result, much information as to correct use of existing information systems is lost. Also, when the Director of Student Records or the Business Manager change in the small college, there is often a change in priorities, and needs as perceived from the 'top' resulting in changes that impact the information systems.

The case study colleges also cited planning, coordination, and establishment of development priorities as problem areas. These same problems areas--user/provider communications, funding, staff turnover, planning, and determination of priorities--are all frequently documented in the technical literature.

FUTURE DIRECTIONS

What, then, are the future directions in which the small two-year college will travel--directions opened by computing and the new technology, and the undreamed of possibilities that are now feasible? The United States and the Western world are developing into an Information Society. Already 50 percent of the work force in the United States are information workers--about 55 million people (Bauer: 1982: 30). New means of accessing, transmitting, obtaining, or otherwise processing data affect their futures directly. How the leadership of the two-year colleges meets these challenges will be the true determinant of the future of computing in two-year colleges as well as the future of the colleges themselves.

The Technology: New Possibilities

At an ever increasing pace, amazing developments in technology appear and are adapted to instructional applications or impact instruction through administration. These include transistors, integrated circuits on a greater and greater scale, lasers, video disks, microcomputers, telecommunication, voice communications, robotics, touch sensitive screens, micrographics, and electronic mail, to name only a few. The new technology has advanced far beyond the ability of society and of education to apply it effectively--we do not yet fully understand the possibilities that now exist. Developing into and implementing these possibilities will be the thrust of technology for the next few years. According to Calvin H. Holt, vice-president of marketing at Infotecs, "The next five years will be dominated not by new, innovative technology, but by merging or synergistic technology" (Tunison: 1980:

10). The integration of the current and possible hardware with new ideas for office efficiency, communications, instruction, and other means of increased productivity will take time to develop fully. What are the technological changes leading these possibilities?

The microprocessor and the entire industry spawned since 1975, when Altair developed the first micorcomputer, will have the greatest effect on computing technology and its users over the next decade. According to John C. Dvorak (Swaine: 1982: 35) the 'clear cut trends' in microcomputing are:

- multiple processors
- high-performance 8-bit based systems
- fancier output devices
- the talking computer.

Already Intel is reputed to have a microprocessor that can handle a physical memory of 16 megabytes (16 million bytes) and a virtual memory of 1 gigobyte (1 billion bytes) (Computerworld: 1982: 73)--supercomputer capacity. As a result of microprocessor technology, computer graphics is predicted to become one of the major tools for increased office productivity in the 1980's by Hewlett-Packard (Batt: 1982: 24).

The newest chapter in distributed processing is the microcomputer network which became a reality only in 1980 with NESTAR's ability to interconnect up to 65 APPLE microcomputers. Hard disks such as that announced by Corvus, and network software are making this possible. These networks will be used as analytical tools and adjuncts to central data processing. These networks open up access to shared peripherals and data bases as well (Beeler: 1981/82: 58).

Concurrent improvements in communications technology and development of information utilities along with the invasion of millions of homes by microcomputers, have lead to at least 600 accessible on-line data bases (Cox: 1982: ID3) in areas that include everything from medicine, stockmarket data, airline reservations, or libraries to the Sears Roebuck catalog. Also, there are over 1,000 computerized data bases available in science and technology. The shear volume of data is making information inaccessible. As a result new means of dealing with the data are being sought. One concept now in the prototype phase is a "knowledge base" synthesized from the research (Doszkocs, et. al.: 1980).

Benjamin (1982: 17) predicts the "terminal will be as common as the telephone in the office" in the 1990s. As the computer terminal or microcomputer appears on more and more desks, it will become the nerve center of office communications. The complete integration of word processing, facsimile equipment, optical readers, and electronic mail is predicted in the 1990s by many futurists, including Xerox's Benjamin (1982: 11-31) and Pomerantz of Todays Office (1982: 41-47). Tunison (1980: 6-11) predicts a total merger of data processing and word processing in the 1980s. Palizzano of Compu Scan (Tunison: 1980: 6-11) foresees word processing, data processing, communications, and intelligent copies all "tied together" in the 1980s.

Further evidence of the development of "merging" technology is the integration of voice, image, and text via video disk storage and retrieval now predicted by some observors (Pomerantz: 1982: 47). Professor Negroponte of MIT in discussing videodisk technology predicts that in five to ten years there will be advances that now "we can not even imagine" (Needle: 1982: 3). Already the merging of current videodisk and microcomputer technology can produce fantasticaly interactive simulations and scenarios for entertainment or learning. Currently, however, production expenses are almost prohibitivly high, though use costs are already low.

Interest has always been great in voice communication. Voice communication involves both recognition of human speech by the computer and speech synthesis which converts machine data into intelligible synthetic speech. This is viewed by some as the ultimate in a user friendly system. Kornbluh (1982: 41) predicts that although it will only be fair in quality, the use of such equipment will grow substantially even though it is likely to be expensive, and require high maintenance. However, according to Negroponte (Needle: 1982: 6), by July of 1982 a voice-recognition processor had been developed that can recognize a 120 word vocabulary and yet retails for only about $500. A parallel effort is being made to achieve effective touch-sensitive screens as a form of input. IBM's Estridge predicts these will become a major input device (Needle: 1982: 6).

'Merging' technology is also in evidence in the satellite telecommunications field, where data communication, voice communication, facsimile, and teleconferencing are linked as part of an integrated service as Bell and other communications giants enter this field.

Paralleling the hardware developments is the "synergistic" aspect of technology--the development of software that will enable the 'possible' to become reality. How crucial is the software development effort? Accordingly to Xerox's Benjamin (1982: 21) ".... the largest constraint on the success of the Information System function for this decade will be the inability to deliver the software required ...." That is just as true of educational systems--both instructional and administrative as it is of industrial information systems. The constraints on software development are both financial (as will be discussed in the section on economies) and human. A comment by Sir Norman Kipping over a quarter of a century ago applies: "The limits of what can be done are less and less imposed by scientific knowledge, more and more by human psychology" (Instructional Innovator: 1980: 15). Benjamin (1982: 13-15), however, predicts "steady improvement in all aspects of software" due to developments in reusable code, data base systems, structuring methodologies, design languages, and user languages, and the shared use of software packages.

New Economies

The new technology and the demands that result are producing new economies in industry, the offices, and education. The drastic declines in hardware costs for a given performance capability over the past twenty years has become a cliche. According to Sperry's Gehring, "In 1955, it may have cost $50,000 a month to use the latest hardware. Today, those same capabilities cost about $200 per month" (Tunison: Sept/Oct 1980).

Hardware, then, is no longer the major expense in computing, instead, the provision of the service is the major cost--either software or staff or both. As early as 1977, a Datamation survey reported that hardware and maintenance were only 38 percent of the data processing budget, while personnel costs were 52 percent (Kanter: 1977). Surveys as reported earlier in this monograph show that the cost of developing or purchasing software now exceeds the hardware cost. The extent of this shift is perhaps best illustrated by an offer extended by Quodata in June 1982 to give free a computer with an original list price of over $47,000 to any college buying $64,500 in college administration software that would execute on the free computer (Congdon: 1982).

Benjamin (1982: 12-13) predicts this trend will continue. He projects a 30 to 40 percent annual cost/performance increase during the 1980s, as in the 1970s, for both the computer and storage devices, while labor costs are projected to rise at 10 percent per year giving a 1990 salary 2.6 times that of 1980. Currently a typical terminal work station for a large time-sharing system with terminal, a port, a part of a controller, and necessary system software can cost about $7,000 (Madron: 1982: 37). This is 50 to 60 percent of a clerical salary. Benjamin predicts that by 1990 a very powerful terminal will cost only 11 percent of a clerical salary, less than 4 percent of a professional salary. This would only be slightly higher than current telephone costs.

According to C. E. Exley Jr., president of NCR, "Its been estimated that, during the past twenty years, the cost/performance ratio of hardware has improved 10,000 times. Yet the cost/performance ratio of software has improved only sevenfold. The challenge is to use the advances in technology to aid software development, thus bringing the improvement ratios more in line with each other" (Tunison: Sept/Oct 1980: 9).

In computer instruction the cost of software is dramatically higher than hardware. Christopher Dede of the University of Houston (1980: 22) reports that the purchase of a computer is 10 percent of user cost and programs, 90 percent, for educational computing. The cost of providing computer assisted instruction (CAI) is decreasing by 5 percent per year with a 10 percent per year increase in productivity. Dede (1980: 18) further projects that this trend will continue until by 1990 CAI will be three times as productive as it is now at one-half the cost. The increasing cost of teachers in a labor-intensive educational system makes the declining cost of CAI even more attractive as a less expensive way of teaching, in those areas that machines do well.

As data communication increases in importance in the computing field, its costs must also be anticipated. Benjamin (1982: 13) predicts that data communications costs will decline at a rate about equal to inflation.

The economies of information systems in industry are better defined than for education as the dollar value is easier to ascertain in the market place than in the classroom. Colleges, however, are approaching the era projected in 1974 by Richman and Farmer (297) that "Shortly it will be too expensive not to compute, and universities and colleges will join other complex organizations in obtaining all the information they need to operate reasonably efficiently."

Information Systems Directions

The impact to-date of computer based information systems on small colleges has been mixed--enough success to entice top management to move faster and faster toward such systems; enough problems to cause resentment sometimes among key users; and enough capability greatly to relieve work loads at the operational level and make available the most complete, timely operational data that small colleges have ever had.

Despite costs, resistance to change, implementation problems, and only partial success, computer based information systems are as inexorably the wave of the future for small colleges as for large, or as for business and industry. Small colleges are moving more slowly into this technology than many other components of our society; waiting until the technology is tested elsewhere, using their sparse resources for the most effective tools they can afford.

A strong Management Information System can have both positive and negative impact on an institution. Baldridge and Tierney (1979) reported it would tend to:

- increase administration centralization,
- impact the distribution of power within an organization,
- increase departmental distrust,
- improve quality of data available,
- speed information flow and problem solving,
- facilitate special problem analyses, and
- impact departmental spending patterns.

Faith in such systems for the future abounds, as recorded by Cheit and Plourde when quoted by Lawrence and Service (1977: 67-68), and by Baldridge and Tierney (1979) who stated: "We feel very strongly that adequate data and good management information systems are invaluable aids to decision making." Eickoff (Schouest and Thomas: 1978) stated it most emphatically: "The development of an adequate MIS for your institution may be the most critical effort your college can mount in the forseeable future."

In trade journal articles too numerous to cite and at educational conferences such as a CAUSE conference at which Plourde spoke (Schouest and Thomas: 1978), the future clearly lies with on-line, interactive systems, using distributed network concepts. At a small college this could mean an in-house minicomputer with terminals, intelligent terminals--a mini or several microcomputers--interfaced to a large centralized system off-campus or microcomputers around campus connected on a local network. Local computing terminals with large system network capability hold perhaps the most promise where there is a state computing network designed to serve all state community colleges (this too is a wave of the future). This option provides local, autonomous computing, with access to the power of a large mainframe and state-wide communication capability.

Colleges will not be far behind industry in merging word-processing and data processing and using electronic mail. On-campus electronic mail at universities is now common and multi-university electronic mail systems are now being developed.

Data base management systems and proprietary software packages will be more and more in use both in industry and in small colleges. Rudimentary data base systems are already available for microcomputers. However, in a study reported by Martin (1982: 7) only one-third of fifteen large companies in government sites reported using data base technology for over 20 percent of their application needs.

These packages are part of the effort to overcome the limiting factor in bringing information systems to the small campus--personnel. Eichorn noted (Tunison: May/June 1980: 6-11) that the lack of qualified personnel, both at the company or institution and at the vendor will be the limiting factor in implementing advanced systems such as integrated word and data processing. Tunison also noted (Sept/Oct 1980: 9) that many small systems users, (which would include small colleges) will not be able to develop their own software, as the shortage of trained software development personnel is expected to get worse. Purchase of software will be far more economical.

As the computer terminal and information systems permeate industry, "end user" computing, that is use of the computer directly by office staff, administrators, and others to format output, extract information etc. without programming assistance, is projected to continue to grow from its current level in industry of 40 percent of processor demand to 75 percent by 1990 (Benjamin: 1982: 17). Currently end user computing is only a small part of computing in colleges, with the growth beginning, but anticipated to be at a rate at least as great as that of industry. This will be made possible by access to the hardware, newer "user friendly" software, including tools for data base access, and more computer literate users.

Conceptually, as more experience is gained in industry and in larger institutions, the use of planning and prediction models and other quantitative models can be exptected to increase in small colleges. The impact of the computer can thus slowly move upward from the operational level to impact top management (Glenny et. al.: 1976) (Lawrence and Service: 1977: 64-77). But will this happen? There is a disparity of opinion on the impact of MIS's on management personnel in industry. Kanter (1977) reports two extreme positions ... one that MIS will permit higher level management to control a greater part of the business and another that is skeptical, believing that MIS can do little to nothing to motivate and direct workers. To-date, MIS has had only a slight impact on the planning and decision making processes, even in industry, but have been effective at the transactional and control levels. Kanter identified six elements in the decision process ... 1) identify areas of improvement, 2) analyze these areas, 3) develop alternative solutions, 4) evaluate them, 5) make the decision, and 6) implement the decision. The MIS has played a prominent role only in implementing the decision, due to factors that include the external and generally unstructured nature of the data required, lack of understanding of management techniques by managers, and the use of intuition rather than information by many decision makers. The status of MIS can be put in perspective with this antidote by David Gerrold (1982: 12-13) about a friend of his.

> He told me that he takes his computer with him everywhere he goes. He says that he has the official United States Government five-cent computer. It's a nickel. And every time he has to make a decision, and he gets stumped, he flips the coin.
>
> Sounds pretty stupid, doesn't it? Letting a coin make your decisions for you? That's what I said.
>
> "Oh," said my friend, "I don't do what the coin says. I just look and see if the result makes me happy or sad. Then I know what it is I really want to do." He grinned, "I do the same thing with all that information that churns out of the computers at work. They don't tell me what to do. They just clarify the options so I can be more responsible in choosing what I want to do. That's all.

Information systems, then, can be expected to have their major impact at the transactional and control levels in the small college for some years. Only as top management becomes more knowledgeable in using sophisticated planning and decision support tools can information systems effectively impact the decision making process; yet this will lag industry by a computing "generation".

Instructional Directions

"The last technology to help education significantly was the invention of the printing press in the late 1400s" (Heuston: 1982: 17). Heuston goes on to point out that a book transmits information across distance and time without the personal availability of the author. Computers do this and more. Thus use of computers can generate productive benefits for teachers who use them that will make teaching without them uncompetitive in cost and performance. Computers, like books, can replicate the excellence of top teachers; can reproduce information accurately.

In our current educational system, the average elementary school teacher provides only one or two minutes per day of individual instruction per student (Heuston: 1982: 2). An almost total lack of individualized instruction results then, whether the delivery medium is books, television, movies, or the classroom teacher. Computers, however, offer as their key instructional advantage the ability to be interactive--to give immediate, individual feedback to every learner. Computers are a way to make learning more efficient, not to replace but to augment a good teacher. Their pervasiveness in our society already leaves no doubt that they are an essential part of the education process, both as a tool and an object of instruction.

Jerry Brown, Governor of California, has already defined a new literacy based on the three C's rather than the three R's (Mace: 1982: 30). The new era is that of "communicating, calculating, and computing". The evidence of computing in the classroom assaults us on all sides, from journals, computer stores, sales pleople, parent groups, teachers, and students. The assault includes the extremes ... the "arcademics" concept of games for education, the naive assumption that applying computers in the classroom is a quick and easy "add-on" and will solve all learning problems. In the euphoria over this fancy new tool, many mistakes will be made in application ... using the computer when the real experience is possible, using the computer as a substitute for a teacher, using the computer for its "game appeal", using the computer for that which it does not do well such as teaching imagination or creativity.

But out of this over-enthusiasm by some, and out of the skepticism and fears of others, over the next few years, a powerful, effective tool for more effective learning will be developed.

Instructional applications for computer assisted instruction are already very effective in drill and practice such as that used in lower grades, remediation, and beginning new materials. Tutorials, that not only drill, but individually teach are becoming more and more available in purchased software; however, these take more time to develop than simple drill and practice. Gaming and simulations are proving effective, and will be expanded, for instruction both in business and science. Access to some of the thousands of data bases will enable modeling to be more and more realistic. Simulations in the medical training field, including nursing, and a variety of technological fields will be expanded rapidly through the merger of data base access, video disk, and microcomputers. Sound generation and computing has already become so inexpensive that instruction in music can be effectively done at all levels of education. Voice generators are already being used widely for instruction of some types of handicapped individuals, especially blind people. Experimentation with all these new tools will abound, some part of it, perhaps small, will persist and change the way we teach.

In addition to teaching with the computer as a tool as just discussed, the ubiquitous nature of the computer means that learning about the computer will be as essential as learning to drive or use the phone. Already, there are computer worlds, computer camps, a computer town, computer arcades, computers for kids, computers in libraries, computers in museums, and even computers in schools on which children and adults learn about computers. The local PTA's help sponsor bake sales and computer fairs to raise money for hardware. The two-year college is far behind in this headlong race into computer technology. In only a few areas are two-year colleges leading elementary and secondary schools into instruction in computer literacy. This is a major growth area for the two-year college, one it must tackle soon or lose to other sources of education. Development of effective computer literacy programs aimed at all college students, and at the general public, and the development of the status as a leader in the community in this area is a major challenge for the two-year college over the next few years.

Another major component of the computer in education is that of instruction of computer scientists or computer programmers. Two-year colleges must constantly update and revise their instructional programs in computing to keep them current. One of the major criticism of computer education programs by industry is that they are outdated, and lack instruction in applied areas. Two-year colleges then face a real challenge to maintain adequate hardware, and a viable curriculum. Most of all, they face an enormous challenge in keeping top instructors in the field, since salaries are uncompetitive. Even universities can not get nor keep top quality instructors in the computer field. To address these problems, two-year colleges must work with industry to offer training in the use of computers that meets the needs of industry.

The computer as an instructional management tool is also becoming increasingly popular. Integrated with a computer assisted instruction program, and in the right hands, computer managed teaching and diagnosis can become a powerful total instructional program. This integrated concept, however, requires more sophisticated hardware, software, and especially more sophisticated users than do individual applications. Widespread, effective use will take several more years.

Another major educational direction, especially in the technical college, is the use of the computer as a tool--for computer aided design, automobile diagnosis, drafting, and others. Introduction of such automated tools must parallel that in industry; a significant lag will mean declining jobs for graduates of out-of-date programs and less enrollment. This is a phenomena that many colleges are now experiencing. Therefore, achieving technologically adequate instructional hardware and upgrading the faculty are major challenges confronting the two-year college.

Realistically, with an increasing average age of faculty, and low turnover, these instructional directions will be achieved much more slowly than is technologically possible. In fact, faculty fear of computing and reluctance to change is a major issue with which all two-year colleges must deal. Some may not change in time, but others are even now leading the way to using the best of the past, the knowledge gained from centuries of experience, combined with the latest in computing technology to produce a new era in education--one where the learner is far more in control.

IMPLICATIONS FROM THE STUDY

There are, then, a number of implications for the small college president in considering the role of computers and information systems in his/her college. Some of these have been extracted from the monograph and given below.

Policy Implications

1) Planning for computer hardware procurement and information systems development is essential.

2) Written plans are preferable, using a three to five year period, with input on both administrative and instructional needs.

3) Placement of computer services and information systems within the organizational structure is a key **issue,** with a long-term impact potential on the power-structure of an organization.

4) State offices often play a major role in planning, procurement, and software development. This relationship should be considered in any policies established.

5) Computer services compete with other institutional services for scarce dollars--costing 2 percent to 6 percent per year of the total budget.

6) A method for assigning priorities for accomplishing the computing needed must be developed, both academic and instructional. (This usually closely follows the thinking of the college President.)

7) State provided computing services often greatly reduce the cost to the college of having computing power available though there is far less control over computing resources by the college.

8) Microcomputer proliferation on campus is already becoming a major issue. Who decides if microcomputers can be purchased and how they will be controlled are subjects of controversy. Colleges have neglected this crucial policy area.

Hardware Implications

1) More and more, computing will be on-campus, interactive, and on-line, using either a minicomputer, microcomputer, or both.

2) Most small colleges use the same hardware for both instructional and administrative purposes.

3) Two vendors, IBM and DEC, account for almost 50 percent of all minicomputers in small colleges.

4) Consultant assistance is usually necessary in the small college in the needs assessment and hardware procurement phases, to obtain the necessary level of expertise in these specialized areas.

5) Annual computing costs are far more a factor than initial hardware costs in making computing decisions, as over 50 percent of the typical computing budget is for personnel.

6) Careful analysis is needed to determine whether to lease, lease/purchase, or buy hardware initially, based upon individual factors.

7) Small colleges are now using only 35 percent of their computing time for instruction, a figure which is likely to grow rapidly.

Software Implications

1) The decision to develop new software, upgrade software, buy software, or seek in-state software from another college has a long-range impact on administrative computing and on total software costs.

2) Though internal development of software has been the most popular choice, it is also the most expensive method of obtaining software.

3) The most sophisticated software is usually found when the state takes an active role in providing computer services or software.

4) Adequate documentation of software, especially operations documentation, is essential as a partial safeguard against staff turnover.

5) Software is also a crucial issue in using the computer as an instructional tool.

Personnel Implications

1) In an effort to keep down costs, small colleges often understaff the position of head of computing. This results in less effective computing, especially if software development is underway.

2) An effective head of computing will typically have extensive formal education, experience outside education in computing, management experience, and the ability to deal with both educators and technical staff and will be in a salary range beyond that of comparably educated staff in other areas.

3) Communications between users and computer center staff are an essential area, frought with miscommunications and misinterpretations.

4) User preparation, education, and involvement in administrative systems development and implementation is essential.

5) Users, if afraid, dissatisfied, or otherwise displeased, can totally destory the usefulness of any system.

Additional Issues

1) Evaluation is a necessary part of offering effective computer services. Both internal and external evaluations are needed.

2) External computing evaluations should be conducted annually by an objective consultant.

3) Evaluation should include a review of security procedures used to assure data integrity, software protection, and hardware protection.

4) All software and data files must be "backed-up" (copied) regularly and copies retained in a secure area.

5) Data integrity, validity, and access are key issues in any information system. Procedures to assure valid data must be developed, with both user and computer center input.

6) Computer literacy is already an essential education element--for faculty, students, staff, and administrators, including college presidents.

7) Pressures from secondary schools, businesses, and the community along with the tremendous educational potential, make the use of the computer in the classroom a step that must be taken--now.

8) The computing capability on campus is an effective part of a college image, but more image potential exists in effective applications of that capability.

REFERENCES

Adams, Carl R., Theodore E. Kellog, and Roger G. Schroeder. 1976. "Decision Making and Information Systems in Colleges." The Journal of Higher Education, XLVII(1): 33-49, Jan/Feb.

Amadio, Michael A. 1980. "Breaking the Software Bottleneck." ICP Interface Data Processing Management. 2 (2): 27-33, Summer.

American Association of Community and Junior Colleges (AACJC). 1980. "Community, Junior, and Technical College Directory."

Baldridge, J. Victor and Michael L. Tierney. 1979. New Approaches to Management. San Francisco, CA: Jossey-Bass.

Batt, Robert. 1982. "Graphics Touted as Major Productivity Tool." COMPUTERWORLD. 214, January 18.

Bauer, Walter F. 1982. "Will the New Information Society Grow in Wisdom?" MIS Week. 30, July 14.

Bearley, William L. 1978. Why Systems Fail. ERIC Document ED 167 117).

Beeler, Jeffry. 1981. "Micronets." COMPUTERWORLD. XVI(1): 56-58, December 28, 1981/January 4, 1982.

Benjamin, Robert I. 1982. "Information Technology in the 1990s": A Long Range Planning Scenario." MIS Quarterly. 6(2): 11-31, June.

Best, John W. 1977. Research in Education. (3rd ed.) Englewood Cliffs, NJ: Prentice-Hall.

COMPUTERWORLD. 1982. "Micro Runs Faster." (Author Not Identified). 73, March 22.

Congdon, Myron E. 1982. Letter to College Presidents. QUODATA. June 8.

Couger, J. Daniel, Robert A. Zaroacki and Edward B. Oppermann. 1979. "Motivation Levels for Directors of University Computer Centers vs Those of Their Employees." EDUCOM Bulletin 12 (4): 2-8, Winter.

Cox, Terry. 1982. "Personal Computers Leave the Nest." COMPUTERWORLD. In-Depth 1-3, May 3.

Dearden, John. 1964. "Can Management Information Be Automated?" Harvard Business Review, March/April, 34-44.

Dede, Christopher J. 1980. "Educational Technology: The Next Ten Years." Instructional Innovator. 25(3), 17-23.

Diran, Kevin M. 1978. "Management Information Systems: The Human Factor." Journal of Higher Education. 49 (3): 273-283.

Doszkocs, James T., Barbara A. Rapp and Harold M. Schoolman. 1980. "Automated Information Retrieval in Science and Technology." Science. Vol. 280: 25-30, April 4.

Epsilon Data Management, Inc. 1981. "Results of the 1980 Epsilon Survey of College and University Admissions Practices." Epsilon.

French, Nancy. 1982. "University Students Must Buy a Computer." INFOWORLD. 4(47): 21, November 29.

Gerrold, David. 1982. "Science-Fiction Authors Reappraise Role of Computers." INFOWORLD. 4(26): 12-13, July 5.

Glenny, Lyman A., John Shae, Janet Ruyle, and Dathryn Freschi. 1976. Presidents Confront Reality: From Edifice Complex to University Without Walls. San Francisco, CA: Jossey-Bass.

Hamblen, John W. and Carolyn P. Landis (editors). 1980. The Fourth Inventory of Computers in Higher Education; An Interpretive Report. Boulder, CO: Westview Press.

Heuston, Dustin H. 1982. "Training, Technology, and the Educational Delivery System." WICAT Inc. (Undated).

Instructional Innovator. 1980. "Trends for the Future." 25(3), 14-16.

International Business Machines (IBM). 1980. "Computers in the Mainstream of Education." Viewpoint. 8 (5): September/ October.

Johnson, Robert D. and Thomas M. Gunther. 1980. "Evaluating Computer Systems Financing Alternatives for Educational Organizations." AEDS. 13 (4): 249-259, Summer.

Kaimann, Richard A. and Robert W. Marker. 1967. Educational Data Processing: New Dimensions and Prospects. Boston, MA: Houghton-Mifflin Co.

Kanter, Jerome. 1977. Management-Oriented Management Information Systems. (2nd ed.) Englewood Cliffs, NJ: Prentice-Hall.

Kehl, W. B. (ed.). 1979. "Profiles on Academic Computing." Corvallis, OR: Seminars for Academic Computing, Oregon State University.

Keller, Arnold E. 1980. "1980 DP Salaries Report." INFOSYSTEMS. 27 (6): 42-54, June.

Kornbluh, Marvin. 1982. "The Electronic Office How It Will Change the Way You Work." The Futurist. XVI(3): 37-42, June.

Lawrence, G. Ben and Allen L. Service (ed.). 1977. "Quantitative Approaches to Higher Education Management." Washington, DC: ERIC/Higher Education Research Report No. 4.

Lucas, Henry C. 1976. Why Information Systems Fail. New York, NY: Columbia University Press.

Mace, Scott. 1982. "CA Considers Technological Education Program." INFOWORLD. 4(26): 30-31, July 5.

Madron, Thomas Wm. 1982. "Micros on Campus." Microcomputing. VI(9): 36-37, September.

Martin, E. W. 1982. "Critical Success Factors of Chief MIS/DP Executives." MIS Quarterly. 6(2): 1-9, June.

Meyer, Donald P. 1973. "Yes, We Have No Computer." The Community and Junior College Journal. 43(9): 18-19, June/July.

Mosmann, Charles. 1973. Academic Computers in Service: Effective Uses for Higher Education. San Francisco, CA: Jossey-Bass.

Needle, David. 1982. "MIT Forum Assesses Future of P. C." INFOWORLD. 4(26): 3-6, July 5.

Pomerantz, David. 1982. "Electronic Mail: A New Medium of the Message." Today's Office. 17(3): 41-47, August.

Richman, Barry M. and Richard N. Farmer. 1974. Leadership, Goals, and Power in Higher Education. San Francisco, CA: Jossey-Bass.

Robbins, Martin D., William S. Dorn, and John E. Skelton. 1975. Who Runs the Computer? Strategies for the Management of Computers in Higher Education. Boulder, CO: Westview Press.

Ryland, Jan N. and Charles R. Thomas (ed.). 1975. Higher Education Information Systems: The Challenge of Change. Boulder, CO: CAUSE, December. (ERIC Document ED 119 673).

Schoderbek, Peter R. (ed.). 1971. Management Systems. (2nd ed.) New York, NY: John Wiley and Sons, Inc.

Schouest, Michael E. and Charles R. Thomas (ed.). 1978. Development, Use and Management of Information Systems in Higher Education. Boulder, CO: CAUSE, December 1978. (ERIC Document ED 171 228).

80

Smith, Bruce H. 1980. "Developing a Management Information System Implementation Plan Which Utilized Feedback Techniques to Gain Human Acceptance." Ft. Lauderdale, FL: Nova University (MARP).

St. John, Edward P. 1979. "MIS Development in Higher Education: A Framework for Systems Planning." San Diego, CA: AIR Forum Paper, May 1979. ERIC Document ED 171 348).

Sullivan, Kenneth M. 1980. "Does Distributed Processing Pay Off? DATAMATION. 26 (9): September.

Swaine, Michael. 1982. "The State of Microcomputing." INFOWORLD. 4 (26): 35-45, July.

Thomas, Charles R. 1981. Administrative Information Systems: The 1980 Profile. Boulder, CO: CAUSE Publications.

Tunison, Eileen F. 1980. " The Computer: The Newest Member of the Information Management Team." Corporate Systems. 5(5): 6-10, September/October.

Tunison, Eileen E. 1980. "Word-Processing: Predicting the Future." Corporate Systems. 5(3): 6-11, May/June.

Van Dalen, Deobald B. 1966. Understanding Educational Research, An Introduction. New York: McGraw-Hill.

Walsh, Janet. 1982. "The Eyes Have It." CCN. 3(1): 32-33, September/October.

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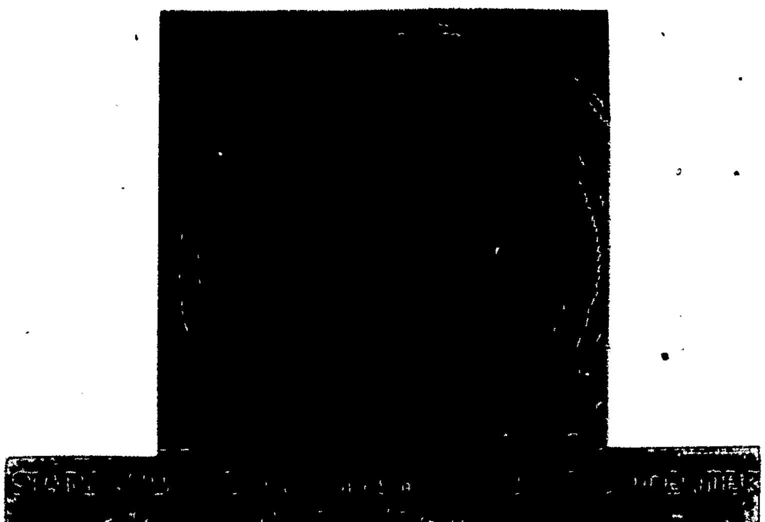

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