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An exploratory pilot study of the development and utilization of computer assisted management information systems in public higher education

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by

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I. INTRODUCTION

A. Background

During the 1950's and 1960's colleges and universities grew rapidly in enrollment, programs, budget, and complexity. As both fiscal and physical elements expanded during this growth period, so also did management demands upon administrators. At the close of the 1960's, resources became less easily available and a recognized need for more effective planning became apparent. Hamelman (10) noted in 1972 that the evidence suggested that higher education was not prepared to deal with or even anticipate such a turn-around in facing scarce resource conditions.

The financial support of higher education continues to be a major political issue. Although little disagreement exists about the facts of financial crisis, there is disagreement about how to deal with it. Historically, all administrators had to do was to ask for additional funding to solve financial woes, and the problem was resolved.

Recent trends, however, show fierce competition for limited public dollars and the issue has become one of not more financing, but better utilization of what there is. College and university administrators have consequently recognized the need for techniques of dealing with unpopular financial decisions and of better planning by obtaining comprehensive data when it is needed to assist them in selecting among alternatives.

Two types of stress are placed upon administrators and managers in higher education. The first is composed of those elements external to the institution which bear upon curriculum, costs, personnel, and other resources. Most external factors are unpredictable and can only be monitored. Included are such variables as inflation, changing student demands and new

technology.

The second category, internal variables, are at least somewhat manageable. Needed for "good" management are requirements for "hard" data that will permit internal analysis (unit costs, student flow, budget control), external analysis (market analysis), and the capacity for satisfying external reporting requirements to state and federal agencies.

To efficiently manage internal variables and to effectively deal with planning needs characterized by the expanding complexity and diversification of services creates a crucial need to analyze the current status of an institution and to better predict the future. Both situations require the availability of selected, appropriate information. Such information is generally in existence, but rarely in a format or central location for suitable retrieval and use.

Systematic long and short term planning does not appear to have been a typical strength of college administrators in the past. Such planning requires not only management skill and motivation, but also a great variety of complex and interrelated information from every segment of the institution. The information must not only be accessible, it must also be available at a suitable level of generalization, at the proper time, and in an appropriate format to enhance improved decision-making. Educational administrators have recognized the potential for improved planning and managing through the use of computer assisted management information systems (CA MIS) as one approach to the planning and problem solving dilemma. The need for improved techniques in planning and management has been highlighted by both of the internal and external types of forces described previously, by recognition of institutional inefficiencies in the use of material and human

resources, the voice of the public demanding budget justification in a period of economic depression in higher education, and continuing competition for scarce fund resources.

Generally, the development of CA MIS has resulted from, or been initiated by, some particular lack of data or information caused by the development of conceptually unrelated (segmented) subsystems which are internally incompatible within the institution. Development of CA MIS essentially takes on a different approach resulting in a totally compatible institutional system built from a master plan.

To fulfill institutional planning and management requirements, the literature indicates that a CA MIS must ideally satisfy three basic needs:

1. It must provide reliable, accurate, and timely information about day-to-day operations for administrators.
2. It must possess a capability to support both long and short term planning activities.
3. It must have a reporting capability for state and federal agencies, governing boards, top management, the faculty and other parties.

Basically, a CA MIS operates within the framework of an institution's organizational structure. This structure is composed of various decision levels which determine the flow of decisions and communication channels.

For a computer assisted management information system to be truly effective, according to Systems Dimensions Limited (32), it must fit within a well-defined planning framework which operates from a set of goals and objectives and by strategies designed to achieve those goals.

No CA MIS can achieve miracles, nor can it be a substitute for

decision-making, yet it may offer a modern tool for administrative use. To facilitate higher education decision-making, CA MIS have been and are being developed within today's educational environments.

For purposes of clarifying the discussion, the following are basic components or features of typical computer assisted management information systems as expressed by Heterick (13).

1. A data base management system to facilitate the creation and maintenance of data files, to provide access to those files, and to create various inquiry and application programs.
2. A data administrator who is responsible for control, organization, integrity, and security of the data base.
3. An inquiry capability that allows users to discover the status of important indicators stored in the data base. This implies that data retrieval can be handled easily and quickly, and that sophisticated programming ability is not needed by the user.
4. Application programs that include complex computer programs invoked by the user to obtain regular and/or demand analytical reports concerning his operation.
5. A computer system to support the information system. Required are capacity for large volumes of processor storage, and rapid calculation and data transmission capability.
6. A communications facility to extend the services to locations remote from the computer itself.
7. Security which will limit access to information only to those who can create, update, or retrieve data to maintain privacy and avoid misuse.

8. Integrity to insure that the data provided to the computer storage unit will remain intact as supplied by the data source.

B. The Problem

One of the issues confronting administrators and managers in public higher education is the dilemma of how to make better management decisions concerning the use and allocation of limited or scarce resources. This problem may partially be resolved through the use of new management and decision-making methods and techniques. The computer assisted management information system (CA MIS) is one of the newer developments available to those involved in planning and managing in higher education institutions. The inherent value of CA MIS is its capacity to provide timely and pertinent information to its users, and in a format that lends assistance to the decision-making process.

The problem facing college and university administrators is not, however, a simple one of whether or not to adopt a CA MIS. The more perplexing issue is one of identifying and evaluating the many issues and problems of CA MIS development and use as it relates to report generation and analysis of progress toward institutional objectives.

Generation of accurate, timely, and appropriate reports is one contribution that a CA MIS can provide to the decision-making team. The information provided by the CA MIS provides an initial step toward inter-institutional comparison. Without such analysis and comparison, no institution can fully measure how efficient and effective it is with its educational programming.

C. Purpose of the Study

This pilot study was designed to examine a number of the important factors related to the development and utilization of existing CA MIS operated by public, four-year colleges and universities. Readings in the literature indicate that a variety of such systems or approaches have been created for the use of college officials. However, few of the writers present more than how the systems are being used or how institutional operations have been affected. It was therefore considered important to analyze the development processes, time requirements, problems encountered, resource committments needed, and other factors that are essential to consider in making the decision whether or not to adopt a CA MIS for a college organization.

The findings of this research will help answer a number of questions and concerns that could and should be raised by an institution in its attempt to improve its planning and decision-making processes as they relate to computer assisted management information systems.

D. Parameters of the Study

This research was limited to an investigation of a number of elements related to the development and use of computer assisted management systems (CA MIS). The population consisted of public, four-year, baccalaureate-degree granting colleges and universities in the United States. Private institutions and other public colleges were excluded from the study. Only those institutions which operated existing CA MIS were included. Colleges and universities were selected for inclusion from information available in

the Education Directory (35).

An additional limitation for the study was the exclusion of any attempt to evaluate which, if any, CA MIS was superior to any other, or which would be a "best" model to adopt.

E. Assumptions

It was necessary to establish several assumptions in order to limit the scope of the research. These statements reflect several conditions that the study would thus not examine. The assumptions include:

1. Rational models and techniques for decision-making in higher education are superior to intuitive, irrational, and informal decision-making.
2. Decision-making in higher education must become more scientific, data defensible, and accountable.
3. Computer assisted management information systems are essential for higher education decision-making to become more rational, scientific, data defensible, and accountable.
4. Rationally-based decisions and plans will be more acceptable and beneficial to those affected than uninformed and arbitrary ones.
5. Educational outcomes may be defined in acceptable measurement terms as a benchmark for judging the success of management decisions in higher education.

F. Definition of Terms

1. Management: The process of determining how the organization should operate in relation to its structure and efficiency toward achieving its goals and objectives; basic functions include planning, organizing, directing, controlling, evaluating, and budgeting.
2. Planning: The systematic analysis of future events in relation to organizational operations. Important is the view toward allocation of resources to best satisfy the aims and objectives of the institution.
3. Evaluation: The assessment of activities with the objective of improving operational efficienty.
4. Budgeting: The assignment of specific resources to operating units with the aim of satisfying line item needs while striving to reach college goals.
5. Computer Assisted Management Information System: A communications network with computer augmentation that acquires, retrieves, and processes data and which provides managers with information needed for planning and decision-making.
6. Data: A set of characters or signals to which some meaning or significance can be assigned.
7. Information: Selected data that have been processed to make them meaningful and useful.
8. System: An assemblage of objects united by some form of regular inter-action or inter-dependence and which serves a common purpose.

G. Summary

Chapter One has set the stage for this study by presenting a general background overview of computer assisted management information systems and the role they can play in assisting college and university administrators in their decision-making processes. The second chapter will be a discussion of the review of the literature. The methodology for conducting the study is presented in the third chapter. The fourth chapter will include the findings of the research while the fifth chapter discusses the data collected, limitations, and suggestions for further study. The final chapter will summarize the findings of the research.

II. REVIEW OF LITERATURE

The review of literature for this study will introduce the computer assisted management information systems (CA MIS), the conceptual basis upon which a CA MIS is established, the historical origins of CA MIS, the rationale and feasibility of using CA MIS, and a discussion of the development and design features of CA MIS applications.

Sections in this chapter include:

A. Introduction

B. Historical Perspective

C. Systems, Models, and Programs

D. CA MIS Application in Higher Education

E. The Feasibility of CA MIS

F. The Typology of Information

G. Development and Design of CA MIS

H. Summary

A. Introduction

A study of the development of computer assisted management information systems (CA MIS) requires, as a starting point, an introduction to the theory of organizations in order to grasp the broader implications for information systems. Keller (18) summarized the nature of colleges and universities by reflecting that institutions of higher education are organized for a purpose. In that context, he relates that reaching or attaining that purpose implies that some type of objectives are achieved,

In specifying the objectives needed to attain its purpose (or mission), a need exists for the institution to see how it perceives the role it should fulfill.

Four conceptions of the modern institution of higher education are commonly held. The first is that they exist to serve the four functions of preservation of knowledge, transmission of knowledge, augmentation of the stock of knowledge, and application of knowledge. Another view is that colleges and universities are service oriented and should be responsive to the demands of the consumer--both student and public--and subsequently they should be giant smorgasbords available at the beck and call of their constituency.

A third view is that universities should be producers of capital goods, human capital, that is, and therefore a sound, planned contribution is needed to develop the societal environment economically. The fourth, and most traditional view, is that colleges and universities are a source of instruction, and concurrently conduct other primary functions such as research and public service. Regardless of the viewpoint accepted as to why colleges and universities exist, they must be operated and managed by someone, somehow, to produce desired results in pursuit of their purpose or mission.

According to Baughman (4), the medieval counterpart of our college of today was a relatively independent, highly mobile, relatively democratic (political) corporation.

> "In general, universities were self-governing, having their own civil courts as well as rules and regulations, and existed as a privileged, intellectual aristocracy. The dependency on privilege and support dictated the need for organizational recognition of

> the source of the support, but in no case was there the expectation of the "corporation" abdicating the right of self-management to this source. This principle of university autonomy is generally defended in terms of academic freedom."
>
> "Internally, faculty, students, administrators, and trustees represent a pluralistic polity with vested interests and rights to self-management. Externally, the university faces numerous groups with vested interests in specific activities of the university."

Thus, university problems are essentially problems in social relations that can be resolved through political action.

Immegard and Pilecki (16) discuss Easton's model of political process systems theory. Essentially, Easton's theory proposes that political policy and decisions are the results of demands on the political system. A graphic presentation of the model appears in Figure 1:

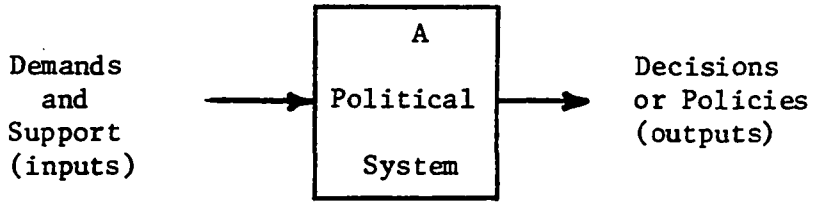

Figure 1. Easton's political process systems theory.

Educational organizations are all characterized by the political process model. Immegard and Pilecki proposed a set of parameters within which educational systems (political process systems) must function in order to be successful. Such organizations must:

1. As open systems, engage in conscious, long-range planning.
2. Pursue real goals and objectives, and members of the organization must be aware of the realness and usefulness of the organi-

zational goals.

3. Be concerned with reduction of waste and adequate allocation of resources and energy.
4. Be concerned with attracting and utilizing appropriate and adequate resources--human, financial, and material.
5. Attract and use competence soundly.
6. Insure that communications are central to what the organization does and how well it does.
7. Involve every organizational member.
8. Continually monitor or evaluate results of their effort.
9. Be change-oriented and receptive to modifications.

To accomplish the above requires a guided direction, that is, some form of leadership or management.

Emery (7) considers the leadership or management of a large organization to fundamentally be a process of contending with complex systems. The organization itself constitutes a system, and its governance is achieved through a system of plans. To understand the planning and control process requires an understanding of the concept of 'system'.

Although many definitions of 'system' have been written, a consensus is that "a system is an assemblage of objects united by some form of regular interaction or interdependence and which serves a common purpose." The essential characteristics of systems as Emery summarizes them are threefold. First, systems are composed of interacting parts, each of which has interest in its own right. Second, the components of a system are linked through various interfaces in the form of inputs and outputs, or,

information represented in a physical form. Finally, some system component will transform input to output.

Planning was introduced by Immegard and Pilecki as it related to the political decision-making process, and by Emery as it pertained to systems. Eurick and Tickton (8) discuss planning in different settings. Reasons for planning, which are highlighted by rapidly changing conditions, include:

1. Some measure of the adequacy of key decisions is required. Plans aid in increasing the chance or opportunity for detecting errors and of taking effective action to correct them.
2. Planning keeps the organization on a set course of action, even in the midst of difficult and unpopular decisions.
3. Planning enables the organization to either stick with a satisfying course of action or to modify an action program to meet change.

Simply stated, the process of planning consists of developing an organizational (institutional) commitment to the planning task, of designating a responsible person for accountability, of collecting all essential data needed to formulate the plan, and then, of building or creating the plan.

Eurick and Tickton set out six characteristics that represent an "adequate" plan. They are:

1. A description of the institution as it currently exists.
2. A clear statement of goals which restricts the functions and does not promise to do all for all.
3. A set of assumptions for the future.
4. Projection of the program with implementation methods and evaluation strategies.

5. Statement of financial requirements needed, and,
6. Provision for regular and adequate accountability to the constituency.

Throughout the introductory paragraphs, the discussions of organizational achievement, systems, and planning have hinged around a common element--information.

Hussain (15) prescribes several attributes of information that are important to the discussion of information in management.

First, timeliness is of utmost importance. The best information to be had is of no value if it is not available when needed. If available too early, it may be out-dated, and if too late, it is of no use.

Accuracy, a second attribute, relates to the absence of error. Different activities require varying degrees of accuracy. To reduce error, potential error sources must be examined and modified if necessary. Four primary sources of error include 'bad' input, poorly designed or poorly followed procedures, incorrect processing, and equipment or processing breakdowns. The cost of operating at an accuracy ratio of 1.0 is often prohibitive, so a decision must be made to accept an accuracy level where the benefits of the results outweigh the costs of achieving the results.

Relevancy and completeness is a combined attribute according to Hussain. When all relevant data are included, then the information is complete. the problem of relevancy and completeness is not only conceptual, it is also practical in nature. Irrelevant or obsolete information must be purged from the system. Nice-to-have, but unnecessary information should be omitted, since it may obscure important items.

Mellor (25) states,

> ". . .in an 'information-rich' society, there is no lack of data on almost any topic you can name. In many instances, the problem is to detect the information that is not relevant to the decision in hand."

Emery brought out the importance of information and information flow in his discussion of systems and communications within systems. His contention was that coordination of a system requires communication among its parts, and that communication channels are required to provide information about activities.

Since direct communication among all subcomponents in a complex organization such as a college or university is often nearly impossible to accomplish, one alternative is to superimpose over the structural, hierarchal communication channels an information system that links each element to a common information pool, or data base. This type of network would thereby offer both economy in the number of information channels required, and a relatively close linkage between and among pairs of activities.

The problem of having too much data to permit decision-making to occur is solved in part by use of the computer assisted management information system according to Mellor. Properly organized, a CA MIS can not only contain all of the data within a total organization, but it can also refine and arrange the data so that it becomes meaningful information to a user.

An educational management information system provides data to help managers make decisions. It integrates and coordinates the various organizational functions from different levels, different places, and different times. The educational CA MIS system is a network of communication channels, information sources, computer storage and retrieval devices, and processing routines.

B. Historical Perspective

In the mid-1960's the chairman of the Commission on Financing Higher Education in Canada called for the construction of an econometric model to analyze cost data collected by the Canadian Association of University Business Officers (17). Professor R. W. Judy, University of Toronto, determined that the available data would not support that type of investigation. Consequently, Judy submitted a counter-proposal to develop a cost simulation model. The Commission accepted the proposal and authorized Judy and J. B. Levine to proceed. The pilot simulation model was developed during early 1965 using the Faculty of Arts and Sciences at the University of Toronto.

Late in 1965, University of Toronto administrators asked Professor Judy to develop plans for the implementation of the CAMPUS (Comprehensive Analytical Methods for Planning in University Systems) simulation model. Thus began the evolution of CA MIS in North America. CAMPUS I was the 1965 test case model developed by Judy and Levine. In 1966, the pilot study was used as the basis for CAMPUS II, a full-scale implementation model. Developed in parallel was a resource planning cost estimation model for application in the Faculty of Medicine at the University of Toronto. This work was begun in 1968. The campus-type modelling efforts evolved into CAMPUS V, a complete software package with applicability in a wide variety of institutional circumstances.

One major realization that grew from the CAMPUS development efforts was that model-building information systems, budgeting systems, and planning systems were not capable of being developed fully except within the

framework of a total management system.

In the United States the first outgrowth of information systems developed from the Performance Budgeting concept advocated by the Hoover Commission in 1949 (38). The decade of the 1960's saw attempted application of PPBS (Planning, Programming, Budgeting Systems) in all federal agencies after Secretary of Defense McNamara had adopted it for the Department of Defense. In the late 1960's, several states adopted the PPBS approach and imposed it upon the public sector, including higher education.

Some educational institutions, stimulated by the American Council on Education, began to develop their own analytical data bases and planning and management systems as a prelude to initiation of PPBS. Then, in 1969, the U.S. Office of Education funded a major program in thirteen western states to address the same issue. This project developed into the National Center for Higher Education Management Systems (NCHEMS) and is currently the major focal point for CA MIS development for higher education in the United States. The product of the NCHEMS effort is the Resource Requirement Prediction Model (RRPM).

A number of smaller scale and more localized management information systems have been developed within and for institutional applications during the past six to eight years. Since most are being operated on a pilot basis, they have not received the national recognition of the larger pioneering efforts.

C. Selected Present Systems, Models, and Programs

The variety of systems models and programs available to higher education administrators and the claims about their usefulness have led to confusion by those searching the field for possible usage.

In 1973, Shoemaker (30) prepared a catalog of management information systems available to higher education and outlined major features of many of them. Several of these are briefly presented below. An index of their "effectiveness" is not, however, available from the document.

On-Line Administrative Information Systems (OASIS) OASIS is a management information system for data related to current operations. As of 1972, it had no planning function incorporated within it. Rather, it had the goal of providing department chairpersons, program directors, and top-level administrators with an integrated data base for information and control of daily operations. The system is built upon an aggregate of files from various institutional offices. Remote terminals may be used by non-technical persons to extract "tailored" reports. An elaborate security provision is built in to prevent unauthorized access to information. The OASIS computer program is in the public domain.

TOTAL TOTAL is a proprietory software program used to compile, store, and retrieve operational information. The data base is quite diverse and any data element may be related to any or all other elements, regardless of the source. On-line capability was not initially a feature of TOTAL although it is under development.

MARK IV MARK IV is a general purpose, software computer program developed as a proprietory product. It is a system which facilitates file

definition, organization, maintenance, scanning and selection of data. MARK IV arranges and sorts data, summarizes information, and provides reports according to specification. Educational applications include student records, inventory, alumni records, personnel data, payroll preparation, class scheduling, student registration, accounting, and library cataloging It is possible to obtain reports directly from inquiry without special programming. Claims are made that the system is simple enough for non-technical personnel to learn about and use within a few hours and an on-line capability exists. MARK IV is not a data based management information system, but rather is a computer program for using, maintaining, and developing current data files.

National Center for Higher Education Management Systems (NCHEMS)

NCHEMS products are an outgrowth of work begun by the Western Interstate Commission for Higher Education. The system consists of a set of subsystems and "building blocks" of which the first is a data element dictionary. The dictionary provides common or uniform definitions for data items and helps to organize the data in general categories. The second component of the NCHEMS system is a program classification structure (PCS). The PCS provides standard sets of categories for defining college activities. Each category becomes, then, a cost center. A complicated portion of the NCHEMS system is a course load matrix which identifies courses taken by students outside their major field. The matrix develops data on a program-by-program basis which will indicate cross registration among departments. Instructional program costs may thus be computed to represent the cost of a major or of a degree program.

NCHEMS has a computerized program, the resource requirements prediction

model (RRPM) which accommodates up to 200 departments, seven course levels, six faculty ranks, four groups of operating staff, five categories of instructional expenditure, and seven other kinds of departmental expenditures. Data are highly aggregated and normally are available at the institution.

Comprehensive Analytical Methods for Planning in University Systems (CAMPUS) CAMPUS is an integrated, data-based planning system. Data are organized according to the NCHEMS program classification structure. Input includes data on programs, students, staff, space, equipment, and finances. Incorporated also is a computer simulation function which can be used to generate multi-year, annual, or semi-annual reports; past, current, or future; detailed or general. The simulation model provides data about future resource requirements and cost implications of policy decisions. This model requires massive amounts of data, but of the type normally collected by universities anyway. Data of each user is continuously updated and stored.

Systems for Evaluating Alternative Resource Commitments in Higher Education (SEARCH) SEARCH assumes that a college is an interactive system. Based upon a mathematical simulation model, it explores the magnitude of alternative policy decisions. Statistics on students, programs, faculty, facilities, and finances over time are used as a basis from which to project future data in annual increments up to ten years. Variables may be manipulated or held constant to simulate alternative decision options.

Higher Education Long-Range Planning/Planning Translator (HELP/PLANTRAN) The HELP/PLANTRAN system aids administrators in determining the important elements that must be considered in college planning. Mathematical relation-

ships of components processed by computer provides a report of logical consequences over a ten year period. Actual simulation is not a feature of the system. The weakness of this system, as with any other planning model lies in the detail of the equations provided by the planners.

While Shoemaker examined general characteristics of systems models and programs, Weathersby and Weinstein (39) completed a structural investigation of analytical models used in college and university planning. Their study, completed in 1970, was conducted at a time when many models were still in the research and development stages. Evolutionary and refinement processes occurring since then have essentially out-dated many aspects of their report. However, the general information, applications, and features of models under development would be of interest to the reader searching for such information.

The few selected systems, models, and programs presented in this section represent a very sketchy picture of the total CA MIS development effort throughout the nation's colleges and universities. The literature review indicated that many institutions have developed subsystem information processing packages and software to deal with a minor component of total institutional information needs. Examples that were observed ranged from accounting systems to student record systems to grant management systems.

Although these smaller subsystems do create management information, they do not fit the comprehensive models discussed above.

D. Applications of CA MIS in Higher Education

The use of CA MIS in making planning decisions was discussed by Huff and Young (14). They reported that administrators who are unfamiliar with planning and management system capabilities find it difficult to use those systems efficiently in the planning-budgeting process.

Huff and Young defined four key groups of decisions required for college and university management. The categories of decisions include:

1. Decisions related to each instructional discipline at each course or instructional level. These are input decisions and include such factors as faculty productivity ratios and faculty rank mix. Planners must examine the historical data and make decisions about whether the two ratios are acceptable or whether they should be changed, and if so, how much.
2. Decisions related to the number of support staff available, salary and wage schedules, and direct expense formulas that are applied to each department. Decisions to stay with a status quo require no input.
3. The changes in enrollment that are likely to occur in each department. An analysis of student flow and/or admissions policy ceilings is needed to accurately forecast program enrollments for input.
4. Non-instructional cost centers may be treated most easily with formula applications. For example, library or student services expenditures are frequently a function of FTEE, credit hour production, or a flat percentage of the instructional budget.

In using CA MIS in planning and budgeting exercises (when conducting simulation activities), normally only a few changes are made for each computer run. If too many changes are made, the task of sorting out the impact of each decision cannot be determined.

Institutions must plan and budget early in the fiscal year for the following year's activities; but during the current year, only incomplete data are available. This situation forces the institution to devise long-range projections for many decisions, an "inconvenience" to higher education planning which cannot be avoided.

Cost information alone is simply inadequate, according to Huff and Young. CA MIS analytical tools tell users the cost of everything, but the value of nothing. The difficulty is knowing when the outcome of an activity is worth the investment. Therefore, planners need information about outcome assessment that can be related to cost data. Degrees awarded, credit hours or FTEE produced, or student satisfaction attitudes each contribute only a small part of the total concept of outcome assessment. More remains to be done in this area to validate the use of outcome measure assessment for planning and management applications.

Micek and Wallhaus (26) expanded upon the problem of defining outcome information. They reflect that educational planners are normally well aware of the issues confronting their institutions. They recognize also that sound planning directions cannot be created solely from historical cost data; nor will an analysis of demographics and institutional resources provide a final answer for making decisions and laying plans for increased effectiveness. An understanding of the necessity for an outcome oriented approach to planning is emerging in the minds of college administrators.

This approach is based upon information about the results of educational programs rather than being based upon what goes into the programs.

Micek and Wallhaus discussed several difficulties in the identification and measurement of higher education outcomes.

1. Few explicit measures of program effectiveness are available. It's too easy and one-sided to see if a plan were accomplished by simple analysis of the consumption of resources rather than by measuring educational outcomes.
2. Even when educational outcome data are available, techniques for analysis and interpretation are largely underdeveloped. Therefore, analysts cannot determine true cause and effect.
3. Most planners and decision-makers have difficulty converting goals into specific outcome objectives. Goals remain in unmeasureable, non-operational terms, and optimization analysis cannot be performed.
4. The use of outcome data is frequently played down due to a fear of misuse. With the true picture not being told, those in planning and decision-making positions may take improper action.

The measurement of outcome information will continue to be a problem for some time to come. Although research has been conducted and still continues in this area, it does not contribute highly to the issue. In the meantime, planners struggle on as best they can.

Functions of the typical computer assisted management information system, according to Mellor (25) and Emery (7), include:

1. Data collection. Collection is the sensing function of the organi-

zation, since all data must be collected. Two aspects of data collection include volume (each event must be coded some way) and methods (the how of sensing and recording).

2. Data classification and indexing. When data are recorded, the items must be described in such a manner that will permit retrieval. Some type of classification and index scheme must therefore be devised and used.
3. Data compression. The organization must not be swamped with trivial data. Several methods of eliminating excessive data include a filtering process, aggregation of data into broader classifications, and compressing data by using fewer or smaller parameters.
4. Data storage. This is the function that fills the role of memory. Each data element must have a specified format and be assigned to a specific storage device, such as magnetic tape or disk.
5. Data management. The function of data management is to provide access to storage in the data base. Requirements of the data management system include efficient, routine processing, the ability to respond to ad hoc inquiries, security, generality, and flexibility.
6. Computation. Computation consists of all of the processes that transform input data into output data and also includes data manipulation of a non-computational nature.
7. Data transmission. This function involves the communication of data between geographically separated locations, either physically or electronically.

E. The Feasibility of CA MIS

A computer assisted management information system can provide many opportunities for flexibility in educational planning. Lewis (21) lists a variety of management functions that can be assisted by CA MIS applications. They include:

1. Needs assessment
2. Resource management
3. Logistical control
4. Planning
5. Operational control
6. Evaluation

Lewis made several observations regarding the development of computer assisted management information systems. Reasons he cited for the relatively slow acceptance of CA MIS by educators were high start-up costs, a shortage of working models, and inadequate dissemination of the results achieved by successful operations. He also observed that the most successful CA MIS operations were found in highly centralized organizations.

Management, as defined by Baughman (4) requires that several activities occur before a CA MIS can be used: Planning, in the sense of setting objectives, forecasting, and establishing policy; organizing, in the sense of designing ways of performing activities and providing the resources needed for their performance; and controlling in the sense of measuring and evaluating results in accordance with objectives.

The dilemma of administration versus management is presented by Morisseau (28). He identifies problems by reflecting that information

tends to be scattered about in various offices and operating groups and is recorded with varying degrees of accuracy. A central system for keeping records and exchanging data within the institution is usually absent. A unified view by managers about the relationships between space utilization, capital investment, operating costs, and the quality of the physical environment is seen as either administratively unproductive or unnecessary, or has never been considered. This is how Morriseau feels that institutions administer, but don't necessarily manage higher education, especially facilities.

Hefferlin and Phillips (11) present yet another case for the development of computer assisted management information systems by pointing out several other problem areas. They relate that most informal communication channels are restrictive while most formal communication channels are so impersonal that they are unresponsive. Informal communication, by its very nature, is unsystematic. These channels may be likened to a country lane--winding, narrow, and rutted.

On the formal level, communication channels are inefficient. They are oriented for large groups rather than individuals and they are planned for producers rather than consumers. Many of the present management problems do not occur primarily from a lack of information. Rather, too much decentralization of information is the case. The demand is for administrators to be responsive, accountable and effective; to do this, useful information is needed.

According to Hefferlin and Phillips, most administrators say that their worst difficulty is not a lack of useful information, but rather a lack of ability to screen out useless data. What is needed therefore is not more

data, but improved data. Educational administrators appear to have two major concerns. First, how to seek out a better way to administer what they have to work with, and second, to reorganize the administrative structure and to have the needed back-up information to do the job after the reorganization.

Kornfeld (20) relates a 'proper perspective' for CA MIS. He says,

> "A proper information system will provide a steady flow of relevant information to all levels of management within an educational institution, furnishing the facts needed to develop alternative programs, make decisions, and gauge progress, both for the short term and the long term toward carefully planned goals. An effective information system will get to the core of the financial and nonfinancial information which is basic for planning, operating, and controlling the institutions future."
>
> "Computers should be the physical expression of this 'nervous system' of the enterprise."

Hussain (15) presented the case for CA MIS by tracing the patterns of economics. He reported that industrial evidence indicated that information systems contributed to higher profits by providing the opportunity to identify potential for increased efficiency. He also cited an educational use example: Department of Health, Education, and Welfare projections in 1968 projected a 1967 to 1977 higher education enrollment increase of 10 percent while costs were forecasted to rise by 40 percent for the same period. Development of alternatives to examine the implications of forecasts such as this are possible through CA MIS activities. With demands for other uses of the public dollar, education's relative increase in resource supply will be less than that demanded. This will increase the need for more efficient operations through more efficient information systems.

Several non-economic demands pinpoint an increased need for computer assisted management information systems. They are the state and federal agency reporting requirements, internal pressures brought by students to

speed registration and records handling, and a need to obtain data accurately and quickly for such activities as budget modification or collective bargaining.

Minter and Lawrence (27) proposed four factors that suggest institutions of higher education are becoming more difficult to manage. Increasing size and complexity, public concern for rising costs, student disenchantment with the relevancy of educational activities, and acknowledgement by administrators of uncertainty in decision-making all contribute to this belief. They report as did Huff and Young that analysis of costs without analysis of benefits is meaningless. Decision makers in higher education are confronted with many issues and programs competing for implementation. Those decision makers must determine which programs are worth what they cost in terms of the benefits gained by deciding in favor of one program over another when both compete for the same dollar.

Shoemaker (30) in writing for the Academy for Educational Development supports the development of CA MIS from yet another perspective. His approach examines the topic from the systems point of view. Shoemaker reflects that considerable effort in recent years has been devoted to developing system models and programs to assist college and university planners in obtaining and analyzing data about internal operations. This type of management data is critical in decision-making processes.

The variety of system models and programs available to higher education administrators and claims as to their benefits have tended to confuse the entire issue. At the same time that these models rely on concepts and language of systems theory and make use of new systems-related techniques, they offer a more extensive synthesis of data and a broader perspective than was

ever available in the past.

Shoemaker summarized six major functions which can be served by CA MIS, although he points out that probably no single system will do all of them.

1. CA MIS for current operations collects and uses data necessary to provide information and control over daily or periodic transactions such as cash balances, student grades, or alumni records.
2. CA MIS for planning organizes and analyzes the data needed for long-range planning and for projecting goals, needs, and procedures. Several planning capabilities include computing the cost of various programs, of various enrollment levels, of different instructional procedures, and the resource allocation required to support such projections.
3. Simulation emphasizes the interrelationship in the quantifiable factors of higher education which will result from various assumptions about the learning environment. Examples of such assumptions include enrollment growth or decline, changes in instructional procedures, changes in faculty composition, and overhead.
4. Procedural or process models use Program Evaluation and Review Techniques (PERT) to organize and structure the flow or process of decision-making and planning. This type of application attempts to cover all of the essential steps on a time-flow sequence including consultation with interested groups, decision-making, and the resulting action.
5. Specific needs of a particular college or university are often defined by comprehensive models tailored to apply one of several selected approaches to the development of projections or simulations

needed to resolve the institutional problem.

6. Information exchange services among colleges are possible through CA MIS applications that function as clearinghouses for information exchange.

F. The Typology of Information

Information has varying levels of application. Huff and Young presented the idea that information appears or occurs in stratified levels. The base, or foundation level, is more commonly described as the operating information level; operating information is the type which is needed for the daily business of running the institution (14). Typical reports within this category would include budget and expenditures summaries, student registrations, a master course index, payroll and personnel, grade reports, and inventories.

The second, or intermediate, level of information is the type needed for statistical or analytic reports. This kind of output would include unit cost analysis, faculty workload analysis, student course demand analysis, and educational outcomes analysis. At this level of information use, the CA MIS links data from the operational level information system to produce a series of analytic reports. These reports display extensive historical information about utilization of resources, interrelationships among organizational units, and a variety of measures of the status of current institutional operations. In contrast to operational system information which treats data on a daily basis, the analytic or statistical system reflects data as of specific points in time, such as monthly, the end of the fiscal year, or perhaps the tenth day of a quarter or semester.

Forecasting reports are typical of the highest level information system, the planning and management system. This level offers assistance in strategic planning, devising future budgets, setting enrollment predictions, predicting personnel requirements and other functions related to strategic level activities. These applications predict how resources will have to be allocated internally to allow the institution to pursue its goals and objectives.

The major difference, according to Huff and Young, between statistical or analytic information and planning and management information is that analytic data reports are obtained from historical resources and reflect the current status, while the higher level gives users an opportunity to alter historical input on the basis of policy decisions and then forecast the resource requirements resulting from those decisions. By varying alternative sets of policy decisions for internal resource allocation, planners may obtain a series of "forecast" results from each set of alternatives in order to evaluate the effect of various choices.

The range in specificity of data is portrayed in Figure 2. The greater the width of the pyramid, the greater the detail and specificity of data needed for the system to function.

A notable feature of the CA MIS is its capacity to aggregate data at the level most appropriate for the user. Thus, for forecasting use, the need is for broad, highly aggregated information, while the day-to-day operations require highly detailed, specific information.

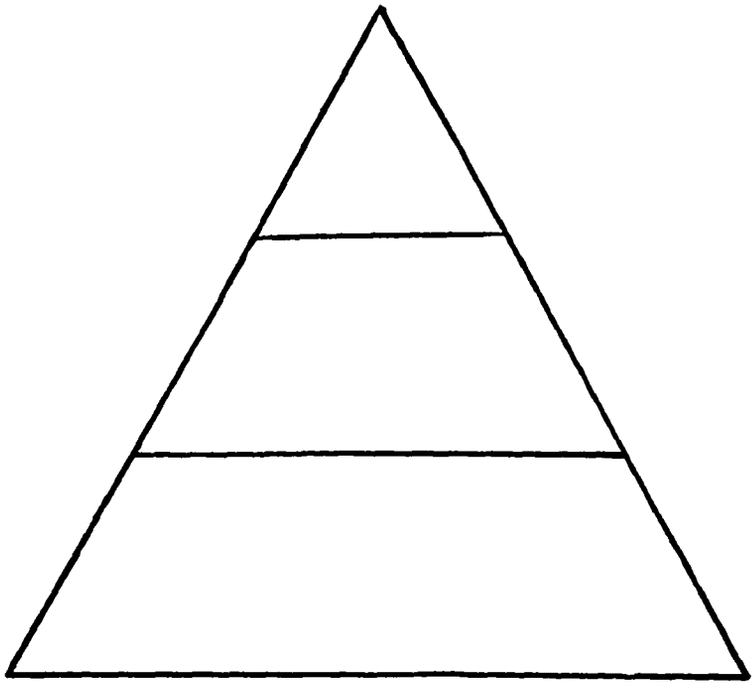

Figure 2. Specificity of data in various information system levels

G. Development and Design of CA MIS

According to most sources, the phases of CA MIS development generally follow the sequence presented below.

1. Project initiation, during which the project is defined, systems and subsystems are identified, and relationships are determined.
2. A survey of users is conducted to identify their information needs and requirements and to define the format for input/output reports.
3. System design activities where policies and procedures, assumptions, requirements, and constraints are carefully decided.
4. The design is reviewed by users.
5. The programming state where program specifications, limitations, and codes are developed.
6. The implementation stage for initially putting the CA MIS in action.
7. CA MIS operation and de-bugging.
8. Evaluation to analyze problems and to set any plans needed for modification.
9. Maintenance of the system to keep it operating as planned.

The determination of what information is to be generated is one of the first steps in the development process of a CA MIS, according to Hussain (15). This activity is the responsibility of the college's administrative team. They must specify when and where the information is to be delivered. The "hows" of this task are left to the systems analyst, who contributes the technical knowledge necessary for transforming user specifications into a

final product.

Planning models, especially simulation models, require extensive amounts of data. Although some data are unique to the model, most is required for operational purposes and is already in the data base of the institution. One major problem is that such data is often not accessible to the planners since the planning department may report to a different administrative unit than the information processing unit. Parallel efforts can be eliminated by restructuring the organization which results in centralization or coordination of both planning and control needs with operational information needs.

Input to planning models is often more detailed than is necessary for operations, but the cost appears to be marginal if incorporated in initial development stages. Simulation model output can be voluminous, so output design must insure easy assimilation as well as quick reference and access.

Koenig (19) introduces two main features of a CA MIS that are essential to consider in the design phase. The first primary feature is that of needing a data acquisition and storage system to maintain orderly records on variables that are important to the decision-making process, and a convenient recall system to make information needed from the file accessible to the decision maker.

The second necessary feature is a logical structure to identify what variables are to be maintained in the file, the computation to be made on the variables, and how the results of the computations are to be used in the process of making decisions. This logical structure (commonly called a model) is necessary in the design of a computer assisted management information system. The model around which the CA MIS is to be designed may be limited in the number of variables it includes and in the class of decisions

to which it contributes, but it must relate to all levels of decision-making if it is to be effective.

The design specifications of a CA MIS must originate in conceptual terms according to Ward in the Management Information System proceedings (23). Specifications must be developed with the following in mind:

1. The requirements for data accumulation, storage, analysis, and dissemination indicate that computer support is needed.
2. All system users should be assigned appropriate priorities for access to and use of the system.
3. The same system must be used for institutional operations and evaluation and planning, with procedures available for extracting information in a flexible form to produce needed reports.
4. Standardized data collection and input techniques are essential.
5. Standardization of codes, terms, and data collection forms to eliminate and/or reduce duplication is needed.
6. A centralized inquiry capability for all information needs is important.

The preferred sequence in designing the CA MIS according to Ward consists of a four-stage process. First is the task of defining and documenting where decisions are made and how information flows within the institution. The CA MIS must be built around the political and power structure, since this is normally the central location of the decision-making process. Second, the design should include a centralized file structure that is comprehensive, flexible, and has adequate capacity. The third design consideration requires that a support system be developed that will:

1. Gather the required data.
2. Have an efficient record format.
3. Possess well-defined procedures for maintaining and up-dating records.
4. Be capable of handling exceptions.
5. Permit an evaluation of the existing system with a view toward modification and up-date.

The fourth and final stage in the design sequence is the creation of a report generator which has the capacity to produce whatever reports are needed at various decision levels.

The literature notes three barriers that must be overcome in the strategy for organizing for CA MIS development, of which the primary problems are people-oriented. The first strategy requires that resistance be overcome. Resistance to adoption creates a roadblock to sucessful operations. It is suggested that a CA MIS can best be devised by managers themselves. A second element to be overcome is that of inefficiency. Should system analysis demonstrate that inefficiency exists, it may be that the planners as well as the system may have to be changed. The third obstacle is fear--fear of change, of the unknown, of the new. The easiest approach for overcoming fear is an advance program of educating, informing, and preparing those to be involved.

White, in the Management Information System proceedings (23), outlined a ten-step process for design and implementation of CA MIS:

1. Division of the institution into logical categories based upon the types of data used for specific purposes (student, staff, courses, facilities, finance).

2. Identification of data elements for each of the categories.
3. Compilation of the data elements by categories.
4. Definition of each data element.
5. Identification of the initial and correct source of each data element.
6. Determination of the frequency of need for each data element.
7. Documentation of procedures.
8. Establishment of the priorities for implementation.
9. Construction of the data base for each of the categories (or modules).
10. Testing the data program and modules.

Characteristics of management information systems were presented by Byers (5) in his discussion of criteria needed to establish the design of a CA MIS. First, CA MIS are based upon an analysis of the information flow in each of the functional areas of the institution. The analysis would seek answers to the following questions:

1. What information is presently available?
2. What information is presently available, but is not needed?
3. What information is needed, but is not available?
4. Where can the information be located?
5. How should the data flow through the system?
6. Where and in what form should the data be kept?
7. Who should provide the original data?

Secondly, the information system must be built upon a fully defined data base. It is important that the data be exactly defined and organized in the data base. Relationships between data from various operational

systems must be clearly distinguishable.

The third criterion is the ability to retrieve data from the data base so as to provide information for the decision-maker. Retrieval may be the result of individual reports which are pre-planned and pre-programmed, may be the result of exception reports which occur only when certain predetermined situations arise, or may be the result of a general retrieval of data using an open-ended, generalized retrieval system.

Each of these retrieval needs is important and must be present if an information system is to be functional. Not all information, however, is processed through pre-planned and scheduled reports, since unmanageable "bottleneck" situations would be created.

Byers presented seven technical features that must exist for a CA MIS to work well.

1. A common data base must exist with no redundancy.
2. A common coding scheme for related data identification is essential.
3. A totally integrated system design is crucial.
4. Timeliness is a critical factor, particularly with regard to processing data and the availability of data.
5. A minimum of judgment decisions should be required for getting data into the system.
6. Consistency in reporting is possible only through use of agreed upon data sources and points in time.
7. Reliability is needed so the systems are balanced, edited, and controlled to assure protection (security) to both data suppliers and to data users.

Byers also presented a number of design planning factors that must be

considered:

1. Determination of the specific items of data that are to be captured and stored.
2. Providing for the addition of new data or deletion of old.
3. Analyzing the flow of data through the system.
4. Responsiveness of the system to requests for data.
5. Assurance of accuracy within the system.
6. The optimal use of storage methods to organize the data to eliminate redundancy and to thus lower the cost of entering and retrieving data.
7. Most appropriate methods and sources for obtaining data.
8. Delegation of responsibility for maintaining data in the data base.
9. Determination of priorities for implementation of the segments of the system.
10. Functional representatives must be included in the planning process.

Simulation modeling for planning was discussed by Wartgow (37) in a presentation to the Association for Institutional Research Forum in 1973. Wartgow identified a number of common factors which he attributed to successful CA MIS utilization experiences. First, he identified two factors which influenced the decision to purchase and implement a computer simulation model.

1. The effort of an individual who had personal interest in new techniques of management.
2. A recognized need for a tool to assist in answering "what if"

types of questions.

Second, simulation models, once purchased and implemented, were utilized more extensively in those institutions which purchased the system to meet a recognized need than in those that purchased a system primarily because of an "innovator" on the campus. Third, Wartgow found no discernable pattern concerning the decision to purchase one of the models in preference to another although models were chosen on the basis of appropriate complexity.

Wartgow investigated the simulation model implementation experiences of universities in a 1972 study. He found four major characteristics:

1. The length of time to make the system operational was significantly underestimated in each implementation case. Reasons were extensive requirements for modification, inexperience of personnel responsible for using the system, and the difference in definition of the word "implementation" for installers and users.
2. Institutions that relied heavily on their own personnel experienced more difficulty than those that utilized services of the firms that developed the models. The least difficulty was encountered by colleges that contracted total implementation to outside personnel. Most typical of the problems encountered were data collection and computer technology.
3. A lack of widespread and active participation by institutional personnel during initial implementation stages appeared to influence the extent of future model implementation.
4. In-service programs made a positive influence toward increasing the extent of utilization.

Wartgow's study of CA MIS simulation models examined means and methods of

system utilization. He found several conditions of applications in his study. Simulation was most extensively used when a formal planning process was exercised prior to its implementation. The amount of user confidence in the accuracy of simulation results was found to be a function of broad participation by institutional personnel in model development and confidence toward the individual conducting the simulation. The accuracy of the data base in the initial use of the model tended to influence the extent of future utilization as well as the degree of use confidence for future simulations. And, insufficient time for planning was identified as a major hindrance to the utilization of simulation models.

Wartgow suggested that persons involved in the development of simulation models consider four types criteria in evaluating models prior to selection of a particular one for their institution.

1. How effective is the model in getting the answers needed?
2. How useful is the system? How frequently will it be used? Is it flexible enough to accept major changes in organizational structure? How many people can make use of it?
3. What is the installation time requirement? How much time is required to collect the data base needed to drive the system? What is the time required for retrieval?
4. Is the value of the information worth the cost of implementation? Will it save time and personnel money? Is it really needed?

Wartgow found that the time and expense involved with simulation models was not justifiable in terms of utilization. He qualified that finding, however, by stating that:

1. Attention did focus upon long-range planning (a practice not common in many colleges).
2. The models have greatest potential in institutions that are in the midst of change.
3. The value of computer simulation depends upon the ability of users to recognize situations where the tool is needed and appropriate.

Mann, in a 1974 study of 722 institutions with 3,000 or more students (24), determined that 68.8 percent were in some stage of CA MIS development or implementation and another 17.7 percent held intentions for such development. Mann found no relationship between geographical location and CA MIS activity. He did find, however, a relationship between complexity (multi-campus vs single campus), control (public vs private), level of degree offered, and CA MIS activity. Larger, public, doctorate-degree granting institutions reported greater involvement with CA MIS than other universities. Mann suggested that these differences were probably due to a greater necessity for uniform management and also probably reflected greater resources.

The Mann study determined that the history of CA MIS involvement began, for many institutions, during the 1969-70 period which coincided with the beginning of financial difficulty for higher education. Analysis by institutional size (based upon enrollment) suggested significant differences among institutions as to progress in planning and implementing CA MIS. Smaller colleges spent less time than larger ones and implementation took less time for them.

Mann's study determined a ranking of reasons for developing CA MIS projects. The five reasons in order of greatest importance were:

1. To improve internal management.

2. To support other management tools.

3. To meet State reporting requirements.

4. To meet Federal reporting requirements.

5. To make better use of existing computer hardware and software.

The agent responsible for promoting CA MIS development was less clear in Mann's study than in other findings. In public institutions Vice Presidents for Administration, Finance, or Planning ranked first, while in private colleges, the Director of Data Processing headed the list. Mann found that the commitment to undertake a CA MIS project involved the highest ranking administrator, either because of cost, or importance. Mann found that academic administrators played a relatively small role in planning and designing the CA MIS, however, it was they who were required to support it with information once operational.

Bateman (3) conducted a study in 1972 of the role of management information systems in higher education planning and decision-making. He found that the major developments in CA MIS had been in the realm of stand-alone, inter-related compatible information systems, such as student records, finance, and personnel. Two-thirds of the institutions he surveyed employed this approach.

Centralized data bases were used by only 30.5 percent of the colleges in Bateman's study, a pre-requisite needed for inter-related and compatible operating systems. His data indicated that the major problem for CA MIS was lack of high level management interest and support. Administrative applications of computer equipment in the Bateman study were identified at the following levels: Admissions and records, 97%; finance, 94%, personnel, 85.5% management planning and control, 81%. Thus, operational, day-to-day appli-

cations accounted for the highest type of computer use. The primary method of data entry was with the batch processing mode, although nearly 20 percent used "on-line" remote terminals in their student services applications.

Bateman also found that planning activities were not as highly utilized as other administrative applications. He noted an increase over a 1966 study written five years prior to his analysis. Bateman found that few colleges and universities were applying a comprehensive systems approach to planning and noted that at that time one-third had no plan for future use of planning models.

Major problems identified in regard to the CA MIS in support of decision-making were lack of administrative support, building a centralized and standarized data base, inability to identify the users' and administrators' needs and requirements, and lack of support funds. Lack of cooperation frequently occurred because of inadequate expertise. Bateman reported that this may have been caused by the nature of the organizational structure which separated various components of the planning and management team.

Simulation modeling was considered to be effective by most of Bateman's respondents, but a substantial proportion of them were uncertain of the real value. The most effective models were resource allocation-cost simulation models and the comprehensive simulation models.

In 1973, Gattie (9) completed a study of the procedures used and problems encountered in developing CA MIS in United States colleges and universities. He found that a fourth of his respondents were using an "integrate later" approach (continuous design and implementation) without a comprehensive plan available beforehand. About a fifth were following a "total systems" approach based upon an initial comprehensive plan. Another fifth

were using a "data bank" technique which relied upon the development of a vast pool of detailed data with everything-that-might-ever-be-needed included. One in seven was following a "top down" format with systems development following need assessment.

Over half of the responding institutions followed a master plan when developing their CA MIS. Time requirements for CA MIS development ranged from 18 months to 10 years, and all but one indicated deviations from the plan to finalize their systems. Financial difficulty was the primary cause of the deviation in over half of the cases.

A second major problem area was that of personnel problems, with a third of the institutions so reporting. Resistance of CA MIS development was reported on the part of clerical personnel in 51.3% of the cases, by mid-level administrators in 43.2% of the cases, and by deans and department chairmen in 37.8% of the cases. Reasons for resistance included fear of the unknown (81%), fear of job loss (73%), fear of losing authority and prestige (65%), and disenchantment caused by initial CA MIS problems (62%).

Of six possible information files, only a student information file and a course information file were operational in a majority of the cases. Alumni facilities, finance, and staff files were less commonly in use.

Gattie identified several benefits from using CA MIS. They were:

1. Administrators made more decisions based upon fact than intuition.
2. Internal and external communications were improved.
3. Redundant duplication of data was reduced and reporting was standardized.
4. Responsibilities of decision makers were clarified, at least to some extent.

Heim (12) in a 1972 study attempted to analyze the advantages and disadvantages of CA MIS and particularly the NCHEMS model. She, as others, stated that planning and management systems are based upon two assumptions:

1. that appropriate and workable prediction models can be developed.
2. that realistic assumptions can be fed into the models developed.

Heim's observations included an uncertainty, however, that realistic assumptions could be defined. Other observations were that supplemental staff are required, that data are not usually available in a useable form, CA MIS operations require new technical specialists, and that the NCHEMS model is best adapted to broad resource planning where the use of average costs are acceptable.

According to Heim, the requirements for successful application of CA MIS include a favorable pre-disposition to their use by the planning and management team, thought patterns that run in quantitative channels, development of understanding and skills in the use of CA MIS, decision-making through policy analysis, institution-wide applications, and a willingness to come to grips with painful decisions.

H. Summary

This chapter introduced the foundations upon which computer assisted management information systems are based and benefits that may be derived from using this type of management tool.

Selected studies and reports were cited which described important implications for the planning, design, and development of CA MIS in public higher education settings.

III. METHOD OF PROCEDURE

This exploratory, pilot study of computer assisted management information systems (CA MIS) was conducted with several objectives in mind. First, an attempt was made to determine if there were any differences between institutions that used CA MIS and those that did not based upon two measures of productivity.

Second, an investigation of the factors involved in the process of developing a CA MIS was included. And thirdly, the applications and uses of CA MIS were analyzed.

This chapter traces the methods and procedures used to gather and analyze the data necessary in pursuing the study. Chapter subdivisions include:

A. Identification of the Population and Sample Selection.

B. Collection of Data.

C. Basic Assumptions.

D. Problems to be Examined

E. Treatment of Data.

F. Summary.

A. Identification of the Population and Sample Selection.

It was decided to include in the study only a sampling of the eligible population. The population was defined as all public colleges and universities in the United States that offered a baccalaureate or higher degree. In states where state systems of public higher education were operating,

apparently autonomous campus operations were defined as single institutions. For multi-campus institutions, the central campus, or administrative center, was selected and branch campus sites were excluded from the defined population. Thus, 418 institutions of a total field of 3000 public and private colleges were identified as the population for the study. Eligibility was determined from information found in the Education Directory (35).

A sample size of 100 was selected for the study. The sample was drawn on a stratified, random selection basis. Stratification was made on the basis of United States Department of Health, Education, and Welfare (DHEW) Regions, of which there are ten. The number of eligible institutions in each of the ten regions was determined by building a roster of colleges from information published in the Education Directory. The lists of the eligible colleges were then assembled in alphabetical order, by state for each region.

Sample selection was accomplished by calculating the percentage of institutions needed for the survey from each region, and by then determining the number of institutions required to satisfy that percentage. A table of random members was used to select the necessary number of institutions within each regional stratification.

B. Collection of Data

Data were collected in a two-stage survey process. The initial survey of the 100 selected colleges and universities sought to determine which public institutions were using computer assisted management information systems. This was accomplished by use of a simple survey form that requested five items of information:

1. Was the institution currently using a computer-assisted management information system?
2. If Item One was answered "No", was the institution considering the use of a CA MIS?
3. If Item One was answered "Yes", respondents were asked to indicate the vendor of the software, if any.
4. Those who answered "Yes" to Item One were asked about their willingness to participate in a more detailed study of CA MIS utilization.
5. The Name and Title of the respondent were requested.

The survey document was mailed to the individual at each of the selected institutions whose name and title as listed in the Education Directory was most likely to be involved in a CA MIS effort, if one existed. Three mailings were utilized to obtain the responses collected.

It was assumed that the institutions which responded "No" to the fourth item, thereby indicating that they did not wish to contribute data to a more comprehensive study, would probably not do so. Therefore, those respondents were eliminated from further research.

The second stage of data collection was accomplished by identifying which institutions had responded "Yes", that they were currently utilizing a computer assisted management information system, and "Yes" that they would be willing to participate in a more detailed study.

A second, comprehensive survey instrument was constructed, based upon readings in the literature, and upon investigator discussions with CA MIS consulting firm personnel. The questionnaire was submitted to a panel of six "experts" for review and critique. The panel consisted of two MIS

development consultants and higher education personnel with expertise in research, instruction, curriculum development, and educational research.

After revision, the survey questionnaire was mailed to the attention of the respondent who signed the first phase survey form. Three mailings were utilized at twenty-day intervals to collect the data.

C. Basic Assumptions

In order to satisfy the objectives of the study, several operational assumptions were established. They were:

1. A definition of computer-assisted management information systems was provided on the survey form. It was assumed that the professional judgment of the survey recipients would yield accurate responses to the items, based upon this definition.
2. A second assumption was that the terminology used would be understood by respondents and that further definition was not necessary.
3. A further assumption was that the most qualified institutional representative would probably complete the survey document.

D. Problems to be Examined

With an overall objective of studying the development and utilization of computer assisted management information systems in public higher education, the following were identified as the problems to be examined:

1. There are differences between institutions that use CA MIS and those that do not, based upon two measures of productivity.
2. The development of a CA MIS is an involved process requiring institutional commitment of resources.
3. Not all colleges and universities use their CA MIS for the same purposes or at the same level of decision-making and planning.

E. Treatment of Data

Data treatment in this study used frequency counts and descriptive rather than inferential statistics due to the exploratory type of approach. The first problem was, however, converted to a null hypothesis format for the purpose of statistical inference that there was no difference between the two types of institutions. Otherwise, the data presented in the Findings Chapter are reported in a descriptive summary format.

F. Summary

This chapter describes the method of procedure designed and employed to conduct the research. The procedure for identifying the sample, the process for questionnaire development and data collection, basic assumptions, the problems to be examined, and the technique for treating data were included. Since this study was a descriptive research effort, its objective was to arrive at a statement of the development and utilization status of computer assisted management information systems in public higher education in the United States.

IV. FINDINGS

This chapter presents the findings of the investigation. The data are reported in tabular format. Five major sections are included in this chapter. They include:

A. The Sample and Response Rate

B. Users versus Non-users

C. Factors Related to the Development Process

D. Outcomes of CA MIS Development

E. Summary

A. The Sample and Response Rate

Of the 418 public colleges and universities defined as being eligible for inclusion in the study, 100 were selected for the sample. Table 1 reflects the distribution of institutions on the basis of the ten United States Department of Health, Education, and Welfare (DHEW) regions serving the United States and Trust Territories, and the number of institutions surveyed by region.

While Table 1 reflects the distribution of institutions in the sample, stratified by DHEW Region, the rate of survey returns and institutional use of CA MIS in sampled institutions is reported in Table 2. As may be noted from the data, over half (36 of 70) of the responding public colleges and universities indicated current use of CA MIS as defined on the initial survey instrument. Another twenty-six reported that they were planning for CA MIS on their campuses. Seventy (70.00) percent of the institutions

Table 1. Distribution of institutions studied

DHEW Region[a]	Number of Eligible Colleges and Universities	Percent of Total Institutions per Region	Number of Institutions Surveyed
I	19	4.55	5
II	26	6.22	6
III	54	12.92	13
IV	81	19.38	19
V	62	14.38	15
VI	65	15.55	16
VII	26	6.22	6
VIII	33	7.89	8
IX	31	7.42	7
X	19	4.55	5
Total	418	99.53[b]	100

[a]A listing of the states and territories within each of the DHEW regions is included in the Appendix.

[b]Total does not sum 100 percent due to rounding.

Table 2. Response rates and reported CA MIS utilization in sampled institutions

DHEW Region	Number Responding	Number Using CA MIS	Number Planning for CA MIS
I	3	1	0
II	5	1	4
III	8	5	3
IV	16	5	9
V	13	11	1
VI	8	4	1
VII	4	1	3
VIII	4	1	3
IX	5	4	1
X	4	3	1
Total	70	36	26

surveyed responded to the survey.

These findings indicate that the sampled institutions were reporting a fairly high degree of use or intentions to develop CA MIS projects. Only eight of the seventy had no current plans for adopting CA MIS.

B. Users versus Non-users

One of the assumptions listed in Chapter One was that outputs of higher education could be measured quantitatively. On this basis, two comparisons of user/non-user institutions were made. Analysis of variance tests were used employing two measures of output, or production, as a basis for comparison. Those two measures were enrollment and degrees awarded.

Enrollment data were collected from the Education Directory (35) while degrees awarded data were obtained from Earned Degrees Conferred: 1971-72 (36). In each case, the publication was the most recent one available from the United States Department of Health, Education, and Welfare.

The computed mean enrollment for CA MIS users was calculated at 14,100 students, while the mean for non-users was 7,356. Thus, the mean enrollment size of CA MIS users was larger than that of non-users. An analysis of variance test was applied to determine whether any differences existed in size of institution between CA MIS users and non-users. Table 3 presents this computation.

The mean square value for colleges divided by the mean square value for within yielded a calculated F-value of 10.14 which was highly significant at the one percent level. On the basis of the available evidence, there was clearly a significant difference in enrollment size between the two groups of colleges.

Table 3. Analysis of variance of enrollment of CA MIS users and non-users

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Colleges	1	795,278,800	795,278,800
Within	68	5,330,069,134	78,383,369
Total	69	6,125,347,934	-

$$F_{1,68} = \frac{795,278,800}{78,383,369} = 10.14^{**a}$$

[a]The table value of $F_{1,68}$ is 3.98. **Denotes significance at the .01 level, here and throughout.

A second concern was whether CA MIS users were different in degree production, that is, in numbers of graduates produced from non-users. CA MIS users conferred a mean of 2,808 degrees, while non-users conferred a mean of 1,377 degrees. The computation of the analysis of variance appears in Table 4.

Table 4. Analysis of variance of degrees conferred by CA MIS users and non-users

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Colleges	1	33,768,643	33,768,643
Within	64	107,450,805	1,678,918
Total	65	141,219,448	-

$$F1,64 = \frac{33,768,643}{1,678,918} = 20.11^{**a}$$

[a]The table value of $F_{1,68}$ is 3.99.

Again, as with enrollment, a significant difference existed at the one percent level between CA MIS users and non-users in their institutional production of degrees.

In summarizing the results of the first phase of investigation, a substantive number of colleges and universities in the pilot exploration were using CA MIS techniques, and significantly larger differences existed for users in terms of both enrollment (level of "business") and degrees conferred (output). It may further be stated from this evidence that larger institutions tended to be involved in development and implementation of CA MIS.

The null hypothesis (that no difference existed between institutions using CA MIS and those that did not on the basis of two measures of output) was rejected from the findings.

C. Factors Related to the Development Process

Of the 70 respondents to the initial survey, thirty-six were using CA MIS. Of those, seventeen indicated a willingness to participate in a detailed analysis of their computer assisted management information system. All seventeen of those contacted responded to the thirty-one item questionnaire for a 100 percent response rate.

One of the first areas of inquiry was related to the length of time that CA MIS users had been using computers for administrative purposes. Two colleges had used computers administratively for less than five years, while ten had used them from five to fifteen years for this purpose. Nearly a third, five of the seventeen, had used computers for more than fifteen years.

Not every college or university owns its own computer. Less than one-third, five of seventeen, of the responding colleges and universities had dedicated, on-site computers used solely for administrative purposes. Ten reported combined administrative/instructional computer use, while only one of the colleges purchased computer service through a service bureau arrangement. Consortium arrangements, while used by two colleges, did not appear to be a popular approach.

Computer assisted management information systems require some motivating force to bring about such a development project. Tables 5 and 6 summarize two types of forces that led to the CA MIS development in the responding institutions. The data in Table 5 indicates that line administrators were heavily responsible in promoting CA MIS development. In six of the seventeen cases, the applications were promoted by Vice President level staff, while in five situations, Directors of Institutional Research were the key promoters. There was no pattern to the other five persons reported as being primarily responsible for CA MIS project development.

In analyzing the level of importance various factors played in the institution reaching a decision to adopt a CA MIS, the highest ranking factor was "a recognized need for improved planning and reporting data". Closely following were "recognized need for meeting state reporting requirements", "recognized need for optimization of internal communications", and the "need for centralizing an information center". Thus, reporting and improving communications led the list of reasons. Low ranking items included state and administrative directives and innovative desires.

It appears from the evidence in Tables 5 and 6 that CA MIS were

Table 5. Persons or agencies involved most in promoting CA MIS development

Force	Number
Institutional governing board	1
President	1
Vice President-Administration, Academic Affairs, Planning, or Finance	6
Director of Institutional Research	5
Other	3
No response	1

Table 6. Factors contributing to CA MIS adoption decisions

Factor	Rank of Importance
A recognized need for improved planning and reporting data	1
Needed for meeting state reporting requirements	2
A recognized need to optimize internal communication ability	3
A recognized need for a centralized information center	4
Needed for meeting federal reporting requirements	5
A recognized need to optimize computer service utilization	6
Administrative directive	7
Desire for innovation	8
State agency directive	9

developed for practical, operational reasons rather than administrative or agency reasons.

Various types of support are available to institutions that move toward adopting CA MIS. Among them are the external elements such as vendors of hardware and software and consultants, and the internal moral and technical support elements.

Vendors of hardware and software were used most highly in the type of activities that were a prelude to actual development, that is, in needs assessment and in preliminary planning. Less important uses were in the activities dealing with technical development such as preparing systems specifications, system design, and documentation design. Table 7 ranks the activities of vendors in the order of their contribution and involvement in the project.

Two types of institutional personnel support were examined in the study. The moral support contributions in preliminary development stages were most highly offered by special staff administrators and data services or management team personnel. This is a logical finding since these staff groups have a high degree of need for the CA MIS output potential. At the other end of the continuum of moral support were students and faculty who, although they would perhaps be most affected by the impact of CA MIS planning outcomes, were least important in supporting the development project.

The contribution of technical support for the development effort most frequently came from data systems technical staff and special administrative staff. Surprisingly, vendors and consultants were ranked next to lowest as providing technical support to the development effort. Two probabilities

Table 7. Use of external vendors and consultants in selected activity phases of CA MIS development

Activity	Rank Order of Use
Surveying institutional need for CA MIS	1
Developing CA MIS adoption plan	2
Determining sub-unit user needs	3
Implementation	4
Selection of software	5
Programming and systems analysis	6
Selection of hardware	7
Developing system specifications	8
Developing documentation design	9.5
Developing system design	9.5

exist for this finding. Vendors and consultants either had no recognized expertise at the time the respondents developed their systems, or the institutions involved did not have capital funds to support the use of external parties in the development cycle. These probabilities are hypothesized, since no data were collected about the reasons for the relatively limited contributions of technical support from those sources. A Spearman rank order correlation was computed to assess the relationship of predesign moral and technical contributions. The coefficient of correlation was computed to be .964, thus allowing the inference that those endorsing the project also contributed highly to the technical development.

The rank order listings of sources of moral and technical support appear in Table 8.

Table 8. Contribution of institutional support by selected groups in the pre-design stage of planning the CA MIS

Support Group	Rank of Moral Support	Rank of Technical Support
Special staff administrators	1	2
Others[a]	2	1
General administrative officers	3	3
Academic administrators	4	4
Consultants and vendors	5	6
Faculty	6	5
Students	7	7

[a]Includes technical and computer services staff.

The literature review indicated that time requirements for development were frequently longer than anticipated. Table 9 summarizes the findings related to various activity time requirements. As may be noted, substantive time requirements were needed for planning the CA MIS. A majority of the respondents spent one to two years in planning and three institutions devoted more than three years to planning. Only two colleges devoted less than one year to this process.

The time needed to design the total CA MIS was also significant for most of the respondents. The findings indicate that all but three of the seventeen participants were able to complete system design activities in two years or less. The other two institutions required three or more years

Table 9. Frequency of length of time in years that the CA MIS was in various development stages (N=17)

Time Period	Pre-design Planning	Design	Implementation
Less than a year	2	4	1
1 or 2 years	10	10	10
3 or 4 years	1	1	2
5 or more years	2	1	2
No response	2	1	2

to complete this activity.

The data indicated that for many of the respondents significant time investments were again required to implement or set the system into action. Data in the table demonstrate a one to two year interval being required for the CA MIS implementation stage for most respondents. Four of the seventeen who responded to this item required three or more years for this effort.

When considering the total time required for planning, designing, and implementing the CA MIS, it would appear from the data that a typical institution could devote from three to six years for such a task. This time commitment, while essential for producing a well-planned, well-designed CA MIS, also creates additional requirements for the personnel and institutional activities during the period, since dual "old" and "new" approaches are concurrently in operation and under development.

The time requirement in and of itself requires investment for planning purposes, but at the same time affords opportunity for inservice

preparation of potential users.

Closely allied to the time element was the approach taken in development of the CA MIS. Table 10 summarizes the strategy followed by respondents. Several approaches exist for developing CA MIS. One is to plan, design, and implement a total system in one effort. Obviously, an approach such as this would require a maximum effort by the institution and would mandate an intensive task. Only one respondent in the study followed this approach. A second alternative is the development of sets of modules, or subsystems, in phases. An example would be the student system typically made up of component subsystems such as admissions, records, registration, and financial aids. Four of the respondents used this strategy which permits a functional subsystem to be developed in a single effort.

Table 10. Strategy used in developing the CA MIS (N=17)

Methodology	Frequency
Total system at one time	1
Sets of modules, in phases	4
Module-by-module	10
No response	2

The third strategy, and the one most frequently exercised by respondents was the development of single modules on an individual basis. Two-thirds (10) of those responding utilized this approach. The advantage of this technique is apparent in that minimal institutional personnel requirements exist at a given point in time, and a balance of development

tasks is possible over a period of time. Needed for such a strategy, however, is a master plan for development with constant reference to that plan to assure system integration occurs as each is developed. Two respondents did not indicate their development strategy.

One aspect of the development process involves the potential use of externally prepared and marketed software packages as opposed to in-house developed software (computer programs). Responses reflected by Table 11 indicate a seemingly limited use of ready-made software packages for management, retrieval, and security system applications. Interpretation of these findings permits the inference that data management, retrieval, and security systems were more frequently developed by the institution than they were purchased. Decisions to build rather than buy were presumably made on the premise that those data systems could more easily or economically be developed than purchased and modified to fit local operating systems. Data were not collected, however, to support this presumption.

Table 11. Utilization of selected types of externally produced software

Type of Product	Number Using
Data management system	8
Data retrieval system	6
Data security system	5
Others	3

It was considered important to analyze how flexible respondents felt the ready-made software packages were for adoption into local systems.

Table 12 reflects the degree of flexibility each of the ready-made types of data packages seemed to have as reported by participants in the study.

It could be predicted that the flexibility of ready-made software products for institutional adoption would have an inverse relationship to the time and effort required to modify that product to fit the institutional system. That is, commercial systems with great flexibility for adoption would require less total time and effort for integration than those with lesser degrees of flexibility.

Table 12. Frequency of degree of flexibility ready-made systems had for institutional adoption

Degree of Flexibility	Data Management	Data Retrieval	Data Security
Unlimited flexibility	1	2	1
Very flexible	3	2	2
Somewhat flexible	2	1	0
Little flexibility	1	0	2
No flexibility	1	1	0
Not Used	9	11	12

The data in Table 12 seems to indicate reasonable flexibility potential for adoption efforts, at least as reported by respondents. Data retrieval and data security systems had greater numbers in higher flexibility categories than data management systems, yet none of the three types of ready-made systems upon which data were collected had substantial frequencies in the lesser flexibility categories. It should be noted, however, that the number of responses is limited and generalization inferences

should be drawn cautiously.

The data collected permit a conclusion that reasonable flexibility may be expected with ready-made software products, but not all institutions reporting the use of these packaged systems consider them equally flexible.

The personnel requirements to staff and support the CA MIS was another area of investigation. Data in Table 11 reflected limited use of externally produced software. This permits an inference that in-house personnel were extensively involved in developing software. The literature review also reflected that extensive time and personnel requirements existed for CA MIS development. It followed, then that data regarding the types and numbers of new personnel needed to develop the CA MIS should be collected. These data are presented in Table 13. Respondents reported that substantive personnel requirements existed for developing and operating the CA MIS. CA MIS managers and data base managers (supervisory personnel) were needed at an approximate rate of one person each in each of the responding institutions. Technical personnel (analysts and programmers) were needed with two-to-three additions required for each category per responding institution. The highest numbers of new personnel needed were in the Operator Personnel category, with an equivalent of over eight persons needed in each responding institution.

Data were not collected concerning the total number of personnel required to support the CA MIS effort, since in many institutions precise delineation of responsibilities cannot be distinguished. It is apparent, however, that additional personnel are required, and that some of them would be relatively high priced individuals.

Table 13. Type and numbers of new personnel required as a result of the CA MIS development project

Classification of Personnel	Number of Institutions Reporting Need for these Staff Additions	Full-time Equivalent Number of New Staff Required
CA MIS manager	9	1.11
Data base manager	6	.92
Lead analyst	3	2.17
Systems analyst	6	2.50
Programmer	9	3.14
Data entry personnel	4	2.88
Operator personnel	3	8.50

One of the major concerns held by institutions contemplating CA MIS development relates to the cost or investment required. Colleges and universities with sizeable computer facilities and with many data systems personnel would have one type of concern in development of a CA MIS, while those with limited hardware and personnel would have different considerations. Methods of funding CA MIS development efforts is summarized in Table 14. The most common method of funding CA MIS development projects was through the use of existing budget allocations. Seven of sixteen respondents reported this to be their source of financial support. Another six colleges and universities reallocated budget resources to accommodate development costs. This activity would consequently result in budgetary reductions for other institutional operations, but would not alter the total institutional budget. Two of the respondents created special funds

for the development task and established a new budget category while one college received external federal funding support to develop its project.

Table 14. Method of funding the CA MIS project (N=17)

Funding Method	Frequency
Reallocated existing institutional resources	6
Utilized existing institutional budget	7
Special funds were allocated and new budget category was established	2
Other	1
No response	1

Analysis of the combined factors of extended time requirements for development, the need for supplementation of existing personnel with new staff, and predominant funding from existing resources permit the conclusion that the development process is a significant undertaking by an institution, and one which cannot be entered into lightly or casually.

The cost of maintaining the CA MIS project once implemented is another factor requiring consideration. Respondents participating in the study reported Fiscal Year 1975 budgets ranging from $7.2 million to $350 million, with a median for the group of $66.036 million. The mean percentage of total budget expended for CA MIS operations was computed to be 0.77 of one percent (seventy-seven hundredths), or approximately $508,000 per year based upon the group mean. The percent of total budget

utilized for CA MIS was estimated by respondents, since precise data often were not available. Never-the-less, half a million dollars represents a significant expenditure for computer operations in support of management and planning even in the largest institutions.

The totally integrated data file system is most characteristic of the "true" CA MIS. With this organization of data, one master file for all data elements is maintained through the central processor and storage facility. Only three of the respondents utilized this format in their system. Nine maintained independent files with integration capability. Several reasons exist for this approach. First, data may be stored in smaller units or in remote locations. Second, a capacity exists to modify or manipulate portions of the data base without disturbing the balance of the master file. And, third, the ability to convert an existing potpourri system to a CA MIS master data system in stages or phases is possible. Four respondents reported the use of independent files with no integration capability. This approach, although manageable, creates extensive programming cross-over difficulties, as well as the possibility that incompatible computer languages may exist among the subfiles. This system is least characteristic of a true CA MIS.

One of the requirements presented in the literature review to have an effective CA MIS was the ability to retrieve information from the system. Essentially, information retrieval may be accomplished in two ways. The batch mode is a retrieval method wherein data are retrieved upon recall from storage and request/delivery turnaround time is measured in hours.

On-line or interactive mode retrieval is characterized by immediate retrieval (measured in seconds of turnaround time) and on-the-spot addi-

tion, modification, or deletion of data elements is possible. Output for the interactive mode is frequently displayed on a video screen (cathode ray tube), whereas batch output data are frequently displayed on paper. By far, the most popular method of information retrieval was the combined batch/on-line mode with thirteen of the seventeen respondents indicating this use. Three colleges utilized batch processing only, and a single institution used on-line processing only.

The information that may be maintained in a CA MIS is nearly infinite. However, in general terms, five or six major modules or subfiles are normal. Typical modules are student data, course and curriculum data, staff data, facility data, financial data, and, in some systems, equipment data. In Table 15 that follows, the extent to which specific subfile data were included by respondents is summarized. As may be noted, the highest utilization category for student/course information was the "Current Use" category with a total use case rate of 71. Within that grouping, course information was most highly included in the CA MIS with student master files, registration, and admissions information following closely in rate of use. The second largest category, and one which demonstrates evidence of an on-going CA MIS development process, was the "Planned" category with 31 reported cases.

Types of student data not yet included, but planned for the future were led in frequency by student scheduling, financial aid, and alumni records. Alumni records and financial aid information held the lowest level of current use, but also held the highest level of intent for future applications as did student scheduling for those that did not have it in operation.

Table 15. Frequency which student and course (curriculum) data were incorporated into the CA MIS (N=17)

Type of Subfile	Not Included	Planned	Being Implemented	Current Use
Admissions	1	4	2	10
Registration	0	4	2	11
Financial aid	3	5	1	8
Student master file	0	4	1	12
Student scheduling	1	6	1	9
Alumni records	4	5	0	8
Course/curriculum file	0	3	1	13
Total	9	31	8	71

Relatively high use levels among course information, student scheduling, and registration data appears logical due to a high interrelationship of such data elements for CA MIS operational processing.

Table 16. Frequency which staff data were incorporated into the CA MIS (N=17)

Type of Subfile	Not included	Planned	Being Implemented	Current Use
Position analysis	2	5	2	8
Employee profile	2	6	1	8
Payroll	1	4	1	11
Staff Evaluation	9	5	0	3
Total	14	20	4	30

The largest category of staff data reported in Table 16 was "Current Use" with 30 cases. The second largest category was "Planned" with a frequency of 20. It was of interest to note that "Not Included" situations had a total of 14.

Within subfiles, payroll was most highly used and staff evaluation applications least often used with the CA MIS. The low level of evaluation use apparently exhibits the inability to mechanize judgmental data in a computer format. Employee profile information and position analysis information were not as highly incorporated in the CA MIS as might be expected, since a number of external report requirements often exist for this type of information.

Table 17 indicates that the category with the greatest level of use for facility data was with the "Current Use" category with a total of 33 situations. Within subfile types, room and building inventories were maintained by thirteen of the seventeen respondents. This information is closely allied to the course and curriculum information used in the student module. Planned use of facility data was reflected at a fairly high level particularly for land inventories and capital date (capital data being defined as the broad category of resources for physical plant-related activities). Land inventory was least frequently included in the CA MIS as of the survey date, perhaps because of its basic stability.

Table 18 exhibits the use levels of equipment subfiles. Both the "Planned" category and "Current Use" had equal application frequencies. Within subfiles, consumables were least frequently included in the CA MIS, yet from an operational standpoint, would conceivably be one of the more important monitoring needs of the management program. Major equipment,

Table 17. Frequency which facility data were incorporated into the CA MIS (N=17)

Type of Subfile	Not Included	Planned	Being Implemented	Current Use
Room inventory	1	3	2	11
Building inventory	1	2	1	13
Land inventory	7	6	0	4
Capital data	3	6	2	5
Total	12	17	5	33

Table 18. Frequency which equipment data were incorporated into the CA MIS (N=17)

Type of Subfile	Not Included	Planned	Being Implemented	Current Use
Fixed equipment	2	6	2	7
Movable equipment	1	6	2	8
Consumables	8	6	0	3
Total	11	18	4	18

both fixed and movable, were not included in the system at substantial rates but plans to include such data were fairly high. The importance of equipment and consumable material use relates to programs, course, and student load information in the sense of operational support.

Table 19 indicates that financial data were reported most highly in the "Current Use" category. All institutions either had current use status,

implementation process status, or planning status for fiscal data. None had excluded such information from the planning system supported by the CA MIS.

Table 19. Frequency which financial data were incorporated into the CA MIS (N=17)

Type of Subfile	Not Included	Planned	Being Implemented	Current Use
Budgeting data	0	4	1	12
Accounting data	0	6	2	9
Total	0	10	3	21

In summation of the preceding five tables, it is obvious upon inspection of the data that the CA MIS employed by institutions are generally not fully developed, but rather represent various stages of development and utilization, even within subfiles. The data that were collected permit the inference that comprehensive, all inclusive CA MIS activities do not "just happen" nor do they appear to be fully implemented on a master system basis.

The findings presented thus far have primarily addressed the level of data utilized in an operational level of CA MIS. Table 20 examines the statistical applications of CA MIS. Statistical applications are generally geared to report data as of a point-in-time, as compared to operational applications which are based upon day-to-day activities. Statistical use is based upon policy decisions, and frequently forms the basis for routine report generation requirements such as those mandated by the Higher Education General Information Survey (HEGIS) or state or other

federal, or even institutional report needs.

Table 20. Frequency which statistical data were incorporated in the CA MIS (N=17)

Statistical Area	Not Included	Planned	Being Implemented	Current Use
Students	0	5	1	11
Staff	1	6	0	10
Facilities	2	5	0	10
Equipment	3	9	0	5
Courses	2	4	1	10
Finance	1	5	2	9
Total Use Cases	9	34	4	55

Statistical systems make up the second level of sophistication of CA MIS following the operational system, and precede the planning, programming, budgeting system in complexity.

The largest category for statistical data utilization as reflected in Table 20 was "Current Use", with 55 use cases reported. The "Planned" category represented another 34 case situations. The greatest "Current Use" subfile was that of student data with eleven of the seventeen institutions reporting this application. Statistical applications for staff, facilities, and courses (curriculum) followed with ten respondents using each. The statistical applications appeared to reflect the kinds of information reports most typically needed for submission to higher levels, or those of greatest concern in planning activities.

One factor highly important in the initial CA MIS design and development process involves the definition of the items or data elements to be included in the data base. This activity is crucial to the success of the CA MIS in that it provides specific definition of the elements of data. The end product of the definition process is often called a data element dictionary. Its primary value lies in the specificity and singularity of terms and their use. Applied on an institution-wide basis, this activity precluded the possibility of confusion over terms and possible duplication of data.

Institutional derivations were most commonly used by respondents in defining data elements. The institution's state governing agency (to whom reports are sent) and NCHEMS sources also were important sources according to the participants. Use of definitions from the NCHEMS system has an advantage of potential inter-institution comparison studies as well as compatibility with national reporting requirements. Latitude offered by national report centers does, however, permit institutional definitions to suffice in many situations.

An important factor contributing to the integration capability of subfiles is the extent to which data element definitions are compatible among or between subfiles. Table 21 summarizes how common data elements are among subsystems. It is apparent from the data in the table that not all CA MIS have internally compatible data element definitions. While six of sixteen who responded reported all definitions were common among subsystems, ten reported some degree of disparity among data element definitions. This condition would provide difficulty in achieving the maximum potential from the CA MIS, since a degree of incompatibility exists

in how data elements could be used. The one institution reporting "very few" data element definitions as being common would, in all probability, have difficulty in effective utilization of its CA MIS, unless that limitation was widely known and provision was made for managing that problem.

Table 21. Commonality of data element definitions among CA MIS subsystems

Degree of Commonality	Frequency
All data element definitions are common	6
Most data element definitions are common	9
Very few data element definitions are common	1
No data element definitions are common	0
No response	1

Development of a CA MIS is not without its problems. Table 22 summarizes the degree or extent to which selected problems were encountered in the CA MIS development effort. According to the data in the table, the greatest problem encountered in CA MIS development was with financial constraints. Following closely were personal conflicts and policy issues. Personal conflicts and policy issues are logically closely associated factors. Their proximity on the problem scale is logical, since policy issue resolution requires give and take by two or more parties.

The least important problems reported by respondents were lack of

consulting assistance, inadequate master planning, and lack of top administrative support. These findings are supported by the data in Tables 7 and 8 which indicated relatively low dependence upon consultants and strong support by upper level administrators.

Table 22. Extent to which selected problems were encountered

Category	Rank in Order of Greatest Problem
Financial constraints	1
Personal conflicts	2
Policy issues	3
Lack of related experience	4.5
User/developer coordination	4.5
Personnel turnover	6
Inadequate advance planning	7.5
Lack of top administrative support	7.5
Lack of consulting assistance	9

Table 23 summarizes data collected in relation to cost and time effects on the CA MIS budget. The data in the table indicate that the greatest overrun on planning estimates were time requirements. The second highest ranked factor affecting the development process was budget reduction, and the third was cost of hardware. Personnel and software costs were factors least affecting the CA MIS development project. The finding that budgeted time requirements took longer than expected is also supported by the data

in Table 9.

Table 23. Cost and time effects on the CA MIS budget

Factor	Rank Order of Greatest Overrun on Initial Estimates
Development time requirements	1
Reduced institutional budget	2
Hardware costs	3
Personnel costs	4
Software costs	5

The second problem thesis around which this study was designed, that the development of CA MIS is an involved process requiring institutional commitment of resources, is supported by the findings of the preceding section.

D. Outcomes of CA MIS Development

This section presents findings about respondent use of CA MIS in institutional applications, advantages, disadvantages, and problems encountered.

Table 24 summarizes the rank order of improvements noted in selected functions as a result of having developed and implemented a CA MIS. According to the data, the highest level of improvement was found in state report generation followed by federal report generation as a result of implementing the CA MIS. Next, below report generation were administrative use for decision-making and institutional research.

Table 24. Ranking of improvements noted in selected functions as an outcome of having implemented a CA MIS

Function	Rank Order
State report generation	1
Federal report generation	2
Administrative use in decision-making	3.5
Institutional research	3.5
Improved internal communication	5
Optimized administrative computer services	6
Computer hardware needs	7
Planning staff size	8
Hard copy storage reduction	9
Total administrative staff size	10

The third position ranking of administrative use for decision-making seems to indicate that the primary improvement has not been in the area of planning (decision-making), although data were not collected on the basis of which functions increased the most through CA MIS adoption. In view of the data in Tables 15 through 19, it is not surprising that decision-making use rates at the position in which it is found. Had full information been currently available, it is possible that decision-making use may have been ranked more highly by the respondents.

Action capabilities of the CA MIS and support staff are summarized in the following table. The greatest capability of the CA MIS features se-

lected for special investigation according to the date in Table 25 was that relating to the ability to alter data by addition, modification, or deletion. Following this action capability was information retrieval across major subfile categories, one indicator of a well designed CA MIS. The third action capability was the ability to respond to unanticipated report or information requests.

Table 25. Rank order of selected action capabilities of the CA MIS and support staff

Action	Rank Order
Ability to add, correct, delete data in existing files	1
Ability to retrieve information across major subfile areas	2
Ability to respond to unanticipated information requests	3
Administrator assistance needed for information retrieval	4
Ability to retrieve historical data	5.5
Difficulty in training new users	5.5
Difficulty in training new operators	7

It appeared from the data that administrators needed assistance with information retrieval requests. The literature review indicated that one strong point of a well designed CA MIS would permit a non-technically oriented person to use the system. It would seem from the data that such was not a major feature of the systems studied. Similar difficulties were

reported by respondents in the training of new users. Placement of that rating would reflect somewhat of a problem for such training. Respondents also reported that training new operators for the CA MIS was its least highly rated capability feature.

Closely associated with the degree of functional improvements (Table 24) and action capabilities (Table 25) is the degree to which selected management and planning activities were enhanced because of having adopted the CA MIS. Table 26 summarizes these findings. Report generation and record keeping were reported to have been enhanced equally highly by having implemented the CA MIS. Following closely were analyzing course load demands, faculty activity analysis, and student enrollment pro-

Table 26. Ranking of the degree to which selected management and planning activities were enhanced by utilization of the CA MIS

Activity	Rank Order
Record keeping	1.5
Report generation	1.5
Course load demand analysis	3.5
Faculty activity analysis	3.5
Student enrollment projections	5
Space analysis	6
Fiscal operation projections	7
Planning, programming, budgeting	8
Equipment analysis	9

jections. Activities least enhanced were planning, programming, budgeting (PPB) and equipment analysis.

The relative standing of PPB (eighth in a list of nine activities) is of interest since this activity represents one of the primary reasons for adopting a CA MIS. PPB is the type of activity that would be representative of the highest level of CA MIS sophistication. Its relatively low status is one indicator that CA MIS projects are not yet fully developed.

Respondents were asked to describe the degrees of advantage or disadvantage that they found with a number of CA MIS functions and characteristics. This data is presented in Table 27. The strongest advantage of the CA MIS was reported for two factors, record keeping and report generation utilization, both of which are predominantly operational level activities. These were followed by value as an analytical tool, administrative acceptance, and user acceptance and reliability of input data.

Lowest level advantages (approaching a limitation category) were the factors of experimentation, complexity of input requirements, hardware requirements, and budgeting information. Of these four, budgeting and experimentation (simulation) are two primary, potential applications of high level CA MIS operations. These findings, as with others in this study, reflect a lack of realizing the potential for CA MIS applications.

Analytical applications generally fell in the central range of the rankings, which indicates some degree of application, but not at levels that would indicate maximum utilization.

The findings in this part of the chapter support the third problem

Table 27. Ranking of strengths and limitations of selected CA MIS characteristics

Factor/Characteristic	Rank Order
Record keeping	1.5
Report generation	1.5
Value as an analytical tool	3
Administrator acceptance	4
Reliability of input data	5.5
User acceptance	5.5
Space Utilization analysis	7
Faculty activity analysis	8
Data base factors	9
Level of generalization	10
Program cost analysis	11
Cost of operation	12.5
Enrollment forecasting	12.5
Budgeting	14
Hardware requirements	15
Complexity of input requirements	16
Experimentation	17

thesis, that not all colleges and universities use their CA MIS for the same purposes or at the same level of decision-making and planning. This conclusion may be drawn from the data presented in Tables 24 through 27.

E. Summary

This chapter has presented the findings of the investigation. It includes the response rate to the surveys, the difference between CA MIS users and non-users based on two measures of output, factors involved in the development process, and the outcomes of CA MIS development.

V. DISCUSSION

As was stated in Chapter I, the purpose of this dissertation was to investigate factors related to the development and use of computer assisted management information systems (CA MIS) in public higher education in the United States. The study attempted to analyze the kinds of issues that should be considered in the process of developing a CA MIS in pursuit of better institutional management practices.

The CA MIS in and of itself is a relatively new higher education management tool and few comprehensive studies of this nature have been completed. It was hoped that by completion of this research, institutions contemplating a CA MIS project would have access and answers to some of the more critical issues that should be considered in making such a decision.

This chapter includes the following points of discussion:

A. Utilization of CA MIS in the Public Higher Education Sector.

B. Factors Related to CA MIS Development.

C. Features of CA MIS Systems.

D. Utility of CA MIS.

E. Analysis of the Propositions.

F. Limitations of the Study.

G. Recommendations for Further Study

H. Summary.

The Review of Literature set the stage for the study. Colleges and universities were characterized as complex organizations, subject to political influences from within and from without. Immegard and Pilecki (16) developed a rationale leading to the conclusion that for institutions of higher

education (as complex, political systems) to be successful, they must deal with the essential functions of conscious planning, pursuit of goals, concern for use of resources, and receptiveness to modification and change. Technological advancement, particularly with respect to computer applications in planning and management, led to the evolution of the computer assisted management information system (CA MIS) as one means of focusing on these essential functions.

It became apparent from the literature that a need existed to examine CA MIS use in public higher education to answer the development questions of "how" as well as "why" for institutions seeking an opportunity to capitalize on this type of planning and management tool.

A. Utilization of CA MIS in the Public Higher Education Sector

Preliminary searches for information about CA MIS utilization tended to indicate that limited applications of such systems existed in the public sector of U.S. higher education. In fact, a tentative judgment seemed to indicate that very limited use was being made of CA MIS from the literature that was available.

A brief survey was designed to determine how many colleges and universities in a stratified random sample were either using CA MIS or were planning to develop CA MIS in the near future. It was found, in apparent disagreement with some of the literature citations, that more institutions were using what they termed CA MIS than was expected. One hundred surveys were distributed, and seventy were returned. Thirty-six reported current use of CA MIS and another twenty-six reported plans to develop CA MIS.

With that level of use, it was interesting to note that very little research was available on the topic of CA MIS development.

As is true with many new technological developments, confusion often exists over the true meaning of the language and terminology associated with those items. It does not appear from the evidence nor from the literature, that any different case existed with CA MIS. A functional definition of computer assisted management information systems was provided to the survey addressees with the assumption that all would respond as if they had full understanding of the expression. It was apparent, however, that some who responded affirmatively to the question of whether or not they used CA MIS were, in fact, using data processing for administrative operations. It appears, then that a number of college officials are not fully aware of what a CA MIS really is nor what may be gained from taking advantage of this technological breakthrough.

The literature indicated that one difficulty encountered in higher education was the effective measurement of the outputs of the educational enterprise. For the purposes of the study, two variables were accepted as adequately defining output in order to permit comparison between CA MIS users and non-users. Both opening fall enrollment and the rate of conferring degrees were significantly larger for institutions using CA MIS than those that did not. Size of institution and volume of activity according to these two measures thus characterized institutions which were engaged in the use of CA MIS. This was not a surprising outcome, since one would generally anticipate that larger and busier institutions would have more complex planning and management needs than smaller institutions.

A second instrument was developed to collect detailed information from the seventeen institutions responding that they were using CA MIS and that they would be willing to participate in a more comprehensive study. The survey document was designed around readings in the literature, and with advice from management information system consultants known by the researcher.

The purpose of the instrument was to collect data about a number of selected factors involved in developing and using CA MIS. Discussion in the following sections is based on the responses to that survey.

B. Factors Related to CA MIS Development

One area of investigation was an examination of the time element factor involved in the CA MIS development project. It was also considered desirable to determine the length of time that respondent institutions had used computers for administrative purposes. Fifteen of the respondents reported having used computers for more than five years for this function. This would tend to support an assumption that institutions had a general acceptance of computer use and a recognition of their application potential.

In examination of the type of access administrators had to computers at the institution, it was found that most often combined administrative/ instructional uses were practiced. Availability of the computer in situations such as this creates an additional management problem related to priorities of use. Although specific data were not collected on priority of use, the fact that the administrative computer was shared with instruction creates the question of who uses the hardware and at what times.

This consideration is directly related to development time requirements since the old system would have to be maintained while the new one was being implemented and instructional time would place yet another demand on computer availability.

Generally stated, extended time requirements existed for each development phase studied. The modal time interval for predesign planning activities was one to two years. The time requirement for the design stage again was also one to two years. And in the third development category studied (implementation), the modal response was again one to two years.

It appears, then that at least three to six years are typically required to bring the CA MIS from pre-design planning to full implementation. In comparing this reported time requirement with the length of time computers had been used by institutions, it is obvious that for many, the CA MIS development project began soon after administrative computer service was procured.

Another major area of interest was related to the whys of entering the CA MIS operation. In general, it appeared from the literature that CA MIS were developed in response to a recognised need for better information, more appropriate information, or more timely information for planning and management. These were supported by this research.

Persons most highly reported to support CA MIS development were those who, if not directly responsible for making decisions, were at least responsible for recommending decision alternatives - the institutional line officers including Vice President for Administration, Academic Affairs, Planning, or Finance, or their equivalent. The second highest category of

persons promoting CA MIS development were those responsible for institutional research. These staff officers are frequently called upon to provide the information needed for planning and management.

It was also considered necessary to examine the forces that caused the promoters of the CA MIS to take their position. It was found that the need for improved planning and reporting data led the list of reasons. This was followed closely by the need to satisfy external agencies to whom institutional reports are submitted and to improve internal communication ability. The findings obviously pointed to the need for improved ability to report and communicate. These findings substantiate other studies. Satisfaction of the report preparation and communication needs enhances the manager's ability to react to situations as well as to become involved in pre-situation management activities.

Two primary types of support exist in preparing for and conducting the CA MIS development project. The first comes from internal sources such as line and staff officers, while the second is made up of external consultants or vendors of products. In general, external support was utilized at a fairly low rate by respondents. When outside sources were used, it was most frequently for the kinds of activities associated with pre-design planning and assessment. Examples cited for use of external consultants were in surveying the institutional need for CA MIS, developing a plan for adoption, and to a limited extent, determining user needs. The least use of consultants was found in the technical activities, including development of system specifications, development of design, and documentation. Thus the high reliance on internal personnel is one which apparently contributed to extended

time requirements for development.

Internal support was characterized by two types of assistance, moral support and technical support. Moral support was most highly contributed by special staff administrators and secondly by data systems technicians. Technical aid, as might be expected from the relatively low utilization of consultants, was most highly offered by the technical data systems staff and by special staff administrators and managers. The high level of moral and technical support provided internally is a logical finding, since those persons are in a position to benefit the most from the CA MIS project. In both moral and technical support categories, students and faculty (instructional personnel) contributed the least levels of support. This finding was not surprising since neither category seems to play a major role in the management or planning function of the university or college.

Various CA MIS development strategies exist for institutions undertaking such a project. The possibilities include total systems development in one massive effort, development of sets of modules (subsystems) in phases, or a module-by-module approach.

Respondents to the survey reported the latter approach in two-thirds of the cases. Several factors should be considered with this approach. First, the development of single subsystems, for example, student admissions or registration, may result in a segmented larger system and problems of integrating the total system may be encountered. Secondly, this approach will extend the total CA MIS development time. It is also probable that dual-use operations of the computer system will be required. On the other hand, one advantage is that fewer total persons are required at a given time in the development process.

Development of the total system in one effort deserves comment. One advantage is reduced time to implement a total CA MIS. However, disadvantages exist, too. Substantial numbers of development personnel are required. extensive development task communications are needed, and massive logistical requirements exist to accommodate the changeover.

The preferred development approach, from the evidence collected, would be one of phasing by functional categories. In this approach, for example, all student modules would be developed concurrently, including the admissions, registration, records, financial aid, and perhaps placement activities. By developing a functional set of modules (subsystems) assurance may be made that the subsystem will be more adequately integrated than with a more segmented approach.

An extensive variety of software packages are available to colleges and universities that are developing CA MIS. Findings of the study, however, indicated that institutions preferred to develop their own software (computer programs) for their CA MIS. Those respondents who used pre-prepared software found, in general, unequal, but adequate flexibility of those packages. It appears that the decision to buy externally developed software is a combined function of its flexibility, the project budget, staff expertise, time, the master design of the CA MIS.

Personnel requirements for the CA MIS development project varied extensively from respondent to respondent. Over half of those responding reported a need to employ a CA MIS manager as the result of the project. A third needed data base managers, and most needed additional programming, entry, and operations people.

A logical linkage exists between the requirements for personnel and the

time needed to produce the CA MIS. Institutions requiring new staff would have the advantage of delegating the development project to those staff, while those not adding personnel would require extended time for development due to the need to continue existing operations while developing the new system.

Data were not collected on the cost considerations of additional personnel; however, it is apparent that some classifications of people needed are relatively expensive. CA MIS managers and systems analysts (supervisors and high-level technicians) are fairly expensive positions to fill in contrast to data entry and operations staff. Yet that type of expertise is required in the development and maintenance of CA MIS.

A final factor included in analysis of the development activity was that related to financing the CA MIS. Of the alternatives available, most of the respondents depended upon existing institutional budgets. This is another factor that contributed to extended development and implementation time as well as the relatively limited use of external consultants.

The second most prominent method of funding the project was through reallocation of existing institutional resources. This method, while not affecting total institutional budget, would require the diversion of funds from other budget activities. Reallocation would probably have to be based upon a prioritization of budget and would consequently result in reduced funding in other areas.

In only three of sixteen respondent situtations were special funds established for the CA MIS project. It is obvious from these findings that special funding for CA MIS development is not always available for this

kind of project. Institutions are thus confronted with a trade-off situation. They must trade away time and external consultant services in exchange for in-house development.

An encouraging note is that institutions, in the face of stabilizing, or even declining funding support, are willing to take on the additional expense of developing CA MIS. It is apparent that institutions that do so expect a positive cost-benefit in future activities as a result of the project.

The level of financial support needed to maintain the CA MIS, once implemented, varied from a half of one percent to two percent of the institutional budget. It appeared from the evidence collected that this support level was inversely related to the size of the institutional budget, although a correlation was not computed due to limited sample size and approximated responses. By observation, it appeared that colleges with relatively small budgets were spending more on a percentage basis to support the CA MIS than were those with substantial operating budgets. It is likely that the efficiencies gained through improved management capabilities would offset the financial investment in the CA MIS.

C. Features of CA MIS Systems

One of the current operating system factors studied was the organization of the data base. A minority of respondents reported the use of a totally integrated file structure, while slightly over half reported the use of independent files with a potential for integration. Whichever of the two approaches is used, one critical concern is the capacity of the system to blend data from various subfiles to generate reports and management information that is accurate, useable, and meaningful.

The mere storage of data in computer files with no integration capability essentially voids the utility of a CA MIS. It is doubtful that a system with little or no integration capability can even be called a management information system. The retrieval of information from the CA MIS was mentioned in nearly every item of literature reviewed which dealt with characteristics or capabilities of CA MIS. In the current state of technology, two basic methods exist for retrieval of information.

The batch retrieval method recalls data from storage devices and creates a printout information report, within a reasonable period of time, perhaps measured in minutes or hours. The on-line or interactive mode retrieval method utilizes a cathode ray tube (CRT) for instantaneous data display and permits viewing data on a video screen. The CRT device contains a keyboard assembly which enables a user to create instructions for data retrieval and display. Additions, deletions, or changes in the data elements displayed may be made on the spot with the CRT unit. A printing device may also be used with an on-line system to obtain hard copy reports. It was of interest to note that a majority of the institutions used a combined system.

Financially, a greater expense exists with the on-line mode of operation due to the cost of CRTs and the logistics of remote linkages. Users of on-line systems generally place terminals in locations having the greatest need for data access, and might include admissions, personnel, placement, student records, and business office sites.

The types of subfiles most highly reported in use by respondents were financial information and student information, and course (curriculum) information. These files are obviously most closely related to the day-to-day activities of the institution and are a logical starting point for CA MIS development. Less highly incorporated in current CA MIS were personnel, facility, and equipment data files, although respondents indicated an intent to develop such files in the future. These findings alone demonstrate the evolutionary process of creating a CA MIS. More critically needed data are treated on a priority affiliated with daily information needs, while data of a more static nature are considered in later stages.

Day-to-day operational information, in the truest sense, is not management information. Essentially, it is better described as the basis or foundation for driving the management information component of the total information system. Management information basically becomes so classified within the second level of sophistication of the CA MIS, that is, the statistical information system. Slightly over half of the subfiles maintained by respondents had the capability for production of statistical reports necessary for management purposes.

One aspect of using a CA MIS lies with the potential for exchanging data between or among institutions for comparison and evaluative purposes. To accomplish inter-institutional comparisons, however, requires common

definition of data elements among the participating institutions. This research found that the primary source of data element definition lay with institutionally derived definitions.

It is apparent then that inter-institutional comparisons cannot be made effectively when differences exist in definition of data elements. An example is presented for clarification. For instance, how is full time equivalent enrollment (FTEE) defined? Is it computed on the basis of all students enrolled for at least a full-time credit load; is it computed on the basis of total credit hours for which all students are enrolled divided by the minimum credit hours required for full-time status; is it computed on a clock hour basis rather than credit hour basis; or is it based on the total credit hours for which students are enrolled divided by the average full-time student credit load?

Any of the examples given may constitute an acceptable FTEE definition for an institution, but inter-institutional comparisons are not meaningful when divergent definitions exist. This issue is further compounded within institutions. Only six of the seventeen respondents reported that all data element definitions were common across all subfiles maintained in the CA MIS. Thus, caution must be exercised with institutional data interpretations when the use of or definition of data elements is not consistent. Lack of common data definitions would also lead to difficulty in achieving maximum integration potential for subfiles for report generation and the production of management information.

D. Utility of CA MIS

The discussion thus far has considered a number of factors related to development and design of CA MIS and several of the more visible features of them. It is important to include an analysis of outcomes recognized by institutions that use CA MIS.

One area of study included the extent of improvement noted by users in selected management functions. The highest degree of improvement was reported in report generation, for both state and federal purposes. Closely following were improvements in institutional research capabilities and administrative decision-making. These functional uses are closely related. Report generation is needed as a product of institutional research, and as an input for decision-making and planning. Statistical reports frequently include the type of information needed for management activities, thus the relationship. It was encouraging to find that none of the functions selected for examination decreased or declined as a result of the CA MIS project.

The strongest action capability reported by respondents was the ability to modify existing files by adding, deleting, or altering data. This was followed closely by the ability to retrieve information across major subfile categories, and the ability to respond to unanticipated information requests. These combined features exhibit one of the most positive aspects of CA MIS-that of providing the vehicle for updating data elements in storage, of retrieving data as needed from the file in which it is maintained.

All other special capabilities studied reflected a substantial level of respondent acceptance and ease of system manipulation which further supports the feasibility and advantages of CA MIS in public higher education.

The impact of the CA MIS on enhancement of selected management and planning activities was another factor included in the research. Leading the list of improved management capabilities were recordkeeping and report generation. Both of these contribute to the analytical management process by providing needed information. Most highly enhanced functions were analyses of faculty activity, course load demands, enrollment projections, space utilizations, as well as fiscal operation projections.

Planning, programming, and budgeting (PPB) activities, representative of the most advanced level of CA MIS development, were low on the list of capabilities. This activity is one which is frequently sought after as an end product of the CA MIS, yet its relatively low status in comparison to other analytical measures is not surprising since the preponderant number of systems upon which data were reported were still involved in the development process.

Also included in the study was an analysis of some of the problems encountered in developing the CA MIS. The greatest problem encountered was related to financing the project. Next most frequent were personal conflict and policy issues. The relationship between these two variables is easily understood. Policy problems must undergo a resolution process in order to permit advancement on the CA MIS project. The resolution of policy indicates the need for persons to interact and to arrive at a mutually agreeable position. It becomes obvious, then, that the process of resolving policy questions would in all probability create conflict of opinion. Personal conflict as a problem area is a real one and is a concern that must be dealt with in developing a CA MIS.

Least important problems as reported by respondents were with the absence of consulting assistance (apparently little was sought after), lack of top administrative support, and lack of advance master planning. By way of interpretation, it was obvious that master planning and administrative support were present in levels adequate enough that they were not considered major problems.

The study collected data from the respondents summarizing the strengths and limitations of each CA MIS operation as it existed at the time of the survey. As with other findings in the study, the greatest reported lay with record keeping and report generation capabilities. Other positively rated factors included value as an analytical tool, administrative acceptance, user acceptance, and reliability of input data. Items tending to display limitations included cost of operation, value in budgeting, complex input requirements, hardware requirements, and value in experimentation.

Ratings of strength or limitation tended to yield responses that were generally positive in nature and which exhibited strengths in categories that would enhance the business of managing the institution. It was apparent that several of the more negative responses (limitations) would be resolved with further advancement and refinement in the developmental process.

Cost and time elements related to CA MIS development comprise yet another item of discussion. The findings revealed in several cases that time requirements needed for the development process were extensive. Respondents reported the time factor as being the highest rated item on over-run of the initial estimate. This was closely followed by budgetary reduction, and hardware cost. It was encouraging to note that although there were cost and

time over-runs that none of them were reported at "very high" or excessive levels.

The findings of the research relative to development time requirements indicate that CA MIS planners need to be aware of the situations that would extend the development task. Constraints on financial resources will spread the development process over longer periods than in situations where no such limitation is imposed. This type of constraint, however, can be managed to some degree. That is, plans for development can be built around financial resource availability.

Less predictable, however, are the problems encountered in policy resolution. It is very possible that resolution of any given policy problem may consume weeks of time. And, if a major policy issue requires solution before a domino-effect can occur for subsequent, related issues, the entire process could be significantly delayed.

E. Analysis of the Problem Statements

It was noted in an initial section of the Findings Chapter that a substantial number of the respondents in the preliminary survey indicated that their institutions were, in fact, utilizing computer assisted management information systems. On the surface, it appeared that the use of CA MIS was widespread in public, four-year colleges and universities. However, when examination was made of the characteristics of systems reported in the second phase of the study, it became apparent that none of those studied fell fully within the definition established for a complete CA MIS. That definition proposed that a CA MIS consists of a set of computerized processes composed of three distinct, but interwoven functions (strategic planning, man-

agement control, and operational control) that utilize a common data base in support of management planning and decision-making.

Further analysis of the data collected in the research substantiated the fact that administrative computer utilization was occuring beyond traditional data storage and computational activities. Achievement of strategic planning capabilities had not been well capitalized upon by the participants in the study. Consequently, a cloud overshadows the reports of respondents. If, in actuality, CA MIS are not used for long-range, strategic planning, can it be said then that the systems are truly definable as CA MIS?

The dilemma appears to be one of semantics. Considering the developmental nature of the systems upon which data were collected, the findings demonstrate that CA MIS can exist as defined, in operable stages representing progress toward a complete, final product, and that strategic planning can be augmented with a partially developed system. The first proposition stated that there are differences between institutions that use CA MIS and those that do not, based upon two measures of productivity. This proposition, when stated as a null hypothesis for inferential testing, was supported by the findings that users of CA MIS had significantly larger enrollments and awarded significantly larger numbers of degrees than non-users.

These results do not imply that only larger or busier colleges should have CA MIS projects. What it does indicate is that institutions with apparently greater activity levels have considered CA MIS to be one answer or solution in aiding institutional management.

If the assumptions stated in the first chapter about the role CA MIS can play in leading to more rational, accountable, and data defensible planning and decision-making are in fact true, a substantial acknowledgement of

these values has been made by the colleges and universities that have developed CA MIS.

The second proposition stated that the development of a CA MIS is an involved process requiring institutional committment of resources.

Nearly every factor involved in the development process supports the second proposition. Extensive investment of time was required for each phase of development. Many respondents utilized outside consultants to some extent in the project. Institutional staff gave both moral and technical support contributions. Some, although not all, respondents reported that they had used externally produced software products requiring financial investment, and most required some modification to fit into the college's system. New personnel were required, ranging from managers and technicians to operators. Institutional budgets were drawn upon extensively to provide developmental resources, and operational support approached nearly one percent of the institutional budget according to respondents.

Equipment needed by the institutions to operate the CA MIS also required committment of resources. Most of those surveyed owned their computer systems and a strong majority had equipment that permitted interactive mode operations (via cathode ray tubes).

Each of these factors directly exhibits or at least infers the dedication of resources controlled by the institution in developing a CA MIS.

Many additional resources are consumed by the project which did not directly appear in the research. Examples include the time investment of administrative staff in setting the stage for CA MIS during pre-design activities, time and resources committed to surveying the institutional need, interviewing each department or unit that will have any relation to the project,

clerical time, computer time, development of new document format. The list appears to be endless.

These many facts, collected directly from the research and inferred by the findings decisively support the second proposition. Indeed, CA MIS development is an involved and resource consuming project.

Support of the third proposition, although perhaps not as obvious from the data as for the first two, was still gained from the research. That proposition stated that not all colleges and universities use their CA MIS for the same purposes or at the same level of decision-making and planning.

Support for this proposition was determined from two different types of data collected in the research task. The first findings were those summarizing the extent to which various subfiles were incorporated in the CA MIS of responding institutions. Although respondents each felt that they had a working CA MIS, no two operations appeared to be at equivalent stages of development. All reported fairly high use of student and course information and financial information, moderate use of staff and facility information and fairly low use of equipment information. As operational activities in a CA MIS project, these were fairly well implemented or were planned for development.

The second level of CA MIS, the statistical system, was also fairly extensively used or at least plans had been made for development in most colleges. However, the highest level of CA MIS, the experimentation or simulation of the future, was not highly reported in use by most institutions.

The second source of support for this proposition is drawn from the findings about how the colleges and universities used their CA MIS and about the advantages and limitations respondents perceived about their systems. Ana-

lytical and management applications were enhanced at different levels in different institutions, and statistical uses and experimentation were perceived differently as to their advantages or limitations. Taken collectively all of these factors contribute to support of the proposition.

Whether the institutional differences in the use and application of the CA MIS was a function of partially completed systems, or differing administrative perceptions of the desired end product of a CA MIS project was neither examined nor answered by this research. It is anticipated that the differences among the CA MIS included in this study would become larger as each system approaches the final development stage. This is as it should be. Each CA MIS should be developed to meet the planning and management needs of individual institutions as those needs relate to institutional goals and philosophy. Research findings allow the conclusion to be drawn that participating colleges and universities are indeed moving in that direction.

F. Limitations of the Study

The major limitation of this study is presented by the restricted sample size upon which detailed data were collected. From an initial potential pool of 3000 colleges and universities, 418 were identified as a research population. Of that number, 100 were selected for the sample. And although seventy responded to the initial survey, only seventeen volunteered to participate in the final investigation. Thus, the study of a relatively new concept was debilitated to some degree by the difficulty in identifying colleges that not only operated CA MIS but which would also provide information about their systems.

The seventeen institutions participating thus provided an exploratory, pilot research opportunity and were of insufficient numbers to permit meaningful generalization of the data. It should also be noted that the randomly selected sample did not include any of the universities of major enrollment magnitude.

Several problems were encountered during the research investigation. Initially, it had been anticipated that most of the respondents who would have reported the use of CA MIS would have been utilizing externally developed systems such as the CAMPUS, RRPM, and SEARCH programs. Consequently it was hoped that a comparison of those systems in use could be included to permit examination of the relative merits and limitations of each system. When the data were obtained, it was found that the preponderant number of respondents were using institutionally developed CA MIS and the comparison analysis was eliminated from further consideration.

Two significant elements of US higher education were excluded from the study. Neither the private sector, nor the two-year community/junior college sector were a part of the research. This limitation was established to eliminate the possibility of divergent results. It is probable that extensive additional data would have been provided from those sources had they been included.

G. Recommendations for Further Study

Several follow-up studies could be developed using this research as a foundation. One of those would be a companion study of private sector institutions to examine their CA MIS development and use. Such a study would re-

veal data for a segment of higher education dependent upon a different revenue structure. A second study could include a two-year component of higher education. Community and junior college systems are faced with problems slightly different from the senior colleges in that many are struggling to rise from adolesence to adulthood at the same time that fiscal limitations are being imposed. Their problems and needs, because of their emphasis and philosophy, are different from those of senior institutions.

Another possible study would involve a more extensive investigation of the population selected for this research. With larger numbers of respondents, greater statistical analysis would be possible. Several variables for analysis would be possible with larger samples, including comparisons between "new" and "old" institutions, single versus multicampus institutions, differences in the length of time which CA MIS had been utilized, and analysis between those opting for commercial systems and those producing their own.

A fourth type of study could be made of any of several components of this research, such as the problems encountered in development, the financing of CA MIS development, or the use of CA MIS in strategic planning and management.

H. Summary

This chapter has presented a discussion of the findings, the implications of the study, limitations of the research, and possible additional research that could be conducted using this project as a point of reference.

VI. SUMMARY

At the close of the decade of the 1960s financial resources became less easy to procure for public higher education purposes. Public college and university planners and managers who had previously been able to meet institutional crises with increased appropriation requests found that the well was beginning to run dry. Concurrently, the technology of computer aided planning began to emerge in response to a recognized need to obtain better information to assist in better management of the resources that were available. One of those tools is the computer assisted management information system (CA MIS).

It was determined that a pilot development and use study of CA MIS in public higher education would be beneficial, not only as a study of the present status of CA MIS, but also as a guide to provoke thought in the minds of those considering the adoption of such systems.

The purpose of the study was to examine factors involved in the proc[illegible]eveloping CA MIS and to provide answers to a number of concerns that [illegible] and should be considered by institutions investigating possible CA MIS project involvement.

The research was conducted in two stages. A preliminary survey asked 100 of 418 eligible institutions to indicate whether they used CA MIS and, if so, would they be willing to participate in a more detailed study. Seventy institutions responded to the initial survey and over half of them reported using CA MIS while another third indicated plans to move into CA MIS activities. Of the 36 colleges and universities who reported use

of CA MIS, only 17 volunteered to become involved in the follow-up study and each then responded accordingly.

Over four-fifths of those responding to the initial survey indicated some degree of activity in CA MIS (operating or planning) which was surprising from other data collected. A 1974 study by Mann (24) cited in the literature review found that only 40.7 percent of his sample of colleges with more than 3,000 enrollment were actually using CA MIS. Another reference indicated that less than ten percent of the colleges with under 3,000 enrollment were using these management tools. Mann found a propensity for the larger, public universities to be using CA MIS which was supported by this research project. This study found that CA MIS users had significantly larger enrollments and awarded significantly larger numbers of degrees than non-users.

The major findings of this study concerning the development and use of CA MIS follows.

Most respondents had used computers for administrative purposes for significant time periods and had either dedicated, on-site computers or shared administrative/instructional hardware.

Reasons given for adopting CA MIS were led by recognized needs for improved planning data, improved report generation, and optimized internal communication capabilities.

Time was an important consideration in the CA MIS development process for pre-design planning, design, and implementation. Those responding showed a tendency to require from one to two years to accomplish each of these three major tasks.

Institutions that adopt CA MIS tend to build their systems in modules (subsystems within categorical systems) and seemed to prefer "home-grown" systems over commercially available packages.

The funding of CA MIS was most often accomplished through the use of existing institutional resources, although budget reallocation was needed to support the activities.

Student-related data and financial data were most frequently maintained in the systems while to a lesser extent were those data for personnel, inventories of major equipment, and facilities.

Most respondents had a fairly high level of statistical data incorporation. That type of data are needed to generate reports and analytic data for planning. One of the disparities noted in the study was that all data elements were not uniformly defined throughout the CA MIS. This can, and will, create problems in effectively using the CA MIS.

The greatest utility of CA MIS was described by users in the areas of report generation to reporting agencies, for production of decision-making information and for institutional research (as related to management information) as well as for internal communications.

Greatest strengths of operating CA MIS as perceived by users lay in record keeping and report generation, value as an analytical tool, administrative acceptance, user acceptance, and trust in the reliability of the data.

Problems encountered and perceived limitations included financial constraints, complex input requirements, hardware requirements, use in budgeting, and personal conflicts during policy resolution in the design process.

The decision to adopt a CA MIS bears with it a required commitment to devote institutional resources. Resources in the form of time, personnel, hardware, and general budget support are necessary to produce and maintain the CA MIS.

Two recommendations have been formulated as a result of this study. First, a replication of this research should be conducted on a massive basis to generate extensive data not available through a pilot study approach. The second would be one of encouraging college and university management and planning staff to seriously consider the adoption of CA MIS, but to enter such an activity only with their eyes open and with an awareness that significant time resources are required to bring the system to implementation and to support its operation.

The major implication concerning improved college and university management that was introduced by this research study is that the progress toward achieving complete, functional, and workable CA MIS has but scratched the surface. The management assistance that may be realized by use of these modern tools offers extensive potential, but the full impact cannot be completely recognized until maturity has been attained - an accomplishment not yet common in institutions participating in this study.

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IX. APPENDIX A: SURVEY INSTRUMENTS

Dear Colleague:

This is a brief survey to assess the extent to which computer assisted management information systems are utilized by selected colleges and universities in U.S. higher education. For purposes of clarity, a computer assisted management information system is a set of computerized processes composed of three distinct but intertwining functions (strategic planning, management control, and operations control) that uses the data base of campus users in support of management, planning, and decision-making.

Would you take a moment to respond and then return the survey at your earliest convenience? Thank you.

* *

1. Does your institution now utilize a computer assisted management information system?

   ☐ Yes

   ☐ No

2. If (1) was answered "No", is your institution presently considering the use of a computer assisted management information system?

   ☐ Yes

   ☐ No

3. If currently using a CA MIS, please indicate the vendor of the software, if applicable.

   _____

4. Would you be willing to participate in a more in-depth survey of CA MIS use?

   ☐ Yes

   ☐ No

5. Name and title of respondent:_____

A SURVEY OF COMPUTER-ASSISTED MANAGEMENT INFORMATION SYSTEMS IN HIGHER EDUCATION

This study is being conducted to assess selected factors related to the development and utilization of computer-assisted management information systems (CA MIS) in U.S. higher education. Would you please spend a few minutes in completion of the survey. If someone else within the institution is perhaps better suited to respond, please forward to their attention. Circle or write in responses as are appropriate.

Thank you.

* *

1. How long has your institution used a computer for administrative purposes?

a. Not at all	1
b. Less than 5 years	2
c. Between 5 and 10 years	3
d. Between 10 and 15 years	4
e. Fifteen or more years	5

2. Which of the following best describes how your institution uses a computer for administrative purposes?

a. Dedicated, on-site administrative computer	1
b. Combined instructional/administrative computer	2
c. Part of an off-site computer consortium	3
d. Purchase off-site administrative computer service	4
e. Other (specify)_____	5

3. Which of the following management tools is your institution presently using for planning and resource allocation?

	Yes	No
a. Planning, programming and budgeting system	1	2
b. Resource allocation models (RRPM, CAMPUS, etc., specify)_____	1	2
c. Institutional research	1	2
d. Other (specify)_____	1	2

4. Indicate whether your institution makes use of the following types of commercially marketed software (programming) products for computer-assisted management information system (CA-MIS) applications?

	Yes	No
a. Data management system (specify product name)_____	1	2
b. Data retrieval system (specify product name)_____	1	2
c. Data security system (specify product name)_____	1	2
d. Other (specify product name) _____	1	2

5. What degree of flexibility did each of the commercial software packages in item 4 have in adoption for use in your CA-MIS?

	Management	Retrieval	Security	Other
a. Does not apply	1	1	1	1
b. Unlimited flexibility	2	2	2	2
c. Very flexible	3	3	3	3
d. Somewhat flexible	4	4	4	4
e. Very little flexibility	5	5	5	5
f. Not flexible at all	6	6	6	6

6. Please indicate which person or office was most responsible for promoting the CA-MIS concept at your institution? (Circle one only)

a. State coordinating board	1
b. Institutional governing board	2
c. President	3
d. Vice President for Administration, Planning, or Finance	4
e. Director, Institutional Research	5
f. Other (specify)_____	6

7. Please indicate to the best of your knowledge the degree of importance each of the following played in your institutional decision to implement a CA-MIS:

	Degree of importance (1=Not Applicable 2=Low 6=Very High)					
a. Need to optimize internal communications	1	2	3	4	5	6
b. Desire for innovation	1	2	3	4	5	6
c. Need to optimize campus computer services	1	2	3	4	5	6
d. Administrative directive	1	2	3	4	5	6
e. Directive from state agency	1	2	3	4	5	6
f. Need for a centralized information center	1	2	3	4	5	6
g. Need for improved planning and reporting data	1	2	3	4	5	6
h. Need for meeting state reporting requirements	1	2	3	4	5	6
i. Need for meeting federal reporting requirements	1	2	3	4	5	6
j. Other (specify)_____	1	2	3	4	5	6

8. To what degree were external consultants or vendors utilized in each of the following in adapting your CA-MIS?

	1=None 2=Low 5=Very High				
a. Surveying institutional need for CA-MIS	1	2	3	4	5
b. Developing an MIS adoption plan	1	2	3	4	5
c. Determination of user needs	1	2	3	4	5
d. Selection of hardware	1	2	3	4	5
e. Selection of software packages	1	2	3	4	5
f. Developing system specifications	1	2	3	4	5
g. Developing system design	1	2	3	4	5
h. Documentation development	1	2	3	4	5
i. Programming and analysis	1	2	3	4	5
j. Implementation	1	2	3	4	5

9. Rank in order of importance the extent to which each of the following groups contributed to the pre-design planning of your CA-MIS. (1=most important)

	Moral Support	Technical Support
a. General administrative officers	_____	_____
b. Administrative officers	_____	_____
c. Academic administrators	_____	_____
d. Faculty personnel	_____	_____
e. Students	_____	_____
f. Consultants and vendors	_____	_____
g. Other (specify)_____	_____	_____

10. How long was your CA-MIS in the pre-design planning stage?

a. Less than a year	1
b. 1 or 2 years	2
c. 3 or 4 years	3
d. 5 or more years	4

11. How was your CA-MIS developed?

a. Total system at one time	1
b. Module-by-module	2
c. Sets of modules, in phases	3
d. Other (specify)_____	4

12. How long was your total CA-MIS (as now operating) in the design stage?

a. Less than a year	1
b. 1 or 2 years	2
c. 3 or 4 years	3
d. 5 or more years	4

13. How long was your total CA-MIS (as now operating) in the implementation stage?

a. Less than a year	1
b. 1 or 2 years	2
c. 3 or 4 years	3
d. 5 or more years	4

14. How many additional, full-time staff were required as a result of initiating your CA-MIS?

Job Area	
MIS manager	_____
Data base manager	_____
Lead analyst	_____
System analyst	_____
Programmer	_____
Data entry personnel	_____
Operator personnel	_____

15. Describe the nature of funding your CA-MIS project (mark one, the primary source):

a. Institutional funds were re-allocated within existing budgets	1
b. Existing budgets were utilized	2
c. Special, allocated funds and a budget were established for the CA-MIS project	3
d. Other (specify)_____	4

e. If "new money" was utilized, what was the source?

_____

16. Please indicate the nature of the data base at your institution.

a. One integrated file	1
b. A number of separate sub-files with integration capabilities	2
c. A number of separate, unintegrated files	3
d. Other (specify)_____	4

17. Please indicate the degree to which each of the following is incorporated in your CA-MIS:

	Not Included	Planning for Inclusion	Being Implemented	Current Incorporation
Student areas:				
Admissions	1	2	3	4
Registration	1	2	3	4
Financial Aid	1	2	3	4
Student Master File	1	2	3	4
Alumni Records	1	2	3	4
Student Scheduling	1	2	3	4
Staff areas:				
Position analysis	1	2	3	4
Employee Profile	1	2	3	4
Payroll	1	2	3	4
Evaluation	1	2	3	4
Facility areas:				
Room inventory	1	2	3	4
Building inventory	1	2	3	4
Land inventory	1	2	3	4
Capital data	1	2	3	4
Equipment areas:				
Fixed equipment	1	2	3	4
Movable equipment	1	2	3	4
Consumable supplies	1	2	3	4
Curriculum area:				
Course information	1	2	3	4
Financial areas:				
Budgeting data	1	2	3	4
Accounting data	1	2	3	4

17. (continued)

Statistical areas:

Students	1	2	3	4
Staff	1	2	3	4
Space	1	2	3	4
Equipment	1	2	3	4
Programs (courses)	1	2	3	4
Finance	1	2	3	4

18. Please rank the following sources of data element definitions used in preparing your data element dictionary.

(1=most highly used)

a. Institutional definitions _____
b. WICHE data element definitions _____
c. State governing board definitions _____
d. Other (specify)_____ _____

19. How compatible are data element definitions in your total CA-MIS data base among sub-systems or modules?

a. All are common 1
b. Most are common 2
c. Very few are common 3
d. None are in common 4

20. What is the best description of your information retrieval approach?

a. Batch mode only 1
b. On-line terminal only 2
c. Combination of (a) and (b) 3
d. Other (specify)_____ 4

21. What degree of improvement has occurred in each of the following as a result of implementing your CA-MIS?

1=Decrease
5=High degree of improvement

a. Internal communications are improved	1	2	3	4	5
b. Optimization of computer services	1	2	3	4	5
c. Administrative use in decision making	1	2	3	4	5
d. Generation of state reports	1	2	3	4	5
e. Generation of federal reports	1	2	3	4	5
f. Reduction of hard copy storage requirements	1	2	3	4	5
g. Institutional research activities	1	2	3	4	5
h. Total administrative staff size	1	2	3	4	5
i. Planning staff size	1	2	3	4	5
j. Computer hardware requirements	1	2	3	4	5

22. Please indicate the degree to which each of the following are possible by your CA-MIS.

	1=None 5=Very high				
a. Ability to respond to unanticipated information requests	1	2	3	4	5
b. Administrator need for assistance in information retrieval requests	1	2	3	4	5
c. Ability to retrieve historical data	1	2	3	4	5
d. Ability to retrieve information across major information areas	1	2	3	4	5
e. Ability to correct or add data to existing files	1	2	3	4	5
f. Ability to train new users of the MIS	1	2	3	4	5
g. Ability to train new operations personnel	1	2	3	4	5

23. Please indicate the degree to which each of the following are affected by virtue of utilizing CA-MIS.

	1=None 5=Very high				
a. Student enrollment projections	1	2	3	4	5
b. Resource (fiscal) projections	1	2	3	4	5
c. Student load demands	1	2	3	4	5
d. Space analysis	1	2	3	4	5
e. Faculty activity analysis	1	2	3	4	5
f. Equipment analysis	1	2	3	4	5
g. Report generation (for institution, state, federal)	1	2	3	4	5
h. PPB	1	2	3	4	5
i. Record keeping only	1	2	3	4	5

24. What degree of problems were (are being) experienced in adopting your CA-MIS?

	1=Very much 5=No problem whatsoever				
a. Financial constraints	1	2	3	4	5
b. Personnel turnover	1	2	3	4	5
c. Coordination between users and developers	1	2	3	4	5
d. Failure to do advance master planning	1	2	3	4	5
e. Personal conflicts	1	2	3	4	5
f. Lack of top administrative support	1	2	3	4	5
g. Lack of experience	1	2	3	4	5
h. Lack of consulting help	1	2	3	4	5
i. Policy resolution	1	2	3	4	5

25. What effect has each of the following had on the CA-MIS planned budget?

	1=No over-run 5=Very high over-run				
a. Hardware costs	1	2	3	4	5
b. Personnel costs	1	2	3	4	5
c. Software costs	1	2	3	4	5
d. Time requirements	1	2	3	4	5
e. Unfavorable institutional budget change	1	2	3	4	5

26. What was your total institutional budget for Fiscal Year 1975?
$_____

27. What percent of your actual budget expenditure for Fiscal 1975 was devoted to the CA-MIS effort?_____%

28. Please indicate the degree to which each of the following you consider to be a strength (advantage) or weakness (limitation) of your CA-MIS.

	1=Strong limitation				5=Strong advantage
Level of generalization	1	2	3	4	5
Reliability of input data	1	2	3	4	5
Value as analytical tool	1	2	3	4	5
Enrollment forecasting	1	2	3	4	5
Space utilization analysis	1	2	3	4	5
Program cost analysis	1	2	3	4	5
Budgeting	1	2	3	4	5
Faculty activity analysis	1	2	3	4	5
Data base factors	1	2	3	4	5
Experimentation	1	2	3	4	5
Record keeping	1	2	3	4	5
Report generation	1	2	3	4	5
Complexity of input requirements	1	2	3	4	5
Cost of operation	1	2	3	4	5
Hardware requirements	1	2	3	4	5
Acceptance by users	1	2	3	4	5
Acceptance by administrators	1	2	3	4	5

29. Please respond to the following items that relate to the hardware aspect of your CA-MIS:

a. Primary equipment vendor_____

b. Computer model designation_____

c. Main storage size_____

d. Number of disks_____ Model number_____

e. Number of tape drives_____ Model number_____

30. What changes are you considering for your CA-MIS?

_____

_____

_____

31. Name and title of person completing this survey form:

_____

X. APPENDIX B: INSTITUTIONS INCLUDED

States and Territories in Each DHEW Region

Region 1: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

Region 2: New York, New Jersey, Puerto Rico, the Virgin Islands

Region 3: Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia

Region 4: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee

Region 5: Illinois, Indiana, Minnesota, Michigan, Ohio, Wisconsin

Region 6: Arkansas, Louisiana, New Mexico, Oklahoma, Texas

Region 7: Iowa, Kansas, Missouri, Nebraska

Region 8: Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming

Region 9: Arizona, California, Hawaii, Nevada, Guam, American Samoa, Wake Island, Trust Territories of the Pacific Islands

Region 10: Alaska, Idaho, Oregon, Washington

Institutions Included in the Initial Survey

Region 1:
- Central Connecticut State College
- Hartford State Technical College
- University of Maine*
- Southeastern Massachusetts University*
- University of New Hampshire*

Region 2:
- Richard Stockton State College*
- Ramapo College of New Jersey*
- William Patterson College
- State University of New York, Albany*
- State University of New York, Stony Brook*
- State University of New York, Utica-Rome*

Region 3:
- Coppin State College*
- Morgan State College*
- University of Maryland, College Park
- Lock Haven State College*
- University of Pittsburgh*
- College of William and Mary*
- Longwood College
- Norfolk State College
- Virginia Commonwealth University*
- Virginia Poly State University*
- Virginia State College*
- Concord College
- Shepherd College

Region 4:
- Florence State University
- University of Alabama, Huntsville*
- University of Montevaldo*
- Florida A and M University
- University of North Florida*
- Georgia College*
- Georgia Southern College*
- Georgia State University*
- Eastern Kentucky University*
- Kentucky State University*
- Murray State University*
- Northern Kentucky State College*
- University of Louisville*
- Jackson State College*
- Appalachian State University
- North Carolina A and T State University*
- Western Carolina University*
- Clemson University*
- Memphis State University*

Region 5: Southern Illinois University, Carbondale*
University of Illinois, Urbana*
Western Illinois University*
Ball State University*
Indiana University, Indianapolis*
Indiana University, South Bend
Purdue University*
Ferris State College*
University of Minnesota, Duluth*
Miami University (Ohio)*
Wright State University
University of Wisconsin, Eau Claire*
University of Wisconsin, LaCrosse*
University of Wisconsin, Stevens Point*
University of Wisconsin, Stout*

Region 6: University of Arkansas*
Louisiana State University
Southern University A and M
Eastern New Mexico University
New Mexico Highlands University*
Eastern Oklahoma State College
Northeastern Oklahoma A and M College
Southeastern State College
Northwestern State College
Southwestern State College*
East Texas State University*
Pan American University
Texas Women's University*
University of Houston*
University of Texas, Austin*
West Texas College*

Region 7: University of Northern Iowa
Kansas State University, Pittsburg*
Southeast Missouri State University*
Kearney State College*
Kansas State University, Fort Hayes*

Region 8: Adams State College
Colorado State University*
Metropolitan State College
Southern Colorado State College*
University of Montana
North Dakota State School of Science*
Valley City State College
Southern Utah State College
University of Wyoming*

Region 9: California State College, San Bernardino*
California State Poly University*
California State University, Long Beach*
California State University, San Diego
California State University, San Jose*
University of California, Los Angeles
University of Nevada, Las Vegas*

Region 10: University of Alsaka*
Boise State College
Oregon Institute of Technology*
Washington State University*
Oregon State University, Corvallis*

An asterisk (*) indicates that the institution responded to the initial survey.

Institutions Participating in Follow-up Survey

College of William and Mary
Colorado State University
Ferris State College
Indiana University, Indianapolis
Kansas State University
Memphis State University
Miami University (Ohio)
Oregon Institute of Technology
Richard Stockton State College
Southern Illinois University, Carbondale
University of Houston
University of North Florida
University of Pittsburgh
University of Wisconsin, Eau Claire
University of Wisconsin, La Crosse
West Texas College
Western Carolina University