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ABSTRACT

COMPREHENSIVE ANALYTICAL METHODS FOR PLANNING IN UNIVERSITY SYSTEMS (CAMPUS) AND COMPUTERIZED ANALYSIS ADAPTING THE TECHNIQUES OF SIMULATION TO COLLEGES OF APPLIED ARTS AND TECHNOLOGY (CAATS)-2 ARE COMBINED TO REPRESENT A COMPUTER BASED INFORMATION AND PLANNING SYSTEM. THIS SYSTEM IS DESIGNED TO HELP THE COMMUNITY COLLEGES OF ONTARIO GAIN THE MAXIMUM EDUCATIONAL ADVANTAGE FROM THEIR RESOURCES, AND TO DEMONSTRATE THEIR NEEDS TO THE PUBLIC AND GOVERNMENT. THE MAJOR CHARACTERISTICS OF THIS SYSTEM ARE DISCUSSED AND ITS IMPLEMENTATION ILLUSTRATED WITH THREE CASE STUDIES. THE ORGANIZATION AND CAPABILITIES OF THE SYSTEMS RESEARCH GROUP ARE ALSO EXPLAINED. (IC)

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SRG

CAMPUS (CAATS)^2

A PROJECT TO IMPLEMENT A COMPUTER-BASED INFORMATION, PLANNING AND BUDGETING SYSTEM IN THE COMMUNITY COLLEGES OF ONTARIO

S R G

SYSTEMS RESEARCH GROUP

January 1970

CAMPUS (CAATS) ^{2}

An Explanation of the Acronym:

CAMPUS	Stands for Comprehensive Analytical Methods for Planning in University Systems. The CAMPUS model was first developed for universities and health sciences complexes and provided the basic technology that has been adapted for the community colleges.
CAATS ^{2}	Stands for Computerized Analysis Adapting the Techniques of Simulation to Colleges of Applied Arts and Technology. This acronym was contributed by Dr. Bowen, the President of Niagara College to describe the adaptation of the basic CAMPUS methodology.

Thus, the combined acronym CAMPUS (CAATS) ^{2} stands for the present computer based information and planning system that has been developed to report on and to simulate the operations of the colleges of applied arts and technology.

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A. INTRODUCTION

1. The Challenge to Educational Administrators

During the past few years, increasing public aspirations for further education, along with inflation, have caused government expenditures on education in Ontario, as elsewhere in the western world, to increase at a rate far in excess of the increase in G.N.P. Many educators and planners have warned of an impending "crisis" in educational financing if the recent trend is permitted to continue.

Traditionally, it has been assumed that any improvement in educational service is worthwhile, and that, as such, it should be supported financially from public funds. However, modern government financial management under a program planning and budgeting system dictates allocation of resources among the many services such as education, health, welfare, highways, etc., in proportion to their relative priorities. Consequently, it is now apparent that educational administrators must, in turn, consider their own priorities and alternate means of reaching desired goals.

Unfortunately, traditional methods of educational management have not provided educational administrators with the planning

data required for this new challenge. Bundy states the problem as follows:

> But what is much more serious is that with the tools now available they cannot really prove their case. They simply do not have the facts and figures they need. Let me emphasize that I do not say that the facts and figures do not exist -- I say only that they do not have them. They do not have them for the simple and fundamental reason that as a class neither colleges nor universities, public or private, large or small, old or young, have ever made it their business to learn and to tell the whole story of their resources and their obligations, their incomes and their expenses, their assets and their debts, in such a way that the public can fully and fairly judge their economic position. [1]

This is what CAMPUS (CAATS) [2] is all about.

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1 Bundy, McGeorge, "Advice to Educators: Be Candid About Your Money Problems", Think, Jan - Feb 1968, P.32

2. A Way to Meet the Challenge

CAMPUS (CAATS)[2] is a system designed to help the community colleges of Ontario to gain the maximum educational advantage from the resources which are put at their disposal. Equally, it will help the colleges as a whole demonstrate to the public and to government that their needs are real and truly justified.

For over four years now the members of the Systems Research Group have been working on the development of new tools to aid educational administrators. CAMPUS (Comprehensive Analytical Methods for Planning in University Systems) has evolved during this time. As shown in Figure 1, CAMPUS is composed of four basic elements. The central element is a computer based simulation model that is designed to estimate the resource implications of alternative administrative and educational plans and policies. A planning, programming and budgeting system is used to integrate the simulation model into the formal planning and budgeting processes of an institution. A master planning system that uses the model and extends its output is incorporated to interpret the long range academic and administrative plans of the institution into their implications for physical facilities. The system is also designed to support the architectural design function by relating the academic programs to detailed requirements for physical facilities. An integrated management and planning information

CAMPUS COMPREHENSIVE ANALYTICAL METHODS OF PLANNING IN UNIVERSITY SYSTEMS

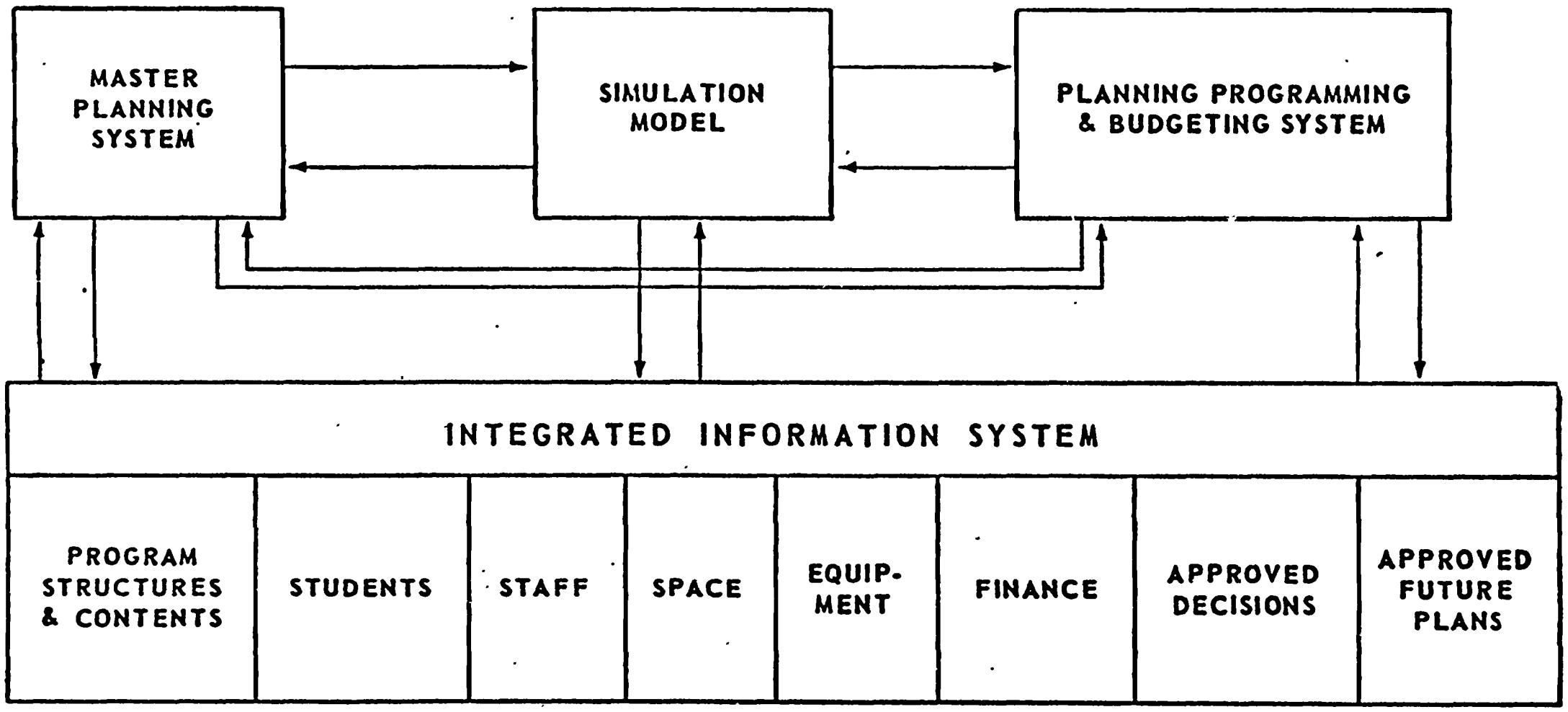


FIGURE 1

system is used to support the other three elements of CAMPUS. It should be emphasized that this information system is not intended to meet day-to-day control and operating needs, but can by itself produce much useful and relevant information on past performance.

3. A Pilot Study

Beginning January 1st 1969, the Systems Research Group undertook a project to develop operational versions of CAMPUS (CAATS) [2] at three of the colleges of applied arts and technology in Ontario. At present these systems are fully operational.

The information and planning system takes the form of a computer program that consists of over 15,000 Fortran language statements. A version of the program and the data that represent each of the three pilot colleges is operating on an IBM 360-85 computer in Ottawa. Using this system the pilot colleges can obtain information on their operations or they can use the simulation model built into it in order to assess the implications of changes in their educational or administrative plans and policies. Figure 2 is a rough schematic of the basic logical structure of the model. In essence the model accepts descriptions of the academic programs being offered in the college, the way in which they are being carried out, combines this with quantitative descriptions of administrative policies and simulates the operation of the institution under these conditions.

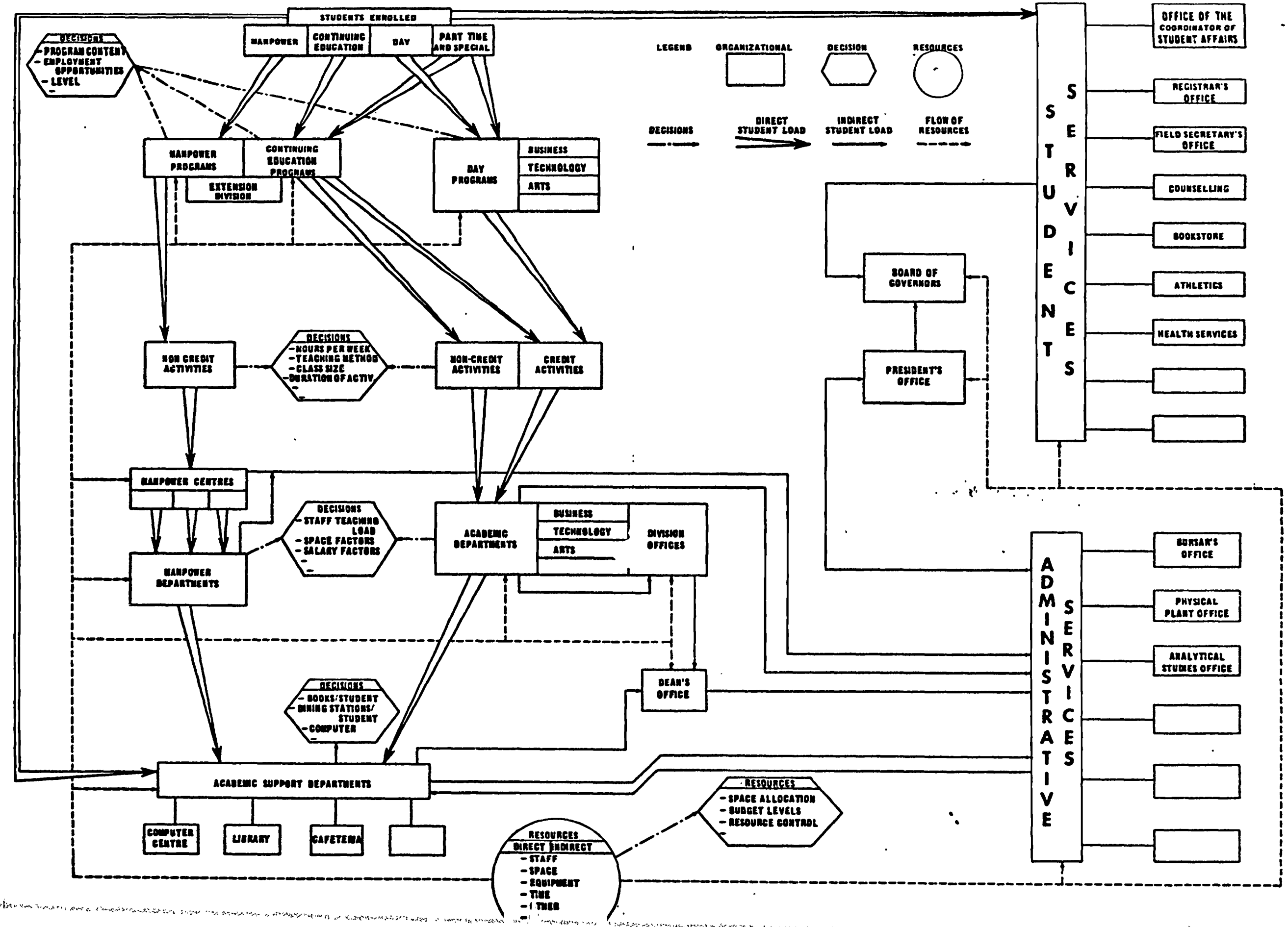
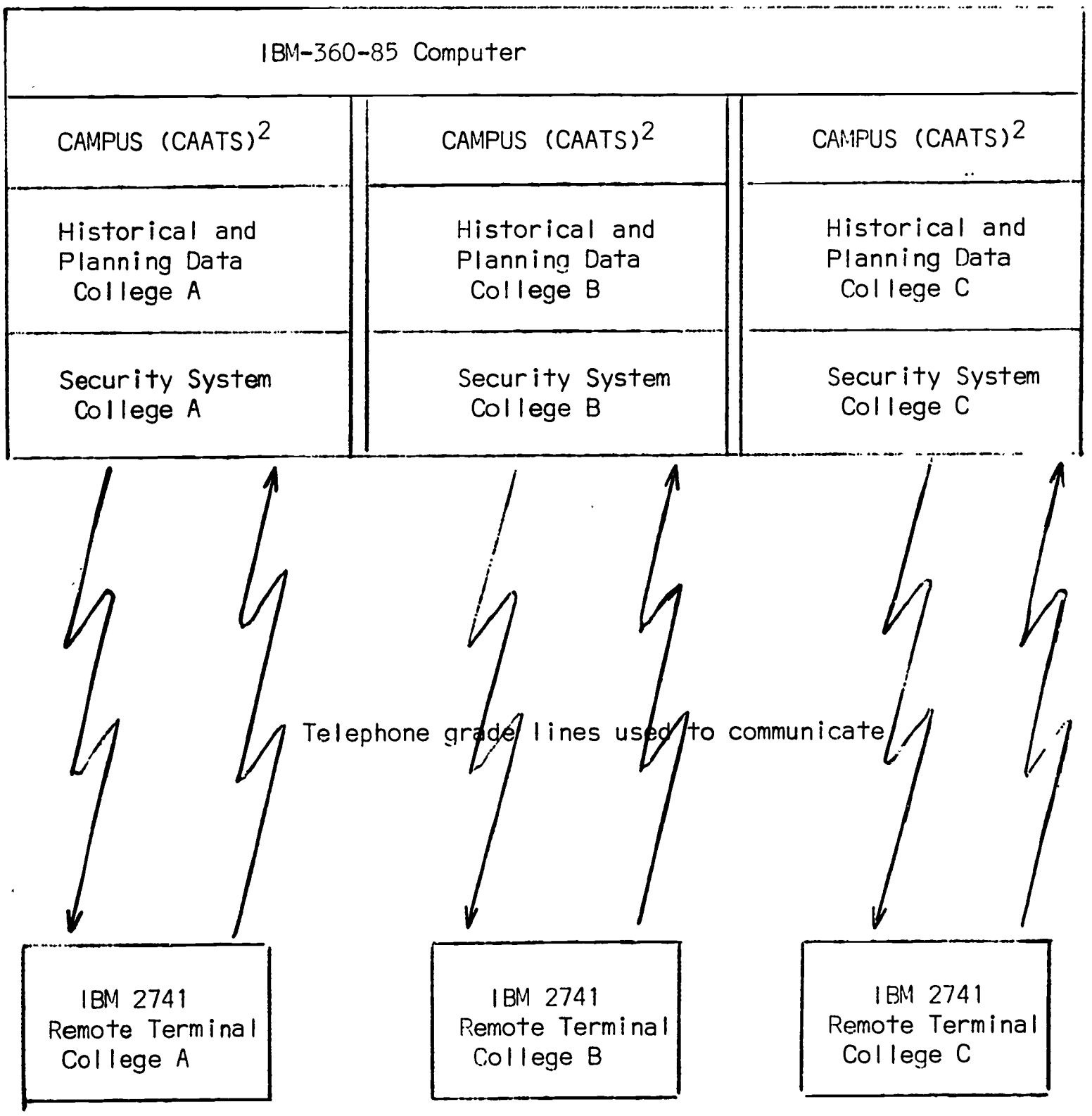

STUDENTS ENROLLED
MANPOWER
CONTINUING EDUCATION
DAY
PART TIME AND SPECIAL
DECISIONS
- PROGRAM CONTENT
- EMPLOYMENT OPPORTUNITIES
- LEVEL
LEGEND
ORGANIZATIONAL
DECISION
RESOURCES
DECISIONS
DIRECT STUDENT LOAD
INDIRECT STUDENT LOAD
FLOW OF RESOURCES
MANPOWER PROGRAMS
CONTINUING EDUCATION PROGRAMS
EXTENSION DIVISION
DAY PROGRAMS
BUSINESS
TECHNOLOGY
ARTS
NON CREDIT ACTIVITIES
DECISIONS
-HOURS PER WEEK
-TEACHING METHOD
-CLASS SIZE
-DURATION OF ACTIV
NON-CREDIT ACTIVITIES
CREDIT ACTIVITIES
MANPOWER CENTRES
DECISIONS
- STAFF TEACHING LOAD
- SPACE FACTORS
- SALARY FACTORS
ACADEMIC DEPARTMENTS
BUSINESS
TECHNOLOGY
ARTS
DIVISION OFFICES
MANPOWER DEPARTMENTS
DECISIONS
- BOOKS/STUDENT
- DINING STATIONS/ STUDENT
- COMPUTER
DEAN'S OFFICE
ACADEMIC SUPPORT DEPARTMENTS
COMPUTER CENTRE
LIBRARY
CAFETERIA
RESOURCES
DIRECT
INDIRECT
- STAFF
- SPACE
- EQUIPMENT
- TIME
- OTHER
RESOURCES
- SPACE ALLOCATION
- BUDGET LEVELS
- RESOURCE CONTROL
BOARD OF GOVERNORS
PRESIDENT'S OFFICE
STUDENT SERVICES
OFFICE OF THE COORDINATOR OF STUDENT AFFAIRS
REGISTRAR'S OFFICE
FIELD SECRETARY'S OFFICE
COUNSELLING
BOOKSTORE
ATHLETICS
HEALTH SERVICES
ADMINISTRATIVE SERVICES
BURSAR'S OFFICE
PHYSICAL PLANT OFFICE
ANALYTICAL STUDIES OFFICE

Figure 2

Figure 3 shows schematically the way in which the system is set up. Each college has on its premises an IBM 2741 Remote Terminal. This is a slow speed terminal that looks much like an IBM Selectric typewriter. The terminal is connected to the IBM 360-85 computer in Ottawa via ordinary voice grade telephone lines. The user college dials the appropriate telephone number in Ottawa and is connected with the central computer. The user must then put in the appropriate security codes that protect the information system from access by any other user. This process essentially involves inserting a six digit security code for the college and a six digit code that authorizes him as a user. Both of these sets of codes can be changed periodically and put the chances of anyone accidentally accessing the file at one in one trillion.

Using a special English language system that has been set up for communicating with the central computer the user indicates kinds of analyses he wants performed and the kinds of information that he wants reports on. An extremely comprehensive set of reports has been developed as part of the system. These can provide concise summaries or very detailed elaborations depending on the needs of the users. Information can be provided for one particular year, historically for a number of years in the past, or simulated for a number of years into the future. The selection of reports is

FIGURE 3


IBM-360-85 Computer
CAMPUS (CAATS)2
CAMPUS (CAATS)2
CAMPUS (CAATS)2
Historical and Planning Data College A
Historical and Planning Data College B
Historical and Planning Data College C
Security System College A
Security System College B
Security System College C
Telephone grade lines used to communicate
IBM 2741 Remote Terminal College A
IBM 2741 Remote Terminal College B
IBM 2741 Remote Terminal College C

at the complete control of the user and he may ask for or delete any or all of the reports available. Information can be produced in both tabular and graphical form with graphical reports being generated by a Calcomp plotter that produces continuous line graphs from the output of the model. The project report entitled "CAMPUS (CAATS) ^{2} System" contains a detailed description of all of the reports available as well as the information requirements and operating procedures of the system.

Thus the reporting system is continuous over time. In other words, should a person in one of the colleges want to get information on the costs of a particular educational program he would select a report number that gave him the amount of detail he wanted. If he were interested in information on what had happened to that program in the year 1967 then he would go into the historical data base and receive an historical summary. If he wanted information on what would likely take place in 1972 he would ask for a report from the simulation model. The only difference in the two reports would be that one report would be entitled 'simulated' the other 'historical', but the format and presentation of information would be the same. The reports are available not only on an organizational basis, that is, by division, department, etc., but also on a program costing basis.

This system brings to the colleges the power of a very large computer and enables them to get rapid response to questions they want to ask. This response is usually in the form of summary reports that are transmitted via the terminal and more detailed reports that are printed at the computer center and sent to the college. The average simulation of a college of applied arts and technology for ten years into the future using this system would take about 30 seconds of IBM 360-85 computer time and cost about $30.00. If the system were made operational on the largest computer that any one of the colleges could expect to have, for example the equivalent of an IBM 360-40 computer, and assuming that all of the technical problems of doing this could be overcome, then the same program would require about twelve hours of computer time and cost about $1,200.00 for a ten year simulation. These figures demonstrate the economic as well as technical reason for using the large central computer. Appendix I contains a list of the problems that can and cannot be analyzed using the system and Appendix II contains some simple demonstration analyses.

The staff support required to operate the system once it has been set up can be broken into two types of personnel. The first kind of person needed is one that can help the decision-makers in the colleges to formulate their problems for analysis and then interpret the results of these analyses back to them. The problem formulator

will have to be a part or full time person residing in the college as part of its formal organizational structure. He could be an executive assistant to the president for planning and budgeting or some other person that logically fits into that category and can assume the role. This person will have to be backed up by a couple of part time assistants to aid in particular with the collection of data in order to maintain the currency of the system. The other types of personnel that are needed are technical people who can maintain and improve the computer models and information systems and make sure that they function properly and are adapted to the changing needs of the colleges. These capabilities have been provided in the pilot study and will be provided in the present project by the Systems Research Group.

4. Summary Advantages of CAMPUS (CAATS)^2

CAMPUS (CAATS)^2 is a manifestation of the systems analytic approach to management and planning. The integration of complex factors into an analytical framework to aid practical decisions is the essence of a systems analysis approach. The complexities of educational decisions can be characterized as follows

- Highly diverse investment choices
- Complex inter-relationships
- Long time periods to measure impact
- Highly dynamic and uncertain environments
- Measurement problems

The long time period over which educational policies take effect increases the complexity of investment choices in a given year by the necessity of linking them with future and past decisions. In addition, we must wait for long periods prior to receiving any evaluation of plans. A poor allocation may not only start a program in the wrong direction but it may also take years to acquire the experience and knowledge necessary to determine the appropriate corrections. Thus, it is extremely important that the implications of current decisions upon the future be carefully evaluated before a decision is finally made.

Information on the future is fraught with uncertainty, but decisions have to be made in any case, and administrators should make their decisions in the light of the best information available. CAMPUS (CAATS) [2] is an attempt to organize such information in the most meaningful way. According to recent work by Pfeiffer [2] and Roth [3], CAMPUS is the most advanced system that has been developed for this purpose.

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2 Pfeiffer, J.: A New Look at Education: Systems Analysis in our Schools and Colleges, Odyssey Press, 1968.

3 Roth, G.J.: "Management Science in University Operation", Management Science, Vol. 14, No. 6, Northwestern University, February 1968.

The following points are intended to summarize the advantages that can be gained by using it.

4.1 Planning Rather Than Responding

The ability to experiment with "alternative futures" should allow the planner to devise plans which are less sensitive to adverse turns of the wheel of fate. The simulation model can serve as a laboratory in which the college administration can test alternative policies before decisions are made. The experimental results of such testing can provide objective estimates of the resource implications of competing proposals. This information would be a healthy check on unsupported departmental proposals, and would bring about more careful planning at all levels. Better knowledge of the cost consequences of alternatives should improve decisions and reduce the number of unfortunate surprises in college planning.

4.2 More Comprehensive Justification of Budgets

The use of computerized simulation models makes possible accurate and substantiated statements of financial requirements. Heightened credibility of these statements combined with the demonstrable use of improved management tools should improve an institution's position in supporting sound expenditure of public funds. The results of a simulation can be

presented either in traditional budgetary formats, or in such a way as to juxtapose program levels and associated costs. A particular advantage of the model is its ability to compute the incremental costs of altering each activity level. This should facilitate efficient allocation of college resources and public funds. An important advantage which appears as a by-product in the college budget-making process is the extent to which CAMPUS (CAATS)[2] should reorient top-level budgetary negotiations from concentration upon aggregate dollar magnitudes towards the underlying decisions which are of more fundamental importance.

4.3 Quicker, Cheaper, Less Tedious Planning

Laboriously produced "master plans" are often obsolete before their ink is dry. Simulation models permit continuous planning in response to changed circumstances and opportunity. Finally, the use of such models obviates the investment of scarce managerial time and talent in slow, manual computations. Because of a paucity of information, an impending decision of any consequence in the college is likely to initiate a search for new data. Each time this occurs, it places a redundant burden on deans and division chairmen as they strive to supply requested information. Because these data are often supplied under tight time limits, the quality is

frequently dubious. Typically, the results of one survey are unavailable or inappropriate to the next. Such a procedure is wasteful and cannot provide uniformly good information. Because it systematically brings together and analyzes information relative to a broad class of problems, the simulation model should reduce this burden of tedious and repetitious paper work.

4.4 Aiding Colleges in the Early Expansion Stages

Colleges in the early growth stage stand to profit greatly from the use of simulation models. The range of decision variables is so broad and the importance of early decisions so great that the planners deserve all the assistance that they can get. The design and use of a simulation model in the formative stages of university planning may avoid costly errors and raise the return from new educational investment.

4,5 Aiding Government Departments

The task of planning for the financial requirements of the total college system can be greatly facilitated by objective analysis of the type obtainable from simulation models.

B. PROJECT DESCRIPTION

The present project is an extension both in scope and content of the pilot study. Firstly, implementation of the system is to be extended

to include all of the community colleges in the province. Secondly, technical innovations are to be incorporated. The information system is to be expanded to include more detailed information in several areas. The computer system itself is to be improved and generalized to handle the peculiarities of the seventeen colleges that did not participate in the pilot study. A set of computer programs and procedures are to be developed for collecting and maintaining province-wide statistics.

Specifically, the following activities are to be undertaken and scheduled as shown in Figure 4:

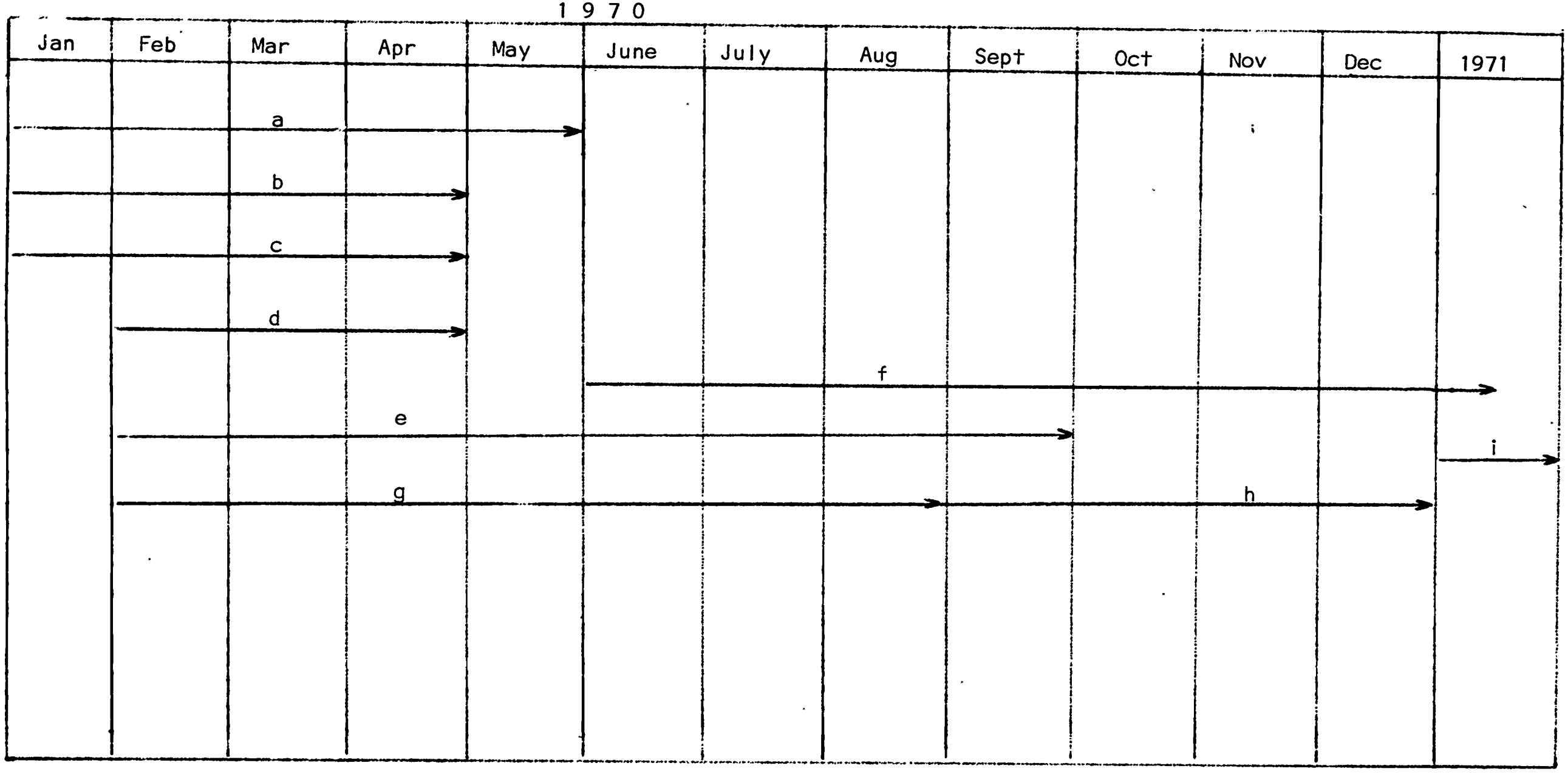
a) Modify, improve and further generalize the CAMPUS (CAATS) ^{2} computer programs, communications systems, reporting and analytical capabilities to serve the needs of all of the CAATS.

b) Expand the CAMPUS (CAATS) ^{2} system so that its information sub-system includes the following types of additional data:

Space	Nil
Staff	Sex Age Number of years teaching
Students	Grades Socio-economic background Employment follow on Progression through the system

FIGURE 4

GENERAL PROJECT SCHEDULE



Academic Program	Entrance Requirements
Organization	Names of people in various positions
Finance	Nil

c) Develop the procedures, forms and computer programs so that actual data can be processed and analyzed as well as forecast information.

d) Develop an agreed upon heirarchy of information security for each college for each type of information. These securities levels could be:

- open to all colleges and the department
- open to all colleges
- open to the department
- open within the college
- open within the college only to deans
- open within the college only to the president

Develop and implement computer programs that can effect the security system.

e) Implement the new CAMPUS (CAATS)^2 system in all twenty colleges modifying it in the three existing implementations. Each implementation should include:

- education and orientation of general staff
- education and training of staff who will be using and maintaining the system
- creation of initial information systems and development of plans and procedures for maintaining it

- adaptation of computer programs and communications link to needs of the college

- testing out the system and producing initial analyses

- integration of the system as much as possible into the long and short term budgeting process

- integration of the system as much as possible into the master planning and facilities design process

f) Provide in depth technical and analytical consultation after the initial implementation.

g) Develop and implement computer programs to provide an information planning and budgeting capability when dealing with questions concerning the group of twenty colleges as a whole.

h) Develop procedures for arriving at an equitable and defensible formula financing system, budget submission procedures and comparative system-wide information, using the information system that has been created.

i) Provide ongoing system maintenance, updating and consultation.

In summary then, the objective of the project is to have operational versions of the expanded and improved system for each of the colleges and the system as a whole by early in the Fall of 1970. Following on this initial implementation period will be a six month period of in depth user orientation and education for each of the colleges. Since the impl ementation in the colleges will be phased during the first nine months, some of the colleges will have operational systems by

June and others not until the end of October. However, it is hoped to have completed both the initial implementation and the follow-on education program by the end of the first quarter of 1971. Thus from then onward, all of the problem formulation and analysis will be done by personnel internal to the colleges and all of the technical systems maintenance as well as consultation on specific problems will be provided by the Systems Research Group.

C. THE IMPLEMENTATION IN EACH COLLEGE

The actual elapsed time for an implementation in one of the seventeen non-pilot colleges will be from four to six months. During that time a number of steps have to be taken. These steps are listed below, along with a brief description of what is involved in each of them.

a) General Introduction, Orientation and Planning

A series of formal and informal educational activities will be carried out to insure that the staff at the institution understand the project and the CAMPUS (CAATS)^2 concepts. This activity is extremely important if the implementation effort is to have any real meaning. It has been our experience that as wide a group of people as possible should be exposed to the concepts at the beginning. In order to do this we will present a two-day seminar at the beginning of the implementation. The participants in the seminar should come away from it with an understanding of the system, how

it will be applied to their institution as well as specific information on the plans and activities needed to implement the system.

b) Detailed Introduction and Interviews

While the general seminars will provide an overall introduction to the concepts it is important that the key administrative and academic personnel in the college be contacted directly. This serves two purposes, 1) it assures the systems designers that the system is capable of handling the problems identified by the people who would be using it, and 2) it provides an opportunity for the person being interviewed to contribute to the design of the system and to ensure that it is being built to serve his needs. The produce of this activity is a detailed plan for modifying the system to meet the needs of the particular institution.

c) Education of College Liaison Staff

While much of the education of the staff will take place by having them take part in the general development of the system and data gathering effort, there is a necessity in the initial stages of the project to have a formal training period. Non-technical systems people will have to be familiarized with the data collection process and fully understand the reporting, input and experimental structure of CAMPUS (CAATS)^2. In addition the personnel working on the project will be given some orientation on acting as effective interfaces with organizational personnel at various levels. Some staff

will be trained to gather data and code the input documents or to prepare computer programs to access existing files of information to produce input information.

d) Data Collection and Analysis

The first step in this activity is to prepare a detailed list of the sources, both formal and informal, of the information that is needed. The information needs will be compared with the data available within the institution. The Systems Research Group will provide education, forms, procedures and programs as well as on site data collection assistance. Furthermore, procedures for maintaining the currency of the information as well as appropriate approval mechanisms will be designed. This will include such matters as allocating responsibility for certain kinds of information to particular individuals or departments, deciding on the relevant timing for updating procedures and developing a methodology for creating updated information.

e) Model Adaptation

While the CAMPUS (CAATS)^2 model that will be the basis for the implementation has been built to be as general as possible, there are usually a number of distinguishing factors in any institution that have to be incorporated. In particular, the model has to be set up to reflect the cost center and program structure of the institution.

The computer program itself has to be parameterized to reflect the institution's size. The time and difficulty in making these changes will be minimized since the model will be running centrally.

f) Initial Tests of the Model

During this phase of the implementation the initial data that has been gathered will be checked and verified by running base cases. These will be examined in detail by appropriate personnel throughout the institution. As a result of these analyses no doubt certain changes will be suggested in terms of the data, the problems being analyzed or the way in which the model has been set up. In addition the use of the experimental routines that are built into the system will be checked out to ensure that they are functioning properly and can handle the kinds of questions that people from the college are posing.

After the initial gross errors have been removed, a first set of problems will be analyzed with a view to further testing the system. Procedures will be set up both for problem formulation and technical operation. At the end of this phase the model will be producing useful analysis from the initial data that has been gathered.

g) Development of Feed-back Procedures

In addition to using output routines of the model to produce simulated reports these subroutines can be linked to an information system to accept actual current data and produce reports on what has happened in a particular semester. There are two basic concepts underlying the need for establishing this capability. The first is based on the necessity of having corrective feed-back in the system so as to judge the extent to which people abide by their policies and the capability of the model to predict. The second reason for having this as part of the system is to create a system of information over time. That is, any administrator or academic can obtain a report on what has happened in the past from the information system or from what is likely to happen in the future from the simulation model using the same comprehensive set of reports. This continuity in format and method of presentation make it much easier for people to use the system and to glean quickly from it the implications of the situation they are considering.

h) The Integration of CAMPUS (CAATS)^2 and Long-Range Physical Facilities Planning

Procedures will be developed in detail for using the model as part of the formal long range planning and master plan creation process. Additional analytical routines will be attached to the model to produce detailed information on physical facilities requirements and to

provide special information to architects for new facilities construction.

i) Integration of CAMPUS (CAATS)^2 with a Planning, Programming and Budgeting System

A design for a PPB system that utilizes the CAMPUS (CAATS)^2 model will be developed. This activity does not involve the implementation of PPB but rather the design for its implementation and the development of an implementation schedule outlining in detail the steps required and the changes needed to existing budgetary procedures. Furthermore a design for alternative formula financing schemes will be developed to demonstrate the way in which this concept can be supported by the model and a planning, programming and budgeting system.

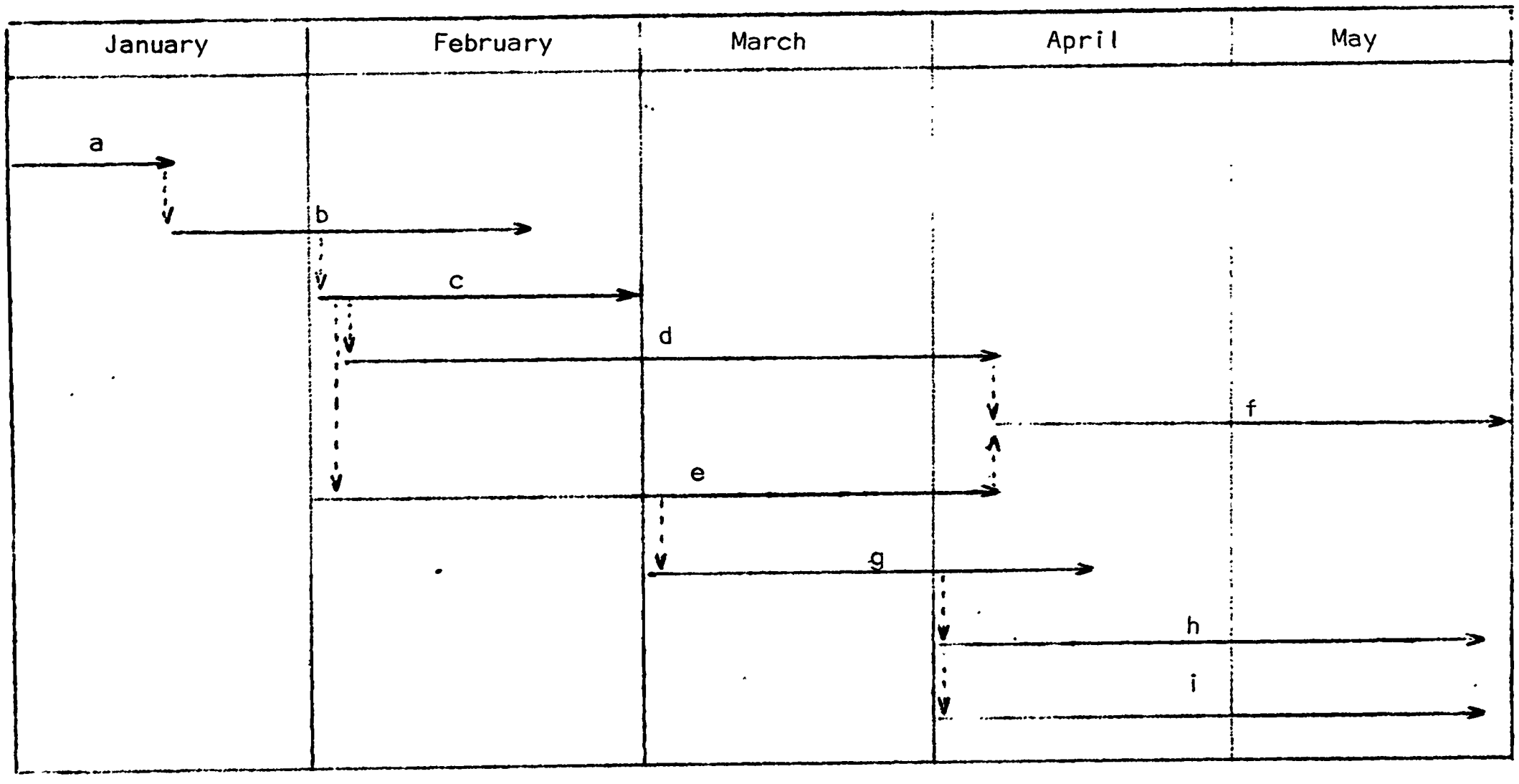
The activities described above are the basic activities that may be carried out in an implementation project. Each of these breaks down into a series of smaller more specific activities. Figure 5 is a typical schedule of events as related to the steps described above.

D. PROJECT BUDGET AND RESPONSIBILITIES

This project is being undertaken by all of the Colleges of Applied Arts and Technology and the Department of Education. Details of the funding procedures for implementation and development of the project, in-depth educational follow-up, and ongoing maintenance of the system will be arranged between the colleges and the Department of Education. Each

FIGURE 5

A Typical Schedule of Steps in Implementing CAMPUS (CAATS)[2] at an Individual College



college will enter into a contractual agreement with the Systems Research Group for the provision of their services, computer and terminal equipment costs.

It is the Systems Research Group's responsibility to develop and implement the system, as well as to educate internal staff in the colleges to use it. Once this educational process has taken place, the major responsibility for using the system and maintaining the currency of the data in it lies with the colleges, while the major responsibility for technically maintaining and updating the system itself, as well as providing periodic consultation on problems that may arise, lies with the Systems Research Group.

E. PROJECT STAFF

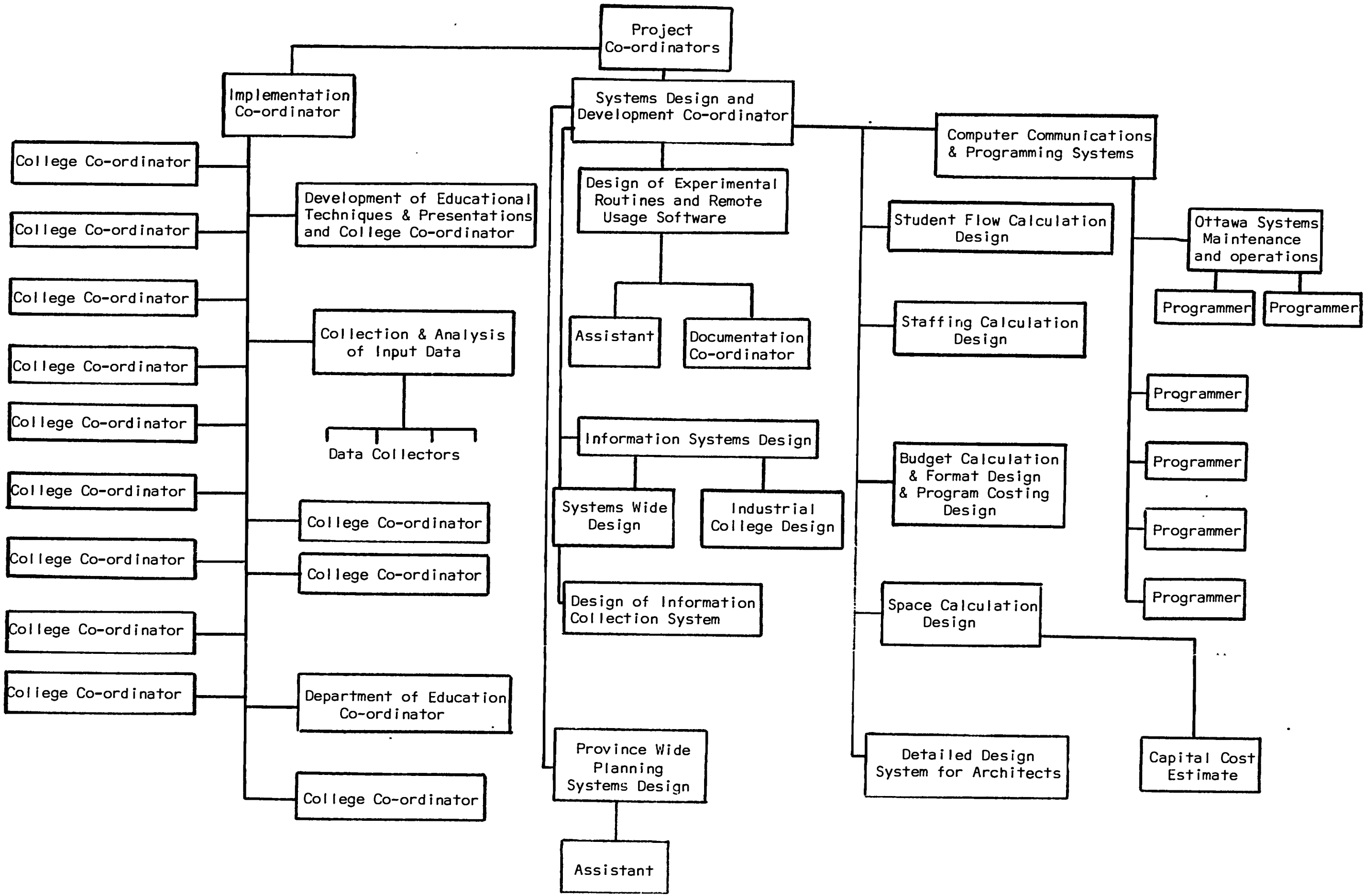
In order to carry out this project in an efficient and an effective manner we have used the project staff from the pilot project as the core and built around that to create a project team that we feel has the necessary technical depth and experience to make this project a success. Figure 6 shows the main members of the team and their roles.

F. INTERNAL COSTS TO THE COLLEGES

In the budget estimates prepared for the Department of Education we have included the total costs that will be incurred by the colleges with the exception of their own staff time. It is our feeling that the

FIGURE 6

SRG PROJECT ORGANIZATION
CAMPUS $(CAATS)^2$



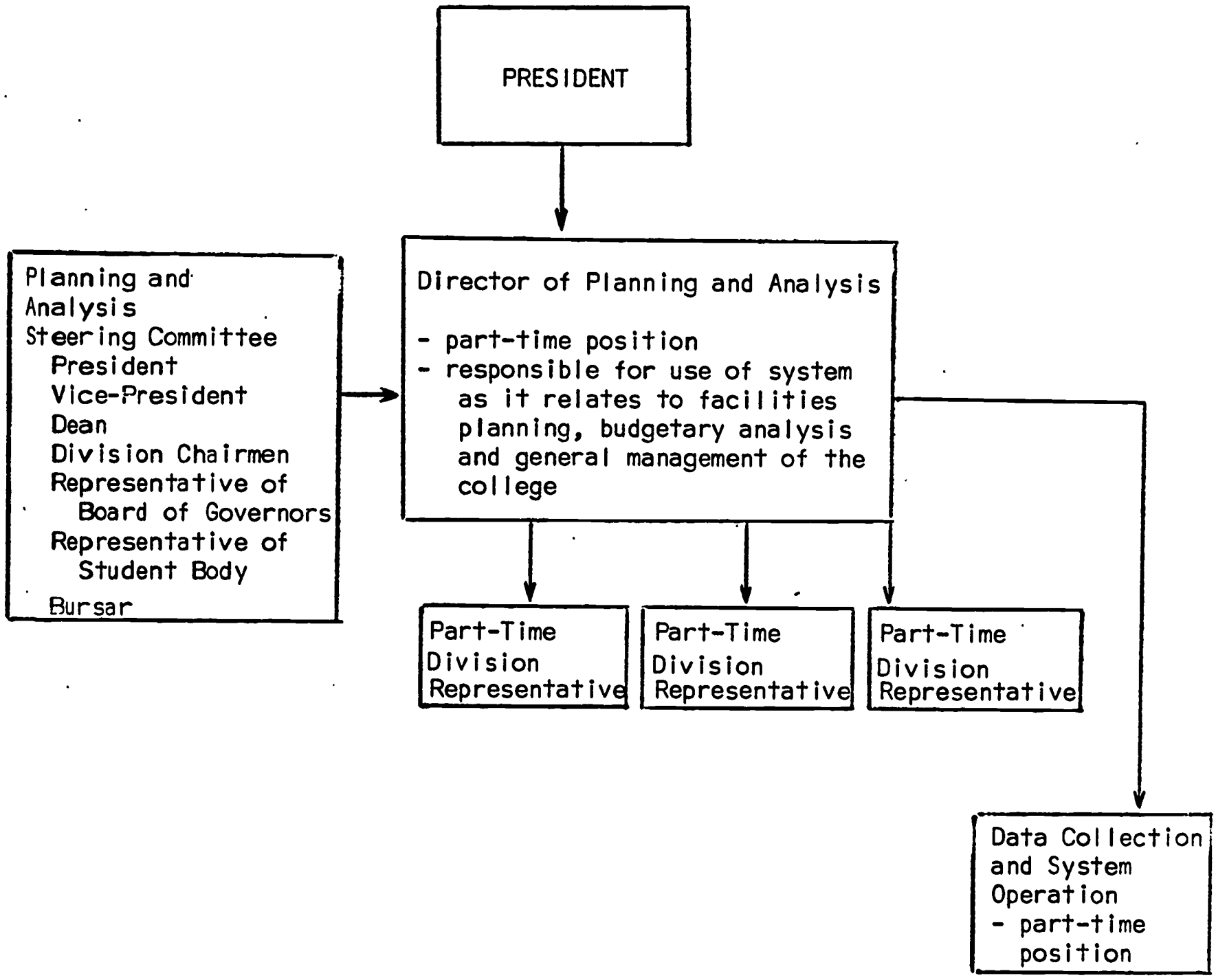
amount of internal staff required time does not demand any increase in budgeting for administrative personnel. In fact, most of the time involved is a redirection of efforts that are presently underway. We do think that the organizational responsibilities for use of the system ought to be formalized but that these can be integrated with positions already identified in those colleges which have made "provision for planning in their present organization patterns".

We do not see a requirement for additional staff as a result of the existence of the CAMPUS $(CAATS)^2$ system itself, for it is merely one of the tools to be used by those who have planning and budgeting responsibility.

In essence we recommend a general organizational structure within the college such as that shown in Figure 7. This will certainly vary from college to college depending on the size, but the concept is fairly general. A senior staff person should be appointed Director of Planning and Analysis with responsibility for insuring that the proper kind of analysis and coordination has gone into facilities planning and budgetary preparation as well as the general management of the college. He should report in this part-time capacity directly to the president and be able to draw on a steering committee composed of the president, vice-presidents, deans, division chairmen, representatives of the board of governors, possibly a representative of the student body and the bursar as he needs them, or as they may

FIGURE 7

SUGGESTED INTERNAL COLLEGE ORGANIZATION



request analyses. In addition he and SRG should ensure that one representative in each of the major divisions of the college understands enough about the system to be able to help their division to formulate problems. However, all problems for analysis should be processed through the director of planning and analysis. The activities involved in ensuring that the data in the system are up-to-date and that analyses are carried out via the terminal should be given again to a part-time person, probably on the data processing side of the college, either administrative or academic.

G. SUMMARY

This project is designed to implement an expanded version of CAMPUS $(CAATS)^2$ in the entire system of community colleges in the province of Ontario. The project plan ensures that the individual colleges will have the use of the system in as short a period as possible, while at the same time developing their own internal capabilities to use it. The project should represent a significant step forward in terms of the ability of the individual colleges to manage and plan their operations and to understand the implications of changes in the educational process on the practical realities of operating and capital budget requirements. At the same time, input from the entire system of colleges will provide the Department of Education with an information system for planning the financial support and future development of the total CAAT program.

APPENDIX I

THE PROBLEMS OF THE CAATS THAT CAN AND CANNOT BE ANALYZED WITH CAMPUS (CAATS) [2]

IN GENERAL

MODEL CAN'T

- Forecast exogenous inputs - - e.g. data on enrolment or rules on staff workloads.
- Predict community needs.
- Evaluate the quality of education.
- Create alternatives, but does analyze them in economic terms.

MODEL CAN

- Calculate the resource requirements of alternative educational programs.
- Compare the costs of different administrative rules on staff, space, equipment, enrolment.
- Enable the administrator to manage and plan the institution in the future.

FINANCE

MODEL CAN'T

- Predict operating and capital allocations from outside sources (except under formula financing).
- Control expenditures.

MODEL CAN

- Provide detailed cost estimates for the college, division, department, program or activity.
- Be used under different assumed funding levels to indicate what courses, enrolments and methods can be supported.
- Be the analytical mechanism of a Planning-Programming-Budgeting System.
- Facilitate preparation of annual budgets and long-term growth plans for review by senior authorities.
- Provide detailed justification of requests for funds, either under present procedures or as a supplement to formula financing.

SPACE PLANNING

MODEL CAN'T

- Say what kind of space should be used in a given program, or set class size.
- Prescribe certain sizes of offices, etc. for academic and support staff.
- Lay down policies on ancillary facilities such as libraries, residences, lounges.

MODEL CAN

- Forecast detailed space requirements under alternative situations.
- Assess the impact on space of changes in teaching methods, enrolment, etc.
- Pinpoint overages, shortages and % utilization of different kinds of space at different future times.
- Assess the impact of alternatives in future construction.
- Evaluate the effect, on space needs, of changes in length of teaching week, computerized scheduling, etc.
- Assess the economics of flexibility.
- Produce information for architects on the affinity of one type of space for others.

ENROLMENT

MODEL CAN'T

- Predict enrolment (total or by course).
- Predict student choice.
- Assess promotional effectiveness.
- Tell about community needs.
- Forecast success of students.

MODEL CAN

- Calculate resources needed for different enrolments.
- Assess different mixes of courses.
- Help cope with uncertainty and variations in actual enrolment.
- Evaluate the economies of scale.
- Help set timing of acquisition of new resources.
- Operate in long and short run context.

ACADEMIC PLANNING

MODEL CAN'T

- Decide what courses should be offered.
- Balance academic vs. professional subjects.
- Say much about community role.
- Design course content.

MODEL CAN

- Compare the resources (staff, space, equipment, etc,) needed for different mixes of program.
- Analyze the resource requirements for changing course content.
- Compare costs of educating different kinds of students (day, extension, industrial, manpower).

TEACHING METHODS

MODEL CAN'T

- Say which methods are pedagogically best.
- Generate new teaching ideas.
- Measure student reactions.

MODEL CAN

- Help make trade-off analyses of different teaching methods.
- Highlight the costs of introducing new methods.
- Calculate how college costs will rise with enrolment given possible changes in methods.
- Help tie together enrolment, program decisions and available resources into a coherent plan.

STAFF PLANNING

MODEL CAN'T

- Say what kinds of staff should be used.
- Help recruit staff directly.
- Evaluate teacher performance.
- Determine staffing policy.

MODEL CAN

- Calculate the requirements for various staff.
- Take into account alternative staffing policies -- load, tenure, etc.
- Analyze the cost of different mixes of staff.
- Predict future staff work requirements under alternative educational and administrative policies.
- Calculate future operating costs under different staffing policies and salary scales.

APPENDIX II

SAMPLE ANALYSES OF PROBLEMS USING CAMPUS (CAATS) 2

SAMPLE ANALYSES OF PROBLEMS USING CAMPUS (CAATS) [2]

During the course of the community colleges study, SRG analysts have gathered data on, and created, a representative community college for demonstration purposes. Although CAMPUS college is imaginary, its organizational and educational structure is realistic, and it is an ideal vehicle for carrying out experimentation and testing without revealing confidential data. A base case and three experimental cases have been run through Remote CAMPUS to illustrate the experimental capabilities of the CAMPUS system.

Base Case

CAMPUS college began operations in the Fall of 1967, and after two years of operations, administrative and academic personnel evolved a ten year plan with enrolment increasing from 1148 students in 1969 to 3591 students in 1978. The forecasted input data and policy parameters are stored on CAMPUS college's data files at a large computer center, and a ten year run was made.

Figure 1 is a summary report for the total operations of the college over this ten year period. Academic staff costs have risen from $1,566,000. to $3,307,000.; total operating costs have risen from $2,147,000. to $4,800,000.; space requirements have risen from 120,000 sq. ft. to almost 284,000 sq. ft. Capital costs were calculated on the basis that deficiencies in space were rectified each year through new construction.

As enrolment has increased, cost per student has dropped from $1870. in 1969 to $1336 in 1978, and space per student from 104 sq. ft. to 79 sq. ft.

Case 1

Due to increased enrolment in area high schools and expected popularity of new programs being offered at CAMPUS College, the registrar has changed his enrolment forecast. It is now expected that total enrolment will reach approximately 5,500 students by 1978. Case 1 is a ten year run with no data or policy changes except the above mentioned increase in enrolment. College costs are reflected in figure 2, and costs for one division or faculty are shown in figure 3. Total operating costs are considerably higher with the increased enrolment, moving to $6,647,000. in 1978 while space requirements have risen to 408,000 sq. ft. in 1978. Although total costs have increased, economies of scale are evident since cost per student and space per student in Case 1 are lower than in the base case.

Case 2

College personnel have decided that the enrolment estimates postulated in Case 1 are realistic, but the college is faced with a stringent operating budget. In order to reduce academic staff costs (the largest single element in the operating budget) administrators have decided to analyze an increase in teaching duties by 15% and an increase in class size by 15% over the

COST CENTRE
COLLEGE

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C A M P U S C O L L E G E

SUMMARY REPORT

OVER TIME REPORT 1.5
SESSION AVERAGES

FIGURE 1

	SESSION									
	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
STAFF										
ACADEMIC	1178	1498	1635	1748	1736	1912	2039	2189	2412	2642
ACADEMIC SUPPORT	33	46	52	52	52	59	59	59	65	72
NON-ACADEMIC	81	96	101	101	111	116	116	126	136	141
SERVICE	274	300	326	342	342	368	368	394	426	452
TOTAL	1566	1940	2164	2243	2291	2455	2582	2768	3039	3307
TOTAL EQUIPMENT COST	352	467	529	566	583	636	694	758	851	948
MISCELLANEOUS	221	319	352	364	371	395	414	442	483	523
MAINTENANCE	8	11	12	13	13	15	16	18	20	22
TOTAL AGGREGATE COST (THOUSANDS OF DOLLARS)	2147	2737	3057	3186	3258	3501	3706	3986	4393	4800
SPACE										
OFFICE	15350	18670	20660	21330	21810	23280	24320	26040	28410	30790
CLASSROOM	17740	23870	26130	27480	27630	30160	33860	36060	39430	41890
INSTRUCTIONAL LABORATORY	1915	3270	3395	3845	4345	4445	4360	5260	5765	5980
SPECIAL LABORATORY	30900	41750	48050	46400	50250	50450	51250	53400	62750	63750
SERVICE DEPARTMENT	54287	71441	80744	85247	87825	95614	104271	113813	127710	142091
TOTAL SPACE (SQUARE FEET)	120192	159001	179479	184302	191860	203949	218061	234573	264065	284501
CAPITAL COSTS										
SPACE - (ACTUAL DOLLARS)	70450	480275	313200	142300	92800	255550	297400	401775	806925	573625
AFFILIATED STUDENTS										
AT THIS COST CENTRE	0	0	0	0	0	0	0	0	0	0
AT AFFILIATED COST CENTRES										
ARTS	277	405	461	490	504	563	626	688	790	890
BUSINESS	434	571	643	682	707	787	868	956	1087	1225
ENGINEERING	437	647	776	834	867	945	1043	1159	1313	1476
CONTINUING EDUC	0	0	0	0	0	0	0	0	0	0
TOTAL	1148	1623	1880	2006	2078	2295	2537	2803	3190	3591
REVENUE										
TOTAL REVENUE FUNDS	0	0	0	0	0	0	0	0	0	0
INDICATORS										
COST PER STUDENT (ACTUAL DOLLARS)	1370	1686	1626	1588	1567	1525	1460	1422	1377	1336
SPACE PER STUDENT SQ.FT.	104	97	95	91	92	88	85	83	82	79

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OST CENTRE
COLLEGE

C A M P U S C O L L E G E

OVER TIME REPORT 1.5
SESSION AVERAGES

SUMMARY REPORT

FIGURE 2

	SESSION									
	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
STAFF										
ACADEMIC	1190	1599	1836	2012	2213	2476	2806	3102	3421	3644
ACADEMIC SUPPORT	39	52	52	59	59	65	72	72	78	78
NON-ACADEMIC	86	101	111	1[illegible]	126	141	156	171	181	191
SERVICE	274	326	342	3[illegible]	394	436	478	520	562	588
TOTAL	1589	2078	2341	2555	2792	3118	3512	3865	4242	4501
TOTAL EQUIPMENT COST	371	506	598	683	761	878	1023	1181	1308	1413
MISCELLANEOUS	225	338	377	410	445	494	553	605	662	702
MAINTENANCE	9	11	15	16	18	21	23	27	29	31
TOTAL AGGREGATE COST (THOUSANDS OF DOLLARS)	2194	2933	3331	3664	4016	4511	5111	5678	6241	6647
SPACE										
OFFICE	15580	19940	22230	24100	26240	29230	32670	35840	39120	41510
CLASSROOM	18030	24900	29440	33110	36040	40750	46370	51960	57420	61270
INSTRUCTIONAL LABORATORY	1715	3410	4445	4360	5260	5765	5915	6960	7375	7600
SPECIAL LABORATORY	32500	41550	51550	49550	55650	63900	68550	79550	85100	88000
SERVICE DEPARTMENT	57059	77339	91086	102554	114210	131691	153153	175503	194437	209965
TOTAL SPACE (SQUARE FEET)	124884	167139	198751	213674	237400	271336	306658	349813	383452	408345
CAPITAL COSTS SPACE - (ACTUAL DOLLARS)	118425	626300	459025	371175	510950	981125	1010375	1263575	962775	712575
AFFILIATED STUDENTS										
AT THIS COST CENTRE	0	0	0	0	0	0	0	0	0	0
AT AFFILIATED COST CENTRES										
ARTS	300	451	540	615	691	818	972	1129	1255	1359
BUSINESS	463	629	743	853	962	1129	1330	1542	1716	1860
ENGINEERING	464	707	886	1021	1160	1354	1598	1855	2082	2268
CONTINUING EDUC	0	0	0	0	0	0	0	0	0	0
TOTAL	1227	1787	2169	2489	2813	3301	3900	4526	5053	5487
REVENUE										
TOTAL REVENUE FUNDS	0	0	0	0	0	0	0	0	0	0
INDICATORS										
COST PER STUDENT (ACTUAL DOLLARS)	1788	1641	1535	1472	1427	1366	1310	1254	1235	1211
SPACE PER STUDENT SQ.FT.	101	93	91	85	84	82	78	77	75	74

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OVER TIME REPORT 1.5
SESSION AVERAGES

C A M P U S C O L L E G E

SUMMARY REPORT

FIGURE 3

	SESSION									
	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
STAFF										
ACADEMIC	244	375	436	472	521	584	658	731	805	855
ACADEMIC SUPPORT	39	52	52	59	59	65	72	72	78	78
NON-ACADEMIC	24	24	29	29	29	34	39	44	44	49
SERVICE	0	0	0	0	0	0	0	0	0	0
TOTAL	307	451	517	560	609	683	769	847	927	982
TOTAL EQUIPMENT COST	0	0	0	0	0	0	0	0	0	0
MISCELLANEOUS	35	65	74	81	88	99	111	123	135	143
MAINTENANCE	0	0	0	0	0	0	0	1	1	1
TOTAL AGGREGATE COST (THOUSANDS OF DOLLARS)	342	516	591	641	697	782	880	971	1063	1126
SPACE										
OFFICE	2920	4080	4660	5010	5410	6110	6840	7520	8170	8720
CLASSROOM	0	0	0	0	0	0	0	0	0	0
INSTRUCTIONAL LABORATORY	0	0	0	0	0	0	0	0	0	0
SPECIAL LABORATORY	0	0	0	0	0	0	0	0	0	0
SERVICE DEPARTMENT	0	0	0	0	0	0	0	0	0	0
TOTAL SPACE SQUARE FEET)	2920	4080	4660	5010	5410	6110	6840	7520	8170	8720
CAPITAL COSTS SPACE - (ACTUAL DOLLARS)	0	30625	18125	10925	12500	21875	22800	21250	20300	17175
AFFILIATED STUDENTS AT THIS COST CENTRE	300	451	540	615	691	818	972	1129	1255	1359
TOTAL	300	451	540	615	691	818	972	1129	1255	1359
REVENUE										
TOTAL REVENUE FUNDS	133	200	240	272	306	362	431	501	557	602
INDICATORS COST PER STUDENT (ACTUAL DOLLARS)	1140	1144	1094	1042	1008	955	905	860	847	828

00 CAMPUS (CAATS)2 CASE TWO - NOV 1969

OST CENTRE
COLLEGE

C A M P U S C O L L E G E

OVER TIME REPORT 1.5
SESSION AVERAGES

SUMMARY REPORT

FIGURE 4

	SESSION									
	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
STAFF										
ACADEMIC	1044	1299	1485	1587	1748	1936	2216	2462	2654	2892
ACADEMIC SUPPORT	33	39	46	52	59	59	65	55	72	72
NON-ACADEMIC	86	101	111	116	126	141	156	171	181	191
SERVICE	274	326	342	368	394	436	478	520	562	588
TOTAL	1437	1765	1984	2123	2327	2572	2915	3218	3469	3743
TOTAL EQUIPMENT COST	371	506	598	683	761	878	1023	1173	1308	1413
MISCELLANEOUS	200	290	322	342	371	407	458	504	540	582
MAINTENANCE	9	12	14	15	16	19	23	26	29	32
TOTAL AGGREGATE COST (THOUSANDS OF DOLLARS)	2017	2573	2918	3163	3475	3876	4419	4921	5346	5770
SPACE										
OFFICE	14240	17360	19260	20530	22380	24630	27740	30490	32730	35150
CLASSROOM	18720	24560	28590	31520	34920	39330	44230	49640	56100	60990
INSTRUCTIONAL LABORATORY	1715	3410	4070	4485	4760	5530	5790	6650	6315	7930
SPECIAL LABORATORY	35000	42750	51650	52650	56250	63500	73900	79400	89300	94800
SERVICE DEPARTMENT	56786	76744	90392	101712	113295	130626	151989	174240	192925	208479
TOTAL SPACE (SQUARE FEET)	126461	164824	193962	210897	231605	263616	303649	340430	377371	407349
CAPITAL COSTS SPACE - (ACTUAL DOLLARS)	111550	615175	443625	376075	479000	944075	1167900	1077525	1109250	859775
AFFILIATED STUDENTS										
AT THIS COST CENTRE	0	0	0	0	0	0	0	0	0	0
AT AFFILIATED COST CENTRES										
ARTS	300	451	540	615	691	818	972	1129	1255	1359
BUSINESS	463	629	743	853	962	1129	1330	1542	1716	1860
ENGINEERING	464	707	886	1021	1160	1354	1598	1855	2082	2268
CONTINUING EDUC	0	0	0	0	0	0	0	0	0	0
TOTAL	1227	1787	2169	2489	2813	3301	3900	4526	5053	5487
REVENUE										
TOTAL REVENUE FUNDS	0	0	0	0	0	0	0	0	0	0
INDICATORS										
COST PER STUDENT (ACTUAL DOLLARS)	1643	1439	1345	1270	1235	1174	1133	1087	1057	1051
SPACE PER STUDENT SQ.FT.	103	92	89	84	82	79	77	75	74	74

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COST CENTRE
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OVER TIME REPORT 1.5
SESSION AVERAGES

C A M P U S C O L L E G E

SUMMARY REPORT

FIGURE 5

	SESSION									
	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
STAFF										
ACADEMIC	219	301	349	375	412	460	523	584	621	683
ACADEMIC SUPPORT	33	39	46	52	59	59	65	65	72	72
NON-ACADEMIC	24	24	29	29	29	34	39	44	44	49
SERVICE	0	0	0	0	0	0	0	0	0	0
TOTAL	276	364	424	456	500	553	627	693	737	804
TOTAL EQUIPMENT COST	0	0	0	0	0	0	0	0	0	0
MISCELLANEOUS	30	52	61	65	71	79	90	100	106	116
MAINTENANCE	0	0	0	0	0	0	0	0	0	1
TOTAL AGGREGATE COST (THOUSANDS OF DOLLARS)	306	416	485	521	571	632	717	793	843	921
SPACE										
OFFICE	2620	3380	3910	4160	4510	4990	5690	6270	6620	7200
CLASSROOM	0	0	0	0	0	0	0	0	0	0
INSTRUCTIONAL LABORATORY	0	0	0	0	0	0	0	0	0	0
SPECIAL LABORATORY	0	0	0	0	0	0	0	0	0	0
SERVICE DEPARTMENT	0	0	0	0	0	0	0	0	0	0
TOTAL SPACE (SQUARE FEET)	2620	3380	3910	4160	4510	4990	5690	6270	6620	7200
CAPITAL COSTS SPACE - (ACTUAL DOLLARS)	0	8750	16550	7800	10925	15000	21875	18125	10925	18125
AFFILIATED STUDENTS AT THIS COST CENTRE	300	451	540	615	691	818	972	1129	1255	1359
TOTAL	300	451	540	615	691	818	972	1129	1255	1359
REVENUE										
TOTAL REVENUE FUNDS	133	200	240	272	306	362	431	501	557	602
INDICATORS COST PER STUDENT (ACTUAL DOLLARS)	1020	922	898	847	826	772	737	702	671	677

OST CENTRE
COLLEGE

CAMPUS (CAMPUS)2 - CASE THREE - NOV 1969

CAMPUS COLLEGE

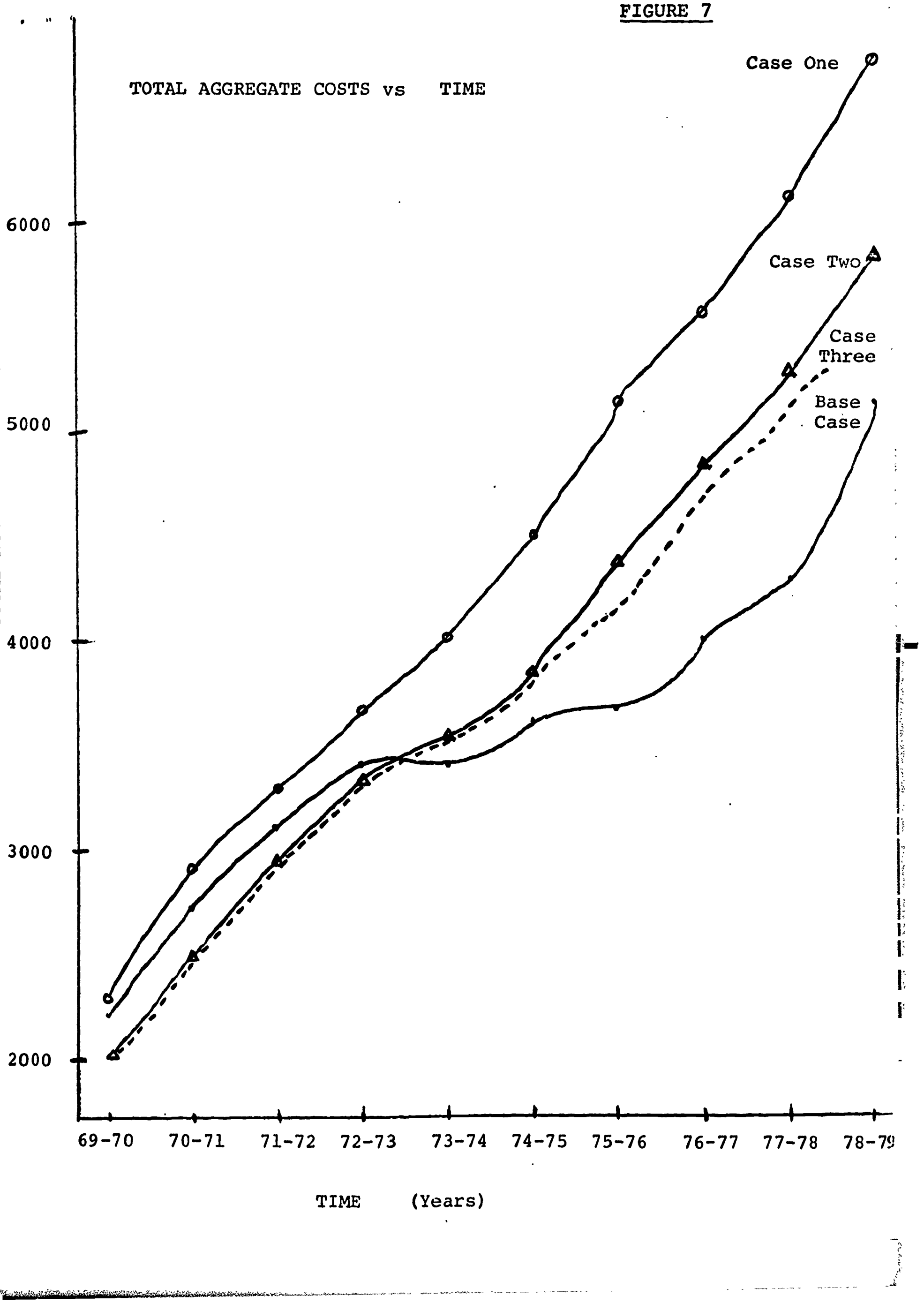
OVER TIME REPORT 1.5
SESSION AVERAGES

SUMMARY REPORT

FIGURE 6

	SESSION									
	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
STAFF										
ACADEMIC	1044	1299	1485	1587	1748	1936	2016	2302	2514	2667
ACADEMIC SUPPORT	33	39	46	52	59	59	65	65	55	72
NON-ACADEMIC	86	101	111	116	126	141	156	171	181	191
SERVICE	274	326	342	368	394	436	478	520	562	598
TOTAL	1437	1765	1984	2123	2327	2572	2715	3058	3322	3518
TOTAL EQUIPMENT COST	371	506	598	683	761	878	1023	1173	1300	1413
MISCELLANEOUS	200	290	322	342	371	407	428	478	517	546
MAINTENANCE	8	11	13	14	15	18	22	24	27	28
TOTAL AGGREGATE COST (THOUSANDS OF DOLLARS)	2016	2572	2917	3162	3474	3875	4188	4733	5166	5505
SPACE										
OFFICE	14240	17360	19260	20530	22380	24630	26080	29150	31540	33290
CLASSROOM	16030	18800	21840	25350	28480	31730	34330	39700	45190	47240
INSTRUCTIONAL LABORATORY	1715	3110	3695	4110	4085	4150	4375	5455	5835	5995
SPECIAL LABORATORY	32900	41400	46850	50250	50400	54000	58600	58800	78800	78950
SERVICE DEPARTMENT	56786	76744	90392	101712	113295	130626	151593	173918	192653	208034
TOTAL SPACE (SQUARE FEET)	121671	157414	182037	201952	218640	245136	284978	317023	354018	373509
CAPITAL COSTS SPACE - (ACTUAL DOLLARS)	111550	605800	441275	376075	371325	556900	1142875	919525	1095450	563775
AFFILIATED STUDENTS										
AT THIS COST CENTRE	0	0	0	0	0	0	0	0	0	0
AT AFFILIATED COST CENTRES										
ARTS	300	451	540	615	691	818	972	1129	1255	1359
BUSINESS	463	629	743	853	962	1129	1330	1542	1716	1860
ENGINEERING	464	707	886	1021	1160	1354	1598	1855	2082	2268
CONTINUING EDUC	0	0	0	0	0	0	0	0	0	0
TOTAL	1227	1787	2169	2489	2813	3301	3900	4525	5053	5487
REVENUE										
TOTAL REVENUE FUNDS	0	0	0	0	0	0	0	0	0	0
INDICATORS										
COST PER STUDENT (ACTUAL DOLLARS)	1643	1439	1344	1270	1234	1173	1073	1045	1022	1003
SPACE PER STUDENT SQ.FT.	99	88	83	81	77	74	73	70	70	68

FIGURE 7


TOTAL AGGREGATE COSTS vs TIME
TOTAL AGGREGATE COST (1000's of $)
6000
5000
4000
3000
2000
Case One
Case Two
Case Three
Base Case
69-70
70-71
71-72
72-73
73-74
74-75
75-76
76-77
77-78
78-79
TIME (Years)

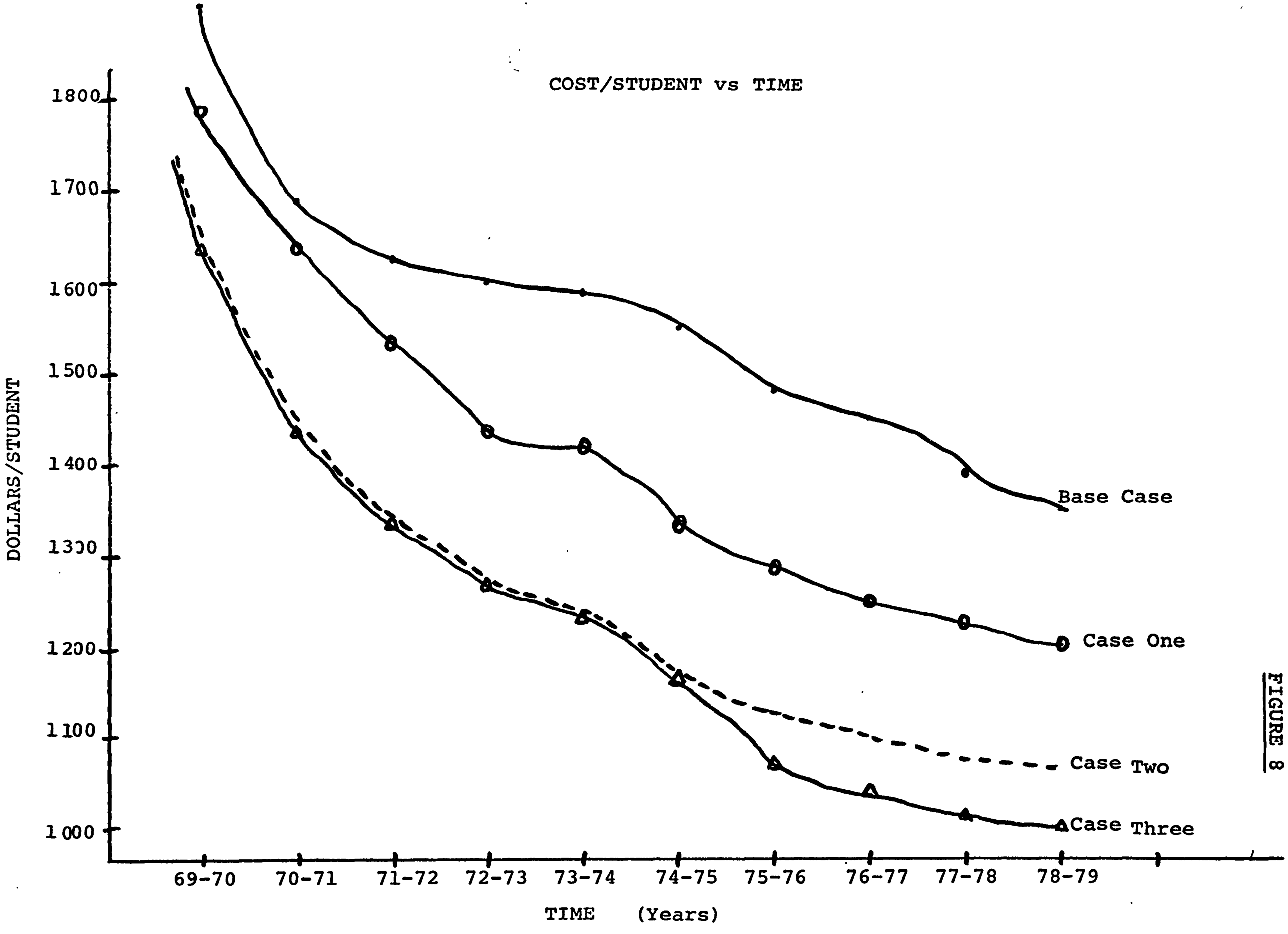

COST/STUDENT vs TIME
DOLLARS/STUDENT
1800
1700
1600
1500
1400
1300
1200
1100
1000
69-70
70-71
71-72
72-73
73-74
74-75
75-76
76-77
77-78
78-79
TIME (Years)
Base Case
Case One
Case Two
Case Three

FIGURE 8

C.A.M.P.U.S. SIMULATION PLANNING ANALYSIS

CAMPUS UNIVERSITY

SPACE BY COST CENTERS

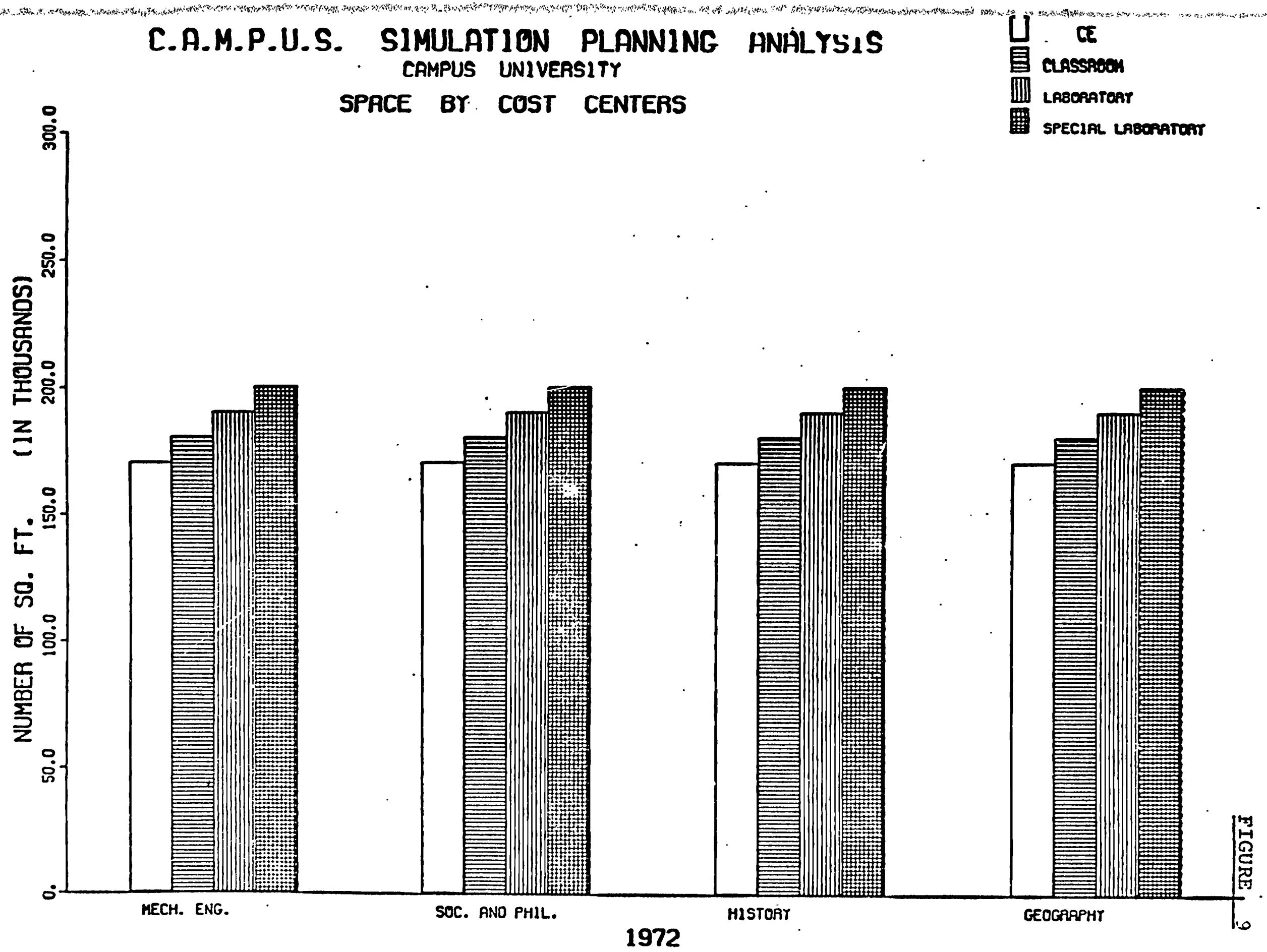


FIGURE 9

ten year period. Figure 4 contains a college summary report which reflects these changes, while Figure 5 contains the same report but for the Arts faculty. Academic staff costs and therefore total operating costs have been reduced considerably as is shown in Figures 4 and 5. Cost per student has also been reduced from $1,778 to $1,643 in 1969 and to $1,051 from $1,211 in 1978. Since overhead costs have remained fairly constant, the drop in cost per student is most evident at the teaching level: This can be seen by a comparison between Figures 3 and 5.

Case 3

Although operating costs for the first five years have been reduced to a reasonable level, it is deemed necessary to reduce space requirements and hence capital costs below the forecasted level. Thus teaching space policy has been altered by changing the length of the teaching week for all teaching space from 35 hours per week to 45 hours per week. The resultant changes in space requirements and capital costs are illustrated in Figure 6. The results show that there has been a small decrease in total space requirements and capital costs; space per student has dropped from 104 sq. ft. to 99 sq. ft. in 1969 and from 74 sq. ft. to 68 sq. ft. in 1978. The drop in space requirements is not proportional to the increase in the length of the teaching week: This is due to the large proportion of the space that is devoted to service departments and is not affected by changes in academic policy, and to some types of teaching space that

were not used fully in earlier years and therefore were not affected by increased availability.

Summary

Figures 7 and 8 illustrate comparisons for total costs and operating costs per student between four runs. In addition graphical output of summary values is available although it was not requested in this case. Figure 9 illustrates one such graph.

The above cases are simplified but bear ample basis in reality to illustrate the ease with which college personnel can analyze problems using a CAMPUS model. This approach replaces the drudgery and inaccuracy of manual calculations and greatly reduces the response time once the user has defined his problem or changes.

APPENDIX III

THE SYSTEMS RESEARCH GROUP

THE SYSTEMS RESEARCH GROUP

1. The Systems Research Group

The Systems Research Group (SRG) is dedicated to the research, development and application of scientific techniques to the planning and management problems of the public and private sectors. SRG is a world leader in educational planning and heavily involved in problems in health, water pollution, air pollution, urban planning, and other areas of major public expenditure. SRG personnel bring to any problem a broad spectrum of scientific and analytical talents. Multi-disciplinary teams of economists, engineers, architects, lawyers, operations researchers, management scientists, medical specialists and statisticians bring to each project the expertise of their specialized training. The common bond among the various specialists at SRG is their ability to use the quantitative tools of systems analysis and the capabilities of the computer.

2. Systems Analysis and Research

Throughout the 1960's it has become increasingly evident that demographic and economic growth produces problems whose solution and/or control require public action. Some problems of this decade whose seriousness will increase in the 1970's are as follows:

- Health care delivery
- Educational planning and management
- Welfare system rationalization and control
- Public housing
- Pollution control
- Urban design and development
- Transportation planning
- Regional development
- Law enforcement and public order

Public expenditures in these areas have grown and will continue to grow considerably faster than GNP. All of these problems involve complex interactions on the levels of economics, technology, public perception and politics. In short, complex human-environmental-economic systems are involved.

Wise policy and decision-making must be based on tough and thorough analysis of the systems to be controlled, of possible objectives to be pursued, of alternative ways of achieving the objectives, and of the costs, benefits and risks attending those alternatives. Last, but far from least, the effectiveness of public programs must be evaluated by relevant criteria and this "feed-back" information must trigger corrective modifications in the programs themselves.

The techniques of systems analysis and research, which have demonstrated their utility in the military and aerospace fields, can make an enormous contribution to rational planning and decision-making in non-military public programs.

The press, the public and many elected officials increasingly realize the potential that systems analysis and other computer-based tools hold for better and more efficient public programs. They increasingly expect these tools to be applied. Unfortunately, the cadre of experienced and trained systems analysts is very small. Government agencies and other public and private bodies lack the quantity and quality of analytical personnel to meet the rising expectations for better planning and analysis in public programs.

SRG has gathered and will continue to gather a unique collection of highly trained and experienced analytical personnel. We bring to each problem a multi-disciplinary team whose talents and training correspond to the needs of that problem. Our permanent staff is augmented, when needed, by the best university-based brainpower available, because SRG has contacts and roots in the centers of North American university research and development. These teams can bring to problems, the most powerful tools of mathematical and computer-based systems analysis as well as the insights of the various social sciences.

The need for sophisticated systems analysis of expensive public and private programs will grow extremely rapidly in the decades ahead. SRG intends to play a major role in meeting that need.

3. Services Provided

SRG offers a complete and integrated set of services. These are consulting services, research and analysis services, computer software development, software utility service and educational courses. It should be emphasized that SRG does not own nor operate its own computer hardware, nor does it intend to, except for terminals.

3.1 Consulting Services

SRG Personnel participate in consulting engagements that are designed to help client organizations develop their own internal analytical capabilities. SRG hires and trains people in client organizations to help them implement advanced analytical and planning techniques that have been developed by SRG or others. These implementation projects occupy a large portion of the efforts of SRG personnel, particularly in view of the techniques that they have developed. These techniques include computer based information systems, computerized simulation models and advanced planning and budgeting systems for public administrators.

The computerized simulation models enable planners in the public sector to simulate the operation of their organization as business men have been doing for some time now. For example, a university administrator can simulate his institution under alternative educational and administrative plans and be able to assess before the fact the implication of these plans for his requirements for staff, space, equipment, operating and capital budgets. He then has the opportunity to experiment with the representation of his institution on the computer, to search for the most efficient way of carrying out his plans.

3.2 Research and Analysis Services

Over the past ten years a phenomenon has developed in the United States known as the "think tank". These organizations develop teams of people to do research and analysis on important questions of public policy. SRG is now organized in such a way as to provide this kind of capability for Canada as well as the U.S.A. and other countries.

The project on "A Federal Strategy for Environmental Quality Control" is prototypical of the work that we will do in this area. This large and important project was awarded to SRG because of the excellence of its systems analytic approach to a very complex problem.

3.3 Computer Software Development

Many organizations are interested in the computer programs that SRG has developed for planning in the public sector, particularly in education. In order to make these programs operational on the computer facilities of individual institutions or to extend them to meet the particular needs of a client, SRG computer programmers and systems analysts are building custom-designed software.

3.4 Software Utility

It has become evident to SRG that a number of public organizations that could benefit from the application of modern management techniques cannot afford to maintain and support them on their own. SRG has developed a system for operating centrally on a computer the planning and management programmes needed by these organizations. A variety of communication links are being evaluated and tested for use in connecting users to this system. The system is advantageous for the client because it enables him to take advantage of these techniques without the headaches of implementing them locally. The client (1) doesn't have to assemble service staff, (2) can rely on our systems maintenance and improvement, and (3) can defer investment until satisfied of usefulness. It is also far less expensive for him.

3.5 Educational Courses

The Systems Research Group offers various kinds of seminars to explain the techniques that it has developed in the area of university and college management and planning. These seminars have received a tremendous response, of which 75% has been from the United States. In addition, a number of state agencies have requested particular seminars to be put on in their jurisdictions. As a result of this enthusiastic reception resulting in some five hundred educational administrators ranging from presidents to department heads attending SRG seminars in 1969, SRG is planning a major expansion and diversification in terms of the programs that it will offer. In 1970 a full range of courses will be offered on educational planning at a number of different levels for primary and secondary school boards, community colleges, health sciences complexes and universities. Seminars will be held publicly throughout North America and under contract at particular locations in the United States and Canada. In addition, seminars will be held on the general techniques of systems analysis and program budgeting, the application of modern management techniques in urban planning, and systems analysis of the planning and design of health care delivery systems.

4. Development and Experience

In 1964 Richard W. Judy and Jack B. Levine, the founders of SRG, carried out their first project applying systems analysis to problems of public policy. The study for the Bladen Commission on the financing of higher education was designed to develop better planning and management techniques for universities.[1] As a result of this pilot project carried out in the Faculty of Arts and Sciences at the University of Toronto, a number of institutions, including the University of Toronto, became interested in implementing the concepts that we have given the acronym CAMPUS (Comprehensive Analytical Methods for Planning in University Systems). This was the beginning of SRG's efforts to help institutions implement CAMPUS. John Pfeiffer in his New Look at Education -- Systems Analysis in Our Schools and Colleges, (Odyssey Press, 1968), devoted a full chapter to CAMPUS and presented the Toronto story in some detail "as a good example of the sort of co-ordinated effort required to produce results". SRG moved on from applying CAMPUS to the general university to adapting it to the peculiar problems of health sciences educational planning.

Beginning in late 1966, SRG analysts were commissioned by the Senior Co-ordinating Committee for Health Sciences Education in Ontario to

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1. A New Tool for Educational Administrators, A Report to the Commission on the Financing of Higher Education, Richard W. Judy and Jack B. Levine, University of Toronto Press, 1965

develop models that could be used in planning the expansion of the University of Toronto's Health Sciences complex. Eventually all five medical schools in Ontario may receive these techniques.

A group called the Health Sciences Functional Planning Unit (HSFPU) worked closely with doctors to develop a set of suitable simulation models to describe the undergraduate, graduate and specialty training situations.

The following is an assessment of the work by the world famous educational economist John Vaizey at a OECD meeting in Paris, France in 1968:

ORGANIZATION FOR ECONOMIC
CO-OPERATION AND DEVELOPMENT

DIRECTORATE FOR SCIENTIFIC AFFAIRS
EDUCATIONAL MANAGEMENT TECHNIQUES

Meeting of Ad Hoc Group on
Budgeting, Program Analysis and Cost-Effectiveness
in Educational Planning

Held in Paris, 3rd - 5th April 1968

Impressions of the meeting
by
John Vaizey

"There followed a number of important papers which dealt with several cost models which have been evolved. The striking example that was presented was from the Federal Republic of Germany, which in essence drew from a number of other developments which had taken place in other countries. There was then an extremely powerful presentation by Professor Judy and his colleagues of a paper dealing with the experiments in the installation of systems analysis procedures in the medical faculty of the University of Toronto. This immensely intriguing and important contribution may well be a model which many delegates felt that OECD should seek to see tried out in a number of other countries. To try to get a university to think rationally about the allocation of resources is difficult, and any effective tool, however complex, is desirable. It is to be hoped that this model will become generally available. The fact that it has been used in a Faculty of Medicine is especially hopeful since this is the refuge of the academic conservatives in many universities."

From this beginning SRG then moved out in a number of directions to extend and adapt its techniques to planning problems in the public sector. Among the education projects in which SRG personnel have participated are the following:

- Development of the original Comprehensive Analytical Methods for Planning in University Systems (CAMPUS), a pilot study undertaken for the Commission on Financing Higher Education in Canada.

- The development of the full scale CAMPUS-II model and the creation, staffing and technical direction of the Office of Institutional Research at the University of Toronto.

- The development and application of CAMPUS models to problems of planning the new health sciences complex at the University of Toronto. The creation, staffing and technical direction of the Health Sciences Functional Planning Unit. This project was sponsored by the Senior Co-ordinating Committee for Health Sciences Education in the Province of Ontario

- The development and application of CAMPUS models to the problems of planning and administering the community colleges of Ontario. This project is sponsored by the Ontario Department of Education.

- The design of a data bank and development of computer software for a national medical student information system. This project was done for the Association of Canadian Medical Colleges.

- A study of the application of systems analysis to national educational planning. This study was done for the Educational Testing Service of Princeton, N.J.

- A study of the application of systems analysis to the problems of planning and administration in public school systems. This study is sponsored by the Ontario Institute for Studies in Education.

- The development of a general educational simulation game for the OECD in Paris.

- Present projects to apply the CAMPUS models to a number of health sciences and core campuses of Canadian and American universities.

SRG personnel have been involved in numerous other projects involving the application of multi-disciplinary analysis to policy and management problems in areas other than education. Most of these have been in the

public sector, the general field in which SRG specializes, but there also have been several in the private sector. Among the most significant of these projects have been the following:

- Systems analysis of logistics management in the U.S. Air Force.

- Development and application of operations research and systems analysis techniques to problems of planning and administering the Ontario hospital system. This project, carried out for the Ontario Hospital Services Commission, involved the establishment of an in-house analytical group, the Management and Operations Research Unit.

- Development of computer simulation procedures for planning in primary industries (mining) and manufacturing (automotive).

- Development and implementation of a planning, programming and budgeting system for the Province of Ontario.

- The application of systems analysis to the problem of developing a federal strategy for environmental quality control in Canada. This project is sponsored by the Department of Energy, Mines and Resources of the Government of Canada.

- The study of the development of an information system for the Canadian Construction industry. This project was sponsored by the Department of Industry of the Government of Canada.

- Design of a computer model to aid in the analysis of low income housing projects for the New York State Urban Development Corp.

- Development of SPACE (System for Planning and Constructing the Environment) for the New York State University Construction Fund.

- Cost Effectiveness analysis of the problem of site selection for urban renewal in Harlem, New York City.

- A study of the economic impact of a Canadian Communications Satellite System.

- Development of a simulation model of the Canadian uranium industry for Eldorado Mining and Refining Company Limited.

- The construction of a demographic forecasting model of Canada for the federal government.

5. Principals and Personnel

SRG has been fortunate to gather together a group of highly qualified individuals who have an outstanding combination of experience and ability. Virtually all the staff are at the M.A. level and a number are Ph.D.'s or Medical Doctors. The following professions are represented in SRG:

- Economists
- Industrial Engineers
- Medical Doctors
- Operations Researchers
- Computer Programmers
- Architects
- Lawyers
- Statisticians
- Social Scientists
- Educational Planners

In addition to its permanent staff, SRG has an arrangement to supplement its staff with many noted academics from leading universities.